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Does size matter? The effects of enterprise size on the perception of benefits and risks of open innovation projects

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Abstract. This article presents an exploratory study investigating the influence of an enterprise's size on its perception and assessment of the benefits and risks expected from participating in open innovation projects. For this purpose an online survey was conducted in Germany, Austria and Switzerland. The result of this paper is empirical evidence showing how the size of an enterprise affects its perception of potential benefits and risks expected within the context of open innovation project participation. Furthermore, the identified effects are discussed against the theory. Existing theory regarding the benefits and risks of open innovation is expanded by 1) finding that they are perceived mostly independently of enterprise size, 2) confirming their practical relevance, and 3) enabling a finer distinction between their degrees of relevance for small, medium, and large enterprises.

Keywords. Open Innovation; OI Participation; Benefits; Risks; SME.

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1 Introduction

According to conventional understanding, the primary factors in successful enterprises and a high capacity for innovation are their employees, R&D divisions, and a fault-tolerant corporate culture. This kind of innovation refers to the closed innovation paradigm (Chesbrough, 2003a). Due to increasing globalization, new market participants, and shorter product life cycles resulting in increased R&D costs, the closed innovation paradigm was superseded in the last century (Gerybadze and Reger, 1999) by the theory of open innovation (OI), which places much more emphasis on the importance of external resources (Chesbrough, 2003a). OI "is the use of purposive inflows and outflows of knowledge to accelerate internal innovation" (Chesbrough, 2006, p.1). OI is thus an interactive, collaborative, and distributed innovation process involving external partners (Diener and Piller, 2010; Veer et al., 2013) that relies on purposively managed knowledge flows across organizational borders (Chesbrough and Bogers, 2015).

For more than a decade, the specifics of this process have been broadly discussed in innovation management in both academia and the corporate world (e.g. Chesbrough, 2003a; Man and Duysters, 2005; West and Gallagher, 2006; Huizingh, 2011; Tidd, 2013; Huizingh et al., 2015). It is indisputable that enterprises, particularly small and medium-sized enterprises (SMEs), benefit positively from OI collaborations due to their inherently limited capabilities (van de Vrande et al., 2009; Lee et al., 2010). However, they also face manifold challenges in OI practice, leading to uncertainty and even renunciation of OI project participation (Valkokari, 2015). Enterprises thus often face the dilemma of having to cooperate with external partners in order to improve their own innovation capacity, regardless of their ability to cope with the related risks.

The benefits of OI - such as risk diversification across different knowledge sources or cooperation partners - are widely studied (cf. Vanhaverbeke et al., 2008; Dahlander and Gann, 2010; Lee et al., 2010, Denicolai et al., 2016). Comparatively, the risks of OI - such as knowledge spillovers or coordination costs - have not received the same attention thus far. Fewer works have addressed the disadvantages of such collaboration projects (cf. Enkel et al, 2009; Lokshin et al., 2011; Veer et al., 2013). In particular, focusing on process-related, knowledge-related, or legal aspects unveils impactful enterprise challenges, such as the *not-invented-here* (NIH) syndrome (Chesbrough and Crowther, 2006), intellectual property (IP) drain (Chesbrough, 2003b), and the untypical, unstructured character of the legal aspects involved, all of which have not yet been examined in open innovation research (Müller, 2013).

The distinction between the risks and benefits of OI is often context-dependent and is thus a serious challenge for enterprises. Judging whether an aspect is perceived as a benefit or risk is usually highly dependent on the subjective perspective of the individual decision maker (March, 1994) and her bounded rationality (Simon, 1982), as well as limited by the impossibility of either predicting the future or capturing all the necessary environmental information. Thus, supporting entrepreneurial decision processes is beneficial specifically in reducing insecurity (Simon, 1979). Additionally, given the fact that risk awareness is of particular importance for entrepreneurial decision making (Liebenberg and Hoyt, 2003), it is pivotal to provide an understanding that decision makers' "risks are greater if they choose not to innovate" (Valkokari, 2015). Therefore, understanding the importance of the risks and benefits (and their particular implications) of OI project participation is mandatory. However, this is a mere first step towards rational decision-

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making in the context of OI participation. At least as important is a thorough understanding of the underlying situation. Perception and assessment biases caused by framework conditions such as the enterprise size must also be taken into account in order to determine whether a situation has been assessed as objectively as possible.

Although various benefits and several risks have been identified in the OI literature and proven through empirical investigations (e.g. Keupp and Gassmann, 2009; Veer et al., 2013), little is known about the way in which specific benefits or risks of OI collaboration are perceived and how factors such as enterprise size influence their perception and, thus, their assessment. It therefore seems quite worthwhile to take a closer look at the variables influencing perception. There are many indications that the perceived relevance of a specific benefit or risk could be affected by the unique situation of an OI project's framework conditions. As one example, the characteristics of (open) innovation projects may differ depending on the enterprise's size. SMEs, for instance, should put more emphasis on the later stages of the open innovation model (cf. Chesbrough, 2003a) since they benefit more from support at the commercialization stage than from technology, product, or process development (Lee et al., 2010). Large enterprises, on the other hand, are usually relatively good at marketing and commercialization activities. They gain more from leveraging external research as a complement to internal R&D activities or from building strong networks in relevant areas (Chesbrough and Crowther, 2006). Consequently, whether one is employed in a small (<50), medium (50-250) or large enterprise (>250) could influence her perception of the benefits and risks of OI projects. The research question is thus stated as follows:

Does the size of an enterprise affect the perception of the benefits or risks of OI projects?

This article presents an exploratory study investigating the influence of an enterprise's size on the perception and assessment of benefits and risks expected by individuals participating in OI projects. Based on the benefits and risks of OI identified in the literature as well as in ongoing OI processes, an online survey was conducted in Germany, Austria, and Switzerland. Innovation managers, employees and researchers in the field of (open) innovation were asked in the survey to evaluate both the risks and benefits of OI. Afterwards, the collected data set was subjected to an exploratory analysis. The result of this paper is empirical evidence on the effects of the size of an enterprise on the perception of the potential benefits and risks expected in the context of OI project participation. Furthermore, the identified effects are discussed against the background of OI theories.

On the foundation laid by Ullrich et al. (2018) who have conducted initial investigations on practitioners' assessment of the benefits and risks of OI projects and in line with Bogers et al. (2016) who, inter alia, point out that OI research is currently lacking in theory development, this article contributes to the aforementioned question by exploring the relationship between the size of an enterprise and the perception of the benefits and risks of OI projects. The research sheds some light on the inter-organizational comparability of the perception of the benefits and risks of OI collaborations based on an intra-organizational aspect, namely, enterprise size. Addressing the size of the enterprise as an important factor when analyzing company-specific OI processes might also enable the identification of determinants for the assessment of OI projects. Implications can thereby be derived and incorporated into managerial policies on innovation processes. For example, the relevance of specific risks or benefits (might) differ for distinct enterprise sizes. Some

enterprises are thus more prone to (perceive) specific benefits or risks than others of a different size category. Depending on the enterprise in question, then, assessment distortions induced by external conditions can be identified and thus consciously counteracted by the enterprise.

This article elaborates on the existing theory regarding the benefits and risks of OI by 1) finding that the risks and benefits of OI are perceived mostly independent of enterprise size, 2) confirming the benefits and risks as practically relevant, and 3) enabling a finer distinction between their degrees of relevance for small, medium, and large enterprises.

The remainder of this article is organized as follows: The next section reviews the literature on OI focusing on the benefits and risks as well as on the particularities of enterprise size in OI projects. Section 3 describes the methodological approach of this study. The results are presented and analyzed in Section 4 and discussed in Section 5. Finally, a conclusion, the limitations, and an outlook are provided in Section 6.

2 Opening the innovation process

In OI, enterprise boundaries can be viewed as permeable to the external environment, whereby the innovation process includes aspects of strategic cooperative partnerships between enterprises within the same or across different industries, or with suppliers, research institutes, or even competitors (von Hippel, 2005; West and Gallagher, 2006; Chesbrough, 2006; Enkel et al., 2009; West and Bogers, 2013). Some other main issues include the role of intermediaries (Diener, 2014), customers as OI partners (Enkel et al., 2005; Foss et al., 2011; Gatzweiler et al., 2017), and enterprise size and innovation process specifics (Lee et al., 2010; Zeng et al., 2010). Especially the enterprise size and more precisely the special features of SMEs and the impact of OI for SMEs are a matter of concern (see van de Vrande et al., 2009; Lee et al., 2010; Bogers, 2011; Brunswicker and Vanhaverbeke, 2015).

2.1 Open Innovation in SMEs

According to Wynarczyk (2013), the competitiveness of SMEs depends on the cumulative effects and interrelationships between two internal key factors: R&D capacity as well as managerial structure and competencies. Compared to large enterprises, however, SMEs often face various innovation shortcomings due to 1) limited time for innovation, 2) a lack of suitable personnel, infrastructure and financial means, 3) a lack of contact with research partners within the innovation network, and 4) high innovation risk (Jenni and Ziltener, 2008). SMEs are thus expected to particularly gain from collaborations with external partners (Nooteboom, 1994; Rogers, 2004). Moreover, involving external partners potentially reduces the innovation gap between small and large enterprises (Gassmann et al., 2010; Nieto and Santamaria, 2010). According to Bougrain and Haudeville (2002), the benefits of the collaboration especially for SMEs are related to the improvement of internal tacit knowledge and the information base. As a result, SMEs gain important competitive advantages and are much more able to analyze relevant information, whereby their uncertainty regarding their own innovation projects is reduced. OI project participation also reduces risks through error compensation and investment sharing, enables cost advantages

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through economies of scale and scope, broadens development potential, increases market penetration, and relieves the application of technologies thus far unused (ibid.).

Against this background, the focus of OI research increasingly (but still insufficiently) shifts from large multinational enterprises to SMEs, which are opening up their innovation processes (cf. Gassmann et al., 2010; Santos, 2015; Vanhaverbeke, 2017). Nevertheless, OI projects in SMEs are still implemented far less frequently than in large enterprises (Santos, 2015). Consequently, the majority of OI research focuses on large enterprises (Santos, 2015) or fails to make distinctions based on size. During the last decade, however, a trend has emerged resulting in a small number of articles focusing on SMEs or on the relationship between SMEs and large enterprises with regard to OI practices and especially on the integration of external knowledge and knowledge absorption (Malecki, 2011; Cheng and Chen, 2013), as well as organizational changes and business incentives for open innovation (Rodriguez and Lorenzo, 2011).

2.2 Structuring the investigation of open innovation's risks and benefits

The positive effects and benefits represent the main research focus of OI (Laursen and Salter, 2006; Lee et al., 2010; Chen et al., 2011). Veer et al. (2013) point out that OI decreases the risk inherent to the innovation process, and simultaneously also the risk and costs related to collaboration activities with different partners. In the context of OI and collaboration, Bogers (2011) identifies many important fields that have yet to be explored. These fields deal with such issues as the complexity of collaborative efforts and the underlying resources and knowledge, the dilemma of knowledge sharing and protection, and the management of innovation when innovating organizations are highly dependent on each other (Vanhaverbeke, 2006).

Braun et al. (2011) distinguish between two levels of analysis (cf. Fig. 1): 1) the operative process level and 2) the strategic level. In addition, 3) the framework conditions affecting the success of the innovation process are also seen as relevant. These three levels form the company arena, which is surrounded by the company's eco-system.

The strategic and operative levels along with the framework conditions form the starting point for the following classification of identified risks and benefits into two main groups: organizational (addressing the strategic level and the framework conditions) and process-related (addressing the sequence of the innovation process - the operative level).

Based on a literature review (from a theoretical perspective) and an analysis of concrete OI projects and ongoing processes (from a practical perspective), a range of benefits and risks of OI projects were identified and structured (cf. Tables 1-4). The benefits and risks identified within these projects and processes through expert interviews (cf. Section 3) are used here to enrich the theoretical foundation. They are marked as statements by the interview partners. The other items identified in the literature are marked with their respective source references as usual.

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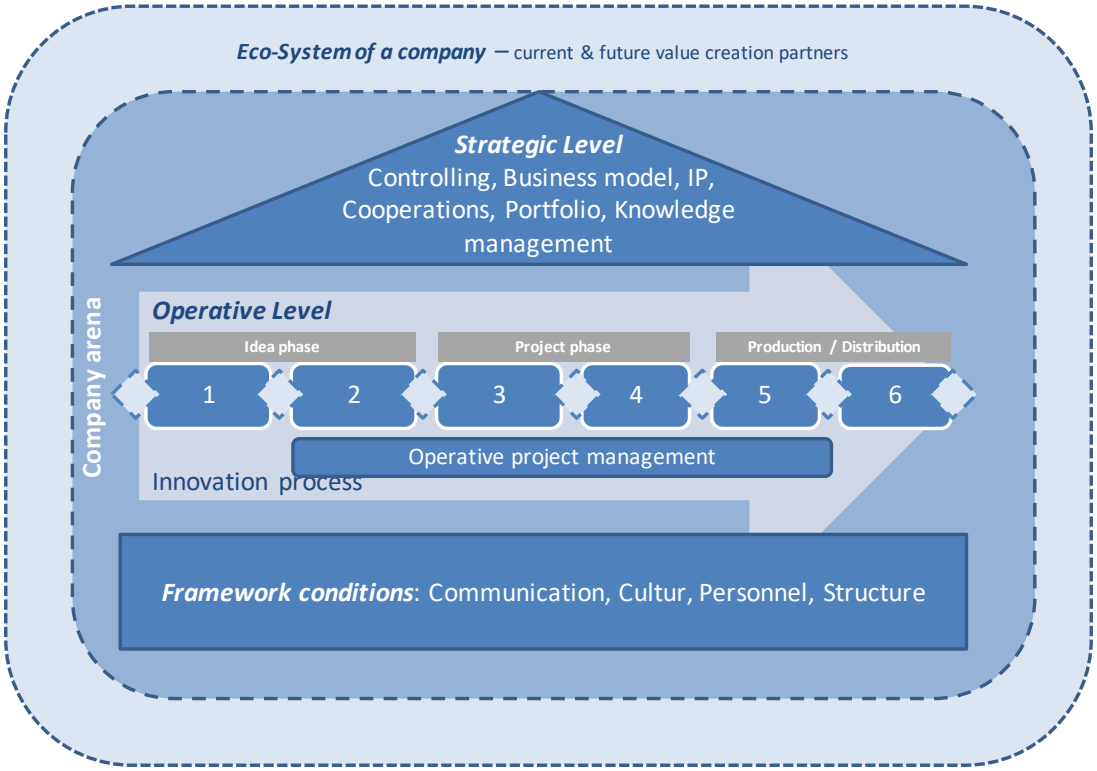

Fig. 1. Open innovation management concept (Braun et al., 2011).

Organizational benefits and risks

As described above, within the innovation process two main levels can be distinguished. The organizational benefits and risks (Tables 1 and 2) have been assigned to the strategic level, which addresses enterprise-specific aspects such as the business concept, knowledge management, intellectual property, product portfolio and controlling. The general conditions as a third main focus, e.g. internal and external communication, corporate culture, and personal development, round out the framework of organizational benefits and risks.

The benefits within this category include the holistic improvement of the enterprise's knowledge basis (e.g. through the inclusion of external experiences), and the improvement of its strategic and competitive power (e.g. benefits from the partner's network, use of the partner's intellectual property) or its internal culture. Taking as an example the filling of internal knowledge gaps, some possible OI benefits for an enterprise might be explained as follows: An enterprise could possess the experiences and potential necessary to develop good and promising ideas for new products. As a consequence of its lack of knowledge in idea development and product distribution, however, the innovating idea could become useless. The benefit of OI in this case is the filling of these knowledge gaps and the successful development of the product.

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Table 1. Organizational benefits of open innovation.

Organizational benefits
Inclusion of external experiences (Lakhani et al., 2006; Laursen and Salter, 2006; Dahlander and Gann, 2010; Chesbrough, 2012; Afuah and Tucci, 2012)
Expansion of the knowledge base (Laursen and Salter, 2006; Lakhani et al., 2006; Chesbrough et al. 2006; Dahlander and Gann, 2010; Afuah and Tucci, 2012; Chesbrough, 2012)
Filling of internal knowledge gaps (Chesbrough, 2006; Laursen and Salter, 2006; Lakhani et al., 2006; Dahlander and Gann, 2010; Afuah and Tucci, 2012; Chesbrough, 2012)
Access to new product and production technologies (Cohen and Levinthal, 1990; Grindley and Teece, 1997; Griffin, 1997; Gassmann and Reepmeyer, 2005; Enkel et al., 2005; Gaso, 2005; Chesbrough and Crowther, 2006; van de Vrande et al., 2006; Page and Schirr, 2008)
Improvement of market knowledge and market requirement detection (Murphy and Kumar, 1997; Enkel et al. 2005; Chesbrough and Crowther, 2006)
Technological synergy effects (Chesbrough and Crowther, 2006; van de Vrande et al., 2006; Vanhaverbeke et al., 2008; Lichtenthaler, 2009)
Extension of the product and service range (van de Vrande et al., 2006)
Benefits from the partner's network (statement interview partners[1])
Synergy gains from patent pooling (van de Vrande et al., 2006; Chesbrough, 2012)
Advantages in technology transfer (Arora and Ceccagnoli, 2006; Chesbrough and Crowther, 2006; Fosfuri, 2006; Nagaoka and Kwon, 2006; Gambardella et al., 2007)
Higher market acceptance via reference effects (Chesbrough and Crowther, 2006)
Use of the partner's intellectual property as a strategic asset (van de Vrande et al.,2006; Chesbrough, 2012)
Improvement of the organizational culture (Rigby and Zook, 2002; Laursen and Foss, 2003; Chesbrough et al., 2006)
Better forecasting of future developments (Chesbrough and Crowther, 2006)
Easy benchmarking of competitors (Rigby and Zook, 2002)
Benefit from foreign cultures (Rigby and Zook, 2002; Laursen and Foss, 2003; Chesbrough et al., 2006)
Risk diversification (Chesbrough and Crowther, 2006; Vanhaverbeke et al., 2008)
Usage of competitive synergies (Gaso, 2005)
Enforcement of standards and designs for new products (Arora et al., 2004; Chesbrough and Crowther, 2006; Lichtenthaler, 2008)
Availability of external experts (Enkel et al., 2005)
Improvement of products or services (Enkel et al., 2005)

Organizational risks (cf. Table 2) on this level could negatively impact the whole enterprise. One example would be selection of the wrong partner. Enterprises often face the challenge of finding the right external project partner, where a partner lacking in complementary knowledge can pose a possible risk. Consequences of this might mean failure of the innovation project or a loss of internal knowledge or confidence.

[1] See Section 3.

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Table 2. Organizational risks of open innovation.

Organizational risks
Selection of the wrong partners (Chesbrough and Appleyard, 2007; Enkel et al. 2009)
Unclear communication of OI goals (Chesbrough and Crowther, 2006)
Insecurities over including the external partner (Chesbrough and Crowther, 2006; Chesbrough and Appleyard, 2007; Enkel et al., 2009)
Unintended knowledge drains (Arrow, 1962; Mazzoleni and Nelson, 1998; Rivette and Kline, 2000; Arora et al., 2001; Bogers, 2011; Gatzweiler et al., 2017)
Coordination problems (Ahuja, 2000; Laursen and Salter, 2006; Enkel et al., 2009)
Partner-specific threats (Bogers, 2011; Antorini and Muñiz, 2013)
Lack of cultural values (Chesbrough and Crowther, 2006; Antons et al., 2017)
Integration of security-critical partners (statement interview partners)
Employees' rejection of the process opening (Chesbrough and Crowther, 2006; Laursen and Salter, 2006; Antons et al., 2017)
Inefficient resource allocation (Cohen and Levinthal, 1990; West and Gallagher, 2006)
Submergence of enterprise and OI strategy (statement interview partners)
Opening of enterprise boundaries (Arrow, 1962; Mazzoleni and Nelson, 1998; Rivette and Kline, 2000; Arora et al., 2001; Bogers, 2011; Gatzweiler et al., 2017)
Dependence on external alliances (Veer et al., 2013)
Increase in employees' needs for training and motivation (van de Vrande, 2006)
Monetary inefficiency (Ahuja, 2000; Knudsen and Mortensen, 2011)
Information overload (Laursen and Salter, 2006)
Financial bottlenecks (Enkel et al. 2009; Knudsen and Mortensen, 2011)

Process-related benefits and risks

The process-related benefits and risks (Tables 3 and 4) were assigned to the operational process level, which includes the project management during the stages of a concrete innovation process (cf. Cooper, 1990). This level is more concrete than the organizational one and addresses the management of the process flow, technology use and employees' behavior.

The benefits refer to improvement in the internal innovation process (e.g. process improvement) as well as process outcomes (e.g. faster time to market). One example is the identification of further potentials during the innovation process sequence, addressing the enterprise's ability not only to perform well within one specific process, but also to learn and apply the process-related experience in the future - in other words, to create specific meta-knowledge. Participation in an OI project broadens an enterprise's horizons and increases its access to relevant knowledge and sources of experience.

Table 3. Process-related benefits of open innovation.

Process-related benefits
Increased innovation performance (Rigby and Zook, 2002; Laursen and Foss, 2003; Chesbrough and Crowther, 2006; Foss et al., 2011; Chesbrough, 2012)
Identification of further potentials during the innovation process sequence (statement interview partners)

Process-related benefits
Enrichment of project evaluations with various facets (statement interview partners)
Establishment of a multifaceted decision making process (statement interview partners)
Shorter product development times (Rigby and Zook, 2002; Chesbrough and Crowther, 2006)
Process improvements through process design by the partner (Laursen and Foss, 2003; Chesbrough and Crowther, 2006)
Faster time to market (Rigby and Zook, 2002; Chesbrough and Crowther, 2006; van de Vrande et al., 2006)
Use of the advantages of external IT infrastructures (Chesbrough and Crowther, 2006)

Possible negative process-related effects and therefore risks (cf. Table 4) include, for example, the complication of the internal process flow, especially through the involvement of external resources and structures. One example within this risk category is insecure and inaccurate decision making through more complex decision structures. This risk addresses the coordination of cooperation and collaboration within an OI project. Well-established internal decision-making structures could collide with new external or jointly created structures. Insecurities or complications can therefore arise.

Table 4. Process-related risks of open innovation.

Process-related risks
Delays with effects on the project progress (Knudsen and Mortensen, 2011)
Inefficient integration of internal and external IT systems (statement interview partners)
Insecure and inaccurate decision making through more complex decision structures (statement interview partners)
Unused result potentials (Herzog and Leker, 2010)
Non-consideration of innovation potentials during the process sequence (statement interview partners)
Pursuit and realization of unattractive ideas (statement interview partners)
Slower product development (Lichtenthaler and Ernst, 2006; Knudsen and Mortensen, 2011)
Outflow of employees with expert knowledge to the partner (Chesbrough, 2012)
Deficits in project evaluation due to wasted potential (Barkema and Schijven, 2008; Agrawal et al., 2010; de Burcharth et al., 2014)
Decreased innovation capacity (Herzog and Leker, 2010; Lokshin et al., 2011; Antons et al., 2017)
Inefficiencies in production and distribution (Herzog and Leker, 2010)

3 Methodology

The present exploratory study is part of a project (cf. Vladova and Ullrich, 2015) that aims to enable enterprises, especially SMEs, to weigh up the risks and benefits of OI participation by developing a 1) methodical procedure and 2) guidance application which will structure and support the decision process. To this end, it is necessary to identify and weigh the benefits and risks of OI projects as relevant from a practitioner's perspective. In the course of this identification process, questions arose as to the factors influencing the perception of the benefits

and risks of such projects.

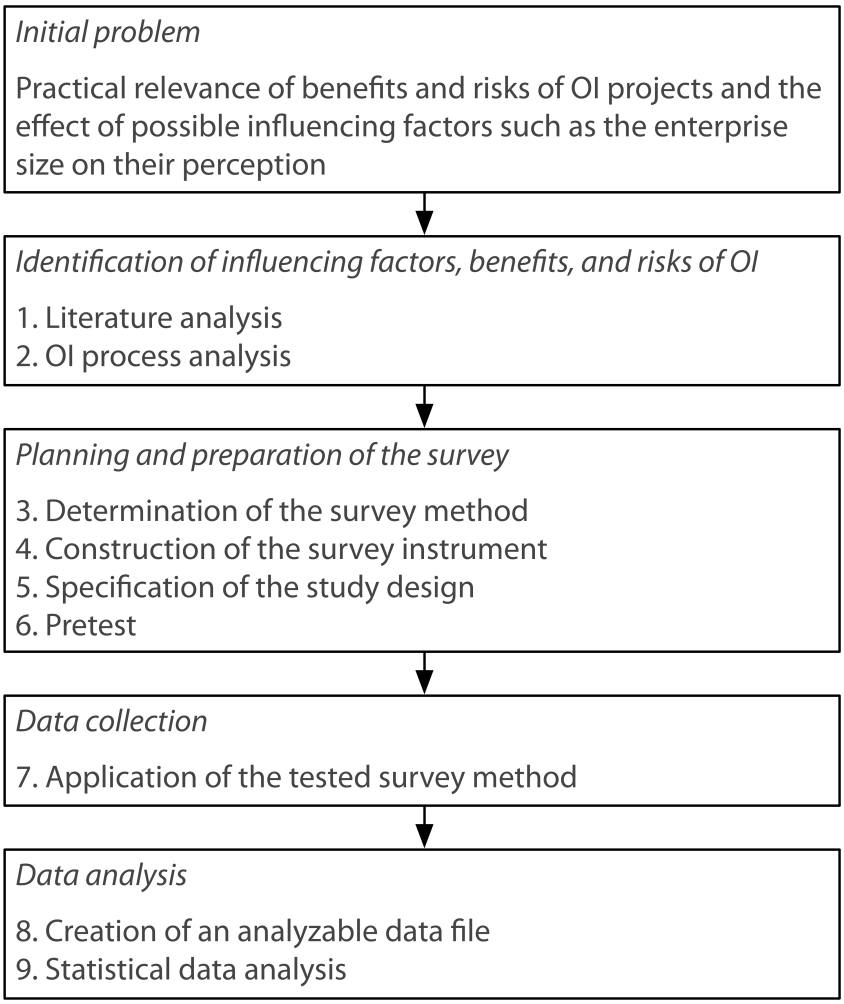

Fig. 2. Methodological approach (following Diekmann, 2012, p. 192f.).

The overall methodological procedure began with a literature review looking at the benefits and risks, influencing factors, phases and evaluation of OI processes, along with the internal and external knowledge interfaces, main actors, and positive and negative aspects of OI in order to establish a solid theoretical background. The procedure identified enterprise size as one potential influencing factor. To enrich this foundation, an analysis was conducted of ongoing OI processes in 15 SMEs on the basis of 35 interviews with decision makers and employees regarding actual benefits and risks. This was followed by planning and preparation of the empirical study (see 3.1), with emphasis on the survey method, construction of the survey, specification of the study design, and a pretest. The data collection (see 3.2) and data analysis (see 3.3) were subsequently examined (Fig. 2).

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3.1 Planning and preparation of the empirical study

Determining the survey method is a particularly necessary starting point for conducting a survey. Widely used methods in empirical studies include (online) surveys and content analysis (cf. Evans and Mathur, 2005; Hsieh and Shannon, 2005). Generally speaking, the advantages of online surveys are the following: avoidance of a bias through anti-sympathetic effects regarding the person conducting the survey, fast feasibility, low costs and no need for data transformation (Wright, 2005; Bryman, 2015, p. 229f.). Potential concerns which should be noted include non-coverage, non-response errors, confidentiality concerns, and technical problems (cf. Sills and Song, 2002). An alternative approach along the lines of content analysis for determining benefits and risks as well as influencing factors would be the concept of stylized facts. Stylized facts are simplified presentations of an empirical finding (Cooley, 1995, p. 3). They can be derived on the basis of empirical data (cf. Kaldor, 1961) or an empirical literature review (cf. Houy et al., 2015). Since the overall survey aims to identify practitioners' perspective towards the benefits and risks, their respective weighting, and especially influencing factors, an online survey was chosen. The choice of a standardized questionnaire in the applied form relied particularly on the respondents' anonymity, sufficient time for response, and the relatively easy opportunities to further process the gathered data (Converse and Presser, 1986).

The survey is structured into five blocks. In accordance with Vladova and Ullrich (2015), benefits and risks were categorized into organizational and process-related aspects. Hence, the five blocks are as follows: demographic information and influencing factors, organizational benefits, innovation process-related benefits, organizational risks and innovation process-related risks of open innovation (cf. Table 5). They were presented exactly in this order. Each block in turn consists of several items in the form of questions pertaining to demographic information and influencing factors (9 items), such as the number of employees in the enterprise or the enterprise's industry sector, and specific benefits and risks (57 items in total, shown in Tables 1-4 in Sec. 2.2). To avoid a potential central tendency bias (Barsalou, 1985), a dichotomous bipolar scale (agree vs. disagree) was applied to measure the respondents' attitude towards each item. Accordingly, the participants stated whether or not they agreed that an item was a benefit or risk.

Table 5. Survey structure.

Classes	**Quantity items (n)**	**Specification**
Demographic information and influencing variables	9	# of enterprise employees, sector, position in the enterprise, decision-making authority in the innovation process, experience in OI participation, initiator of the OI process, intermediary involved in the OI process, location of the company's headquarters, enterprise subject to German jurisdiction
Organizational benefits	19	Listing of the organizational benefits
Process-related benefits	10	Listing of the process-related benefits
Organizational risks	17	Listing of the organizational risks
Process-related risks	11	Listing of the process-related risks

The survey target group consisted of experts from practice and research working in the field of innovation and who were familiar with the OI paradigm. Innovation managers and workers, employees in R&D divisions, owners and managers, as well as academics focusing on innovation research comprised the sample. The regional focus of the sample was set to Austria, Germany and Switzerland.

The pretest aimed to estimate item comprehensibility as well as to check the length of the time period, and was conducted in two subgroups. The first subgroup included two innovation managers with decision-making competence along with two innovation workers, all representing the practitioners' perspective. The second subgroup involved three academics working in the field of innovation management, representing the academic perspective. Their feedback was used for minor revisions to the questionnaire regarding linguistic formulations, as well as the incorporation of explanatory examples of the risks and benefits. The planned survey duration of approximately 20-25 minutes could be verified.

3.2 Data collection

The survey was conducted in order to collect and analyze the practitioners' and academics' perceptions towards the benefits and risks of OI projects, along with possible influencing variables, in the period from June to August 2016. The online survey tool "lime survey" was used to create and host the survey. Through the use of contact databases from research organizations along with a listing of innovation chairs in the above-specified region, the link to the survey was distributed via email to 24,312 target group recipients in total. 348 data sets were answered following two waves of solicitation, which constitute a respondent rate of 1.44%.

Of the total 348 responses, 112 were removed: 110 were blank, one quit part of the way through and one after providing the demographic information. A maximum number of 236 exploitable data sets therefore represent the study's data base. However, a significant number of dropouts (65) occurred after completion of the final demographic information. 16 respondents quit during completion of the survey. The final number of relevant data sets therefore lies between 155 and 171. This steady decrease in exploitable data sets throughout the set of question items is assumed to be explained by the large number of question items (57) and resulting dropouts.

Table 6 visualizes the allocation of the participants into enterprise size categories. 55 of the participants work in enterprises with fewer than 50 employees, 84 in enterprises with more than 250 employees, and 32 belong to the category in between.

Table 6. Sample characteristics.

Variable	**Subclasses**	***N***
Enterprise size (number of employees)	<50	55
	50-250	32
	>250	84

3.3 Data analysis

The data sets captured in the survey were exported to SPSS 23. There, the data was prepared for analysis by removing missing units and incorrect encodings by the program. To find answers to the underlying question, the following procedure was applied: In the first step, a ranking order of the perceptions of all 57 benefits/risks was formed for each enterprise subclass. The rank correlation coefficient *Spearmans rho* was applied to determine whether there were evaluation differences on a general level between small, medium and large enterprises. Scatter plots were also created to identify further information about dependency structures between the enterprise sizes by considering the respective patterns. Cross-tables were then created for every benefit/risk and enterprise size. The *Chi-square test* was used to check which benefits/risks were significantly related to enterprise size. In addition to the significance, the strength of the association was also examined. Therefore, *Cramer's V* was calculated. It is based on the chi-squared statistic and may be used for nominal variables if at least one of them has more than two levels. In the next step, the structure of the associations was specified. This means that differences in the perception of benefits/risks between small, medium and large enterprises were illustrated by comparing the percentages of each. To identify the relevant differences, these percentages were further subjected to a test of significance.

4 Results

In order to gain insight into the possible influence of an enterprise's size on its perception of OI benefits and risks, it was first examined whether there general differences exist between small, medium and large enterprises. After the perceptions of all benefits and risks were placed in a ranking for each enterprise size, it was examined to what extent these rankings differed. Table 7 provides the correlation coefficient according to Spearman. When comparing the ranking for small enterprises with the ranking for medium-sized enterprises, a high degree of agreement (r_s = .861, $p \leq .01$) can be found. Correlations between small and large enterprises (r_s = .867, $p \leq .01$) and between medium and large enterprises are also (r_s = .865, $p \leq .01$) very strong. In summary, the benefits and risks are largely perceived equally regardless of whether an evaluator is employed in a small, medium, or large enterprise.

Table 7. Ranking correlations between the enterprise sizes.

Number of employees		< 50	50-250	> 250
Spearman?s rho (rs)	< 50 employees		.861** (N =57)	.867** (N =57)
	50-250 employees	.861** (N =57)	.865** (N =57)	
	> 250 employees	.867** (N =57)	.865** (N =57)	

** p ≤ .05

Even though the correlations are very strong, the assessments of the benefits/risks according to enterprise size are not identical. The scatter plots (Fig. 3) illustrate the correlations between the company sizes. The perception of the risks is presented along the two axes - small and medium enterprises (left), small and large enterprises (middle), and medium and large enterprises (right).

The spread of the individual benefits/risks is also discernible. The diagonal in each diagram represents perfect correspondence between the enterprise sizes. Many points are located on or close to the diagonal. This means that the perception of these benefits/risks does not differ between enterprise sizes. However, some of the assessed benefits and risks are indeed located some distance away from the diagonal.

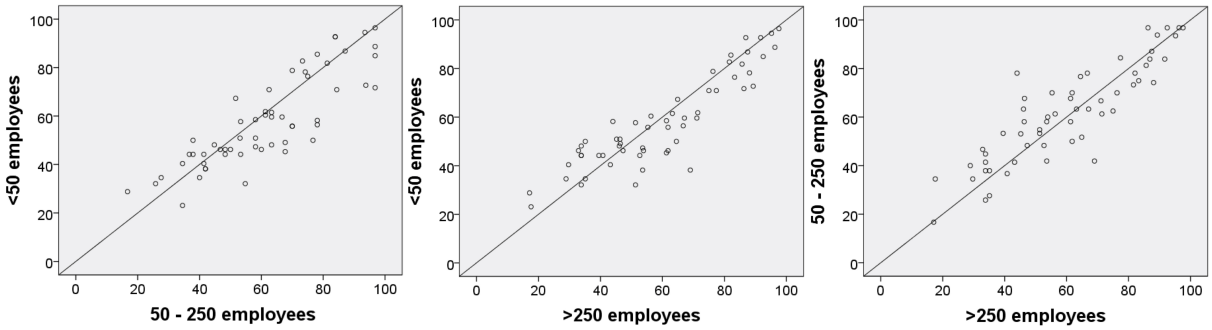

Fig. 3. Distribution of benefits/risks by enterprise size.

According to this general overview of the scatter plots and the apparent general minor deviation in the evaluations according to enterprise size, a detailed consideration of the benefits and risks seems promising. A closer analysis using the chi-square reveals that the perceptions of six benefits and one risk are significantly influenced by enterprise size. The strength of the influence as well as the differences between the enterprise sizes are described for these 7 items below. Table 8 displays the noteworthy associations between the benefits/risks and enterprise size, in which the perception of these benefits/risks is not independent of enterprise size. Here, the strongest association is found for "benefits from foreign cultures." A value of .297, $p \leq .01$ for *Cramer's V* points to a moderately strong correlation. Considering the other benefits, meaningful associations vary from V = .175, p ≤.10 (shorter product development times) to V = .256, p ≤ .01 (easy benchmarking of competitors). With "partner-specific threats", V = .197, p ≤ .05, only one meaningful correlation between risks and enterprise size is found.

Table 8. Correlations between benefits/risks and enterprise size

Benefits/risks		Cramer' s V	N
Benefits	Improvement of market knowledge and market requirement detection	.236***	171
	Benefits from foreign cultures	.297***	170
	Easy benchmarking of competitors	.256***	171
	Identification of further potentials during the innovation process sequence	.244***	164
	Shorter product development times	.175* 164	
	Faster time to market	.191**	164
Risk	Partner-specific threats	.197**	158

p ≤ .10, **$p \leq .05$, ***$p \leq .01$

Based on the correlations, only the strength of the association and the significance can be seen. Table 9 depicts the participants' perception of these significantly different benefits and risks according to enterprise size. Most participants perceive "improvement of market knowledge and

market requirement detection" as a benefit. The lower-case letters in each row illustrate significant ($p \leq .05$) differences between the enterprise sizes (same letter = no difference). Significance can be reported between enterprises having fewer than 50 employees (72.7%) on the one side, and enterprises having 50 to 250 employees (93.8%) as well as enterprises having more than 250 employees on the other side. The same differences are found for "identification of further potentials during the innovation process sequence" (71.7% - 96.8% and 86.3%) and "faster time to market" (32.1% - 54.8% and 51.3%). "Shorter product development times" and "insecurities over including the external partner" reveal a significant difference only between small and medium-sized enterprises (45.3% - 67.7% and 50.0% - 76.7%). A significant difference between medium-sized and large enterprises is found for "easy benchmarking of competitors" (78.1% - 44.0%). Large enterprises estimated the "benefits from foreign cultures" as significantly higher than medium-sized and small enterprises (69.0% - 41.9% and 38.2%).

Table 9. Perception as a benefit/risk according to enterprise size.

	Agreement by enterprise size		
Benefit/risk (*per Number of employees*)	<50	50-250	>250
Improvement of market knowledge and market requirement detection	72.7% $_a$	93.8% $_b$	89.3% $_b$
Benefits from foreign cultures	38.2% $_a$	41.9% $_a$	69.0% $_b$
Easy benchmarking of competitors	58.2% $_{a,b}$	78.1% $_b$	44.0% $_a$
Identification of further potentials during the innovation process sequence	71.7% $_a$	96.8% $_b$	86.3% $_b$
Shorter product development times	45.3% $_a$	67.7% $_b$	61.3% $_{a,b}$
Faster time to market	32.1% $_a$	54.8% $_b$	51.3% $_b$
Partner-specific threats	50.0% $_a$	76.7% $_b$	64.5% $_{a,b}$

Note: Each subscript is a subset of the "size of enterprise," whose column proportions do not differ significantly ($p \leq .05$) from one another.

5 Discussion

In light of the fact that OI in SMEs has its own characteristics and "can scarcely be compared with the existing literature on open innovation" (Vanhaverbeke, 2017, p.7), it is surprising that all subsets (small, medium-sized, large enterprises) are in each case highly correlated ($r \geq .8$) with each other, which implies that there are almost no differences between distinct perspectives regarding the benefits and risks of OI projects. Naturally, design differences in OI processes due to enterprise specifics and size do not necessarily lead to differences in the relevant risks and benefits. Nonetheless, particularly since innovation potential is usually highly available in SMEs, and especially when they are exporting (Love and Roper, 2015) and might lack more in scale effects of commercialization rather than in the development of products or technologies (Lee et al., 2010), it would have to be assumed that benefits such as "improvement of products or services" (average agreement of 87.2%) and "access to new product and production technologies" (average

agreement of 88.2%) would show perception discrepancies. However, these do not comprise any significant evaluation differences between the enterprise size categories.

Although the three subsets are highly correlated with one another, considering scatter plots of the data (Fig. 2) reveals that there is some non-negligible evaluation difference between the subgroups. Hence, one cannot say that no evaluation differences exist.

The item "improvement of market knowledge and market requirement detection" exhibits a moderate association (*Cramer's V* 0.236) between enterprise size and the evaluation of this item. This means that along with a change of enterprise size category comes a moderate tendency to differently assess the relevance of this benefit. The relevance thus differs according to enterprise size. It can be fundamentally noted that, across all subsets, quite a lot of participants considered the item to be a relevant benefit (average agreement 84.8%). Medium- (93.8%) and large-sized (89.3%) enterprises did not reveal any noteworthy differences on this. On the contrary, the assessment difference between small- (72.7%) and large-sized enterprises is significant. Vanhaverbeke (2017, p. xii) points out that the specialties of innovation in SMEs remain under-researched. Tailor and Greve (2006) argue that large enterprises usually tend to have a broader knowledge base that, in turn, makes them more likely to generate innovations. It can therefore be concluded that large enterprises might already be aware of this benefit. Small enterprises, on the other hand, rarely conduct holistic knowledge management (uit Beijerse, 2000), and thus might simply either not be sufficiently aware or might not have or see the necessity of handling such knowledge-related issues. Furthermore, SMEs posses more specialized knowledge in a certain industry or product range and are more locally embedded (Freel, 2003), and for this reason can adapt products, services and innovation attempts perfectly to the relevant markets (Hausman, 2005; Madrid-Guijarro et al., 2009; Bianchi et al., 2010). Despite the significant differences, a large number of small enterprises consider this item a benefit. Thus, the managerial and policy implications that can be derived include the understanding that small enterprises should use OI projects even more intensively to increase their own market knowledge. This needs to be accompanied by a systematic knowledge management approach, however.

The item "benefits from foreign cultures" shows a moderately strong association (*Cramer's V* 0.297) - which is the strongest association found in all items - between enterprise size and the assessment of this item. The perceived relevance of this item differs somewhat strongly by enterprise size. Fundamentally, it can be stated that indecisiveness is prevalent across all enterprise sizes (average agreement 54.1%), whereby the largest distance (and significant difference) is between large (69%) and small (38.2%) enterprises. Small and medium-sized enterprises (41.9%) do not show a noteworthy difference. Medium and large-sized enterprises, however, differ significantly.

According to the literature, cultural differences among small, medium-sized, and large enterprises are present and influence their performance: SMEs are considered to be more flexible, less bureaucratic and less rigid in decision making, as well as able to respond more quickly to new opportunities and threats (Carlsson, 1999; Kuratko et al., 2001). This is seen as their competitive advantage over large enterprises. Small enterprises in particular have less formal structures (Hill and Wright, 2001) and are characterized by a close interaction between management and employees. As a result, their culture is stronger and they are perceived to be considerably more stable than medium-sized or large enterprises. On the other hand, however, "SMEs are handicapped

by 'resource poverty' resulting from financial constraints, lack of professional expertise, and the lack of material and human resources" (Gray et al., 2003). Nevertheless, benefiting from foreign cultures should be a perk regardless of the enterprise size, which would imply that encouraging enterprises towards OI projects in order to leverage this perk would be a notable managerial implication. Furthermore, since benefiting from foreign cultures is perceived relatively strongly as an advantage of OI projects, this perk (as well as others) might be used as a barrier-reduction factor in influencing employees' attitudes. Additionally, enterprises enjoy such gains as new impressions, ideas, etc. from this kind of collaboration. In the case that this item is not sufficiently perceived as a benefit, the responsible person (i.e. innovation manager, entrepreneur, etc.) should put more emphasis on highlighting the immanent benefits of collaboration, because a variety-rich organizational culture enables innovation (Ahmed, 1998).

Considering the item "easy benchmarking of competitors" unveils a moderate association (*Cramer's V* 0.256) between enterprise size and the perception-based assessment of this item. The relevance of this item varies moderately by enterprise size category. Essentially, the item was affirmed indecisively (average agreement 55.0%). Thereby, 78.1% of the medium-sized enterprises consider this item as a relevant benefit. The assessment by small enterprises (58.2%) does not significantly differ from that of medium-sized enterprises. However, the assessments by both small and medium-sized enterprises in comparison to the assessment by large enterprises (44.0%) do differ. Reasons for this might lie in the fact that large enterprises clearly benefit from measurement techniques such as benchmarking (Monkhouse, 1995) and are often the benchmarking partner. Small enterprises, on the other hand, have their niche, and due to their different organizational structure do not necessarily conduct benchmarking (Anand and Kodali, 2008) or have systematic benchmarking procedures (Cassel et al., 2001). Medium-sized enterprises tend to be very competitive and thus rely on benchmarking for continuous improvement and development of the business units. This is not limited to medium-sized enterprises, however; it might be useful to apply benchmarking especially for small but also for large enterprises. Along this line of reasoning, therefore, they could also use OI projects to get a view behind the curtain of other enterprises.

Considering the item "identification of further potentials during the innovation process sequence," the association between an enterprise's size and its perception-based assessment is moderate (*Cramer's V* 0.244). According to this, the relevance of this item varies moderately depending on enterprise size. Given the high average agreement of 83.5%, the majority of respondents consider this benefit as relevant. To be more precise, this item has the greatest importance for medium-sized enterprises (96.8%), followed by large enterprises (86.3%) and small enterprises (71.7%). The assessment is also significantly different between small enterprises and both of the other two enterprise categories. Questions thus arise as to why this item is of less importance for small enterprises. One possibility is that the benefits may be negatively assessed for two different reasons: on the one hand, something could be non-beneficial because it is not seen as important. On the other hand, however, it could be seen as important, yet inapplicable. For small enterprises, the second reason should be convenient - their typically strong core business focus and specialized knowledge basis (Bianchi et al., 2010) could have a negative impact on the perceived benefit of the identification of further potentials.

Given the importance of process innovation for SMEs (Madrid-Guijarro et al., 2009) and the

limited resources of small enterprises, the cooperation with external partners should be seen as an opportunity not only to gain financial benefits but also to gain insights into process structure and flows and to use the lessons learned in order to stay innovative and competitive.

The item "shorter product development times" shows a weak association (*Cramer's V* 0.175). The respective importance thus differs according to enterprise size. The agreement with this item being a benefit is inconclusive across all categories (57.3%). Here, its perception as a benefit from the perspective of medium-sized enterprises shows the greatest strength (67.7%), while small enterprises significantly differ with a value of 45.3%. Large enterprises (61.3%), on the other hand, do not markedly differ from either category. March-Chorda et al. (2002) found that small and medium-sized enterprises generally have shorter product development times, although this depends on the sector. Against this background, it can be argued that small enterprises do not extensively perceive this benefit, since they already have very short product development times and are quite agile in product development (cf. Vanhaverbeke, 2017, pp. 33ff.). However, it is surprising that the perceived relevance of this item for medium-sized enterprises is considerably greater. Medium-sized enterprises are very competitive and try to close the gap with market leaders, which means they aim to grow (Man et al., 2002) and become one of the benchmarks. This might allow them to perceive this benefit as quite relevant, as they are driven by external pressure. Large enterprises do not necessarily depend on very fast development times. This benefit might then simply be less relevant for them than for medium-sized enterprises. Nonetheless, OI projects seem to be an appropriate means to catch up with benchmarks; in our understanding, however, it is not one of the most efficient means to reduce product development times.

The item "faster time to market" shows a weak but noteworthy association (*Cramer's V* 0.191) between enterprise size and the item's assessment. Essentially, the agreement to consider this item as a benefit of OI projects is inconclusive (average agreement 45.7%). However, there does exist a slight tendency towards less relevance. Medium-sized enterprises show the highest agreement (54.8%), followed by large enterprises (51.3%). Small enterprises (32.1%), on the other hand, show a significant difference from medium-sized and large enterprises. Enkel et al. (2009) argue that the inside-out process of OI enables enterprises to bring their ideas to the market faster than they could through internal development. Hence, at a first glance, the perception should not necessarily differ between the categories. In alignment with the competitiveness discussion around the above item "shorter product development times," it can be argued that the market pressure that medium-sized enterprises perceive forces them to reduce the time to market as much as possible and are thus very sensitized to this benefit or, to put it another way, they rely on it to become or stay competitive. Nevertheless, large enterprises do not consider this benefit as noteworthy, which implies that this is also a relevant motivation for them to participate in OI projects. Only small enterprises acknowledge the considerably faster time to market as a benefit of OI. Reasons for this may be found in the fact that they are usually quick to the market with their products.

For the item "partner-specific threats" - which is the only risk item that shows an association between enterprise size and assessment - a weak association (Cramer's V 0.197) is found. The average importance thus differs between the enterprise size categories. As with the items discussed above, the perceived general relevance of this item is broadly inconclusive (average agreement

62.0%). Medium-sized enterprises reveal the highest agreement (76.7%) and small enterprises (50.0%) the lowest value, with large enterprises (64.5%) in between. Small and medium-sized enterprises show a significant difference, and large enterprises do not differ significantly from the other two categories.

The key message in the context of this item is related to perceived insecurity over the decision for or against a particular cooperation partner. According to Diener and Piller (2013), the questions "Who is an external actor that can contribute input for my innovation challenge? How do I find these external actors?" are among the most relevant issues in the context of entrepreneurial OI processes. Here, two basic forms for the selection and involvement in interaction and collaboration can be distinguished: an Open Call - which refers to a publicly announced problem statement, and an Open Search - which refers to a proactive search for information and sources - that is, the active search for potentially appropriate external partners (ibid). Both paths can be associated with 1) insecurities regarding the enterprise's own input and approach, e.g. clear problem statement formulation without disclosing too much critical information, or an appropriate search concept; and 2) insecurities regarding the suitability or trustworthiness of the selected partner.

The low value for the small enterprises could be interpreted as a result of their often passive role in OI projects. The perception by large enterprises shows their awareness of possible risks, yet also their confidence, based on existing mechanisms and methods for facing these challenges. Medium-sized enterprises, however, often actively search within OI projects and do not enjoy the well-resourced position of large enterprises. In order to face this challenge, current applied OI research addresses the important role of intermediaries in the context of the search for an appropriate partner. Enterprises benefit from the intermediaries' tools, methods, existing access to an established community, education and process consulting in order to establish an OI project (Diener and Piller, 2013).

Except for the benefits and risks already mentioned in this section, the results show almost no differences between the evaluation results from different perspectives. Thus, the underlying question of whether the size of an enterprise affects its perception of the benefits and risks of OI projects can be answered generally in the negative. By answering this question, this article contributes to the existing theory regarding the benefits and risks of OI: 1) It finds that they are perceived mostly independently of enterprise size. Thus, the often-emphasized specifics of OI in SME (cf. Bianchi et al., 2010; Gassmann et al. 2010; Brunswicker and Vanhaverbeke, 2015; Santos, 2015; Vanhaverbeke, 2017) seem to have almost no influence on their perception towards the perks and shortcomings of OI. 2) The risks and benefits gathered from the literature (as well as those identified in the expert interviews for this study) were all indirectly confirmed as more or less relevant for OI practice and managerial decision making. This can be concluded by the respective average agreement. Thus, previous research on benefits and risks (see references in sec. 2.2) could be verified and elaborated. 3) A finer distinction between their degrees of relevance for small, medium, and large enterprises has been enabled and elaborates also the existing theory. This allows researchers and enterprises to better understand the importance of certain aspects of OI projects with respect to enterprise size.

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6 Conclusions, limitations and future work

This paper presents empirical findings regarding the effect of an enterprise's size on its perception of the benefits and risks of participating in OI projects. It was revealed that enterprise size does not necessarily have an effect on the perception of the benefits and risks. In a few cases, however, significant effects were identified. Even though small and medium-sized enterprises are usually lumped together in one category, the data analysis shows that the assessment of benefits and risks often significantly differs between these two categories. Medium-sized enterprises in particular show similarities with large enterprises in terms of their assessments. The findings of this paper may be taken as an indication of obvious differences between small and medium-sized enterprises. The results also enable SMEs to gain an understanding of which aspects they particularly need to focus on. Enterprises can use the opportunity to compare their own understanding of the importance of particular benefits and risks with the understanding of other OI experts. Along this line, a managerial tool for assisting enterprises to cope with OI projects, which supports them by weighing the benefits and risks of a given OI project, was developed on the basis of this study's underlying data.

The benefits and risks investigated here focus mainly on the outside-in perspective of OI. The inside-out perspective, in which an enterprise allows unused and underutilized knowledge outside its boundaries, is not explicitly examined here. The same applies for coupled processes (describing cooperative innovation processes with complementary partners or competitors in strategic alliances or network structures) (Gassman and Enkel, 2004). The specifics of each of these paths could influence the perception of benefits and risks in different ways.

Although the goal of the study was achieved and the underlying question was answered whether the perception of benefits and risks differs depending on enterprise size, inevitable limitations do exist. Due to the study's exploratory character, it was merely asked whether or not a listed benefit/risk was perceived as such. The present results are therefore based on a dichotomous dependent variable and thus do not give any information about the extent of the perceived relevance. The use of rating scales would seem to be useful for identifying the differences between more important and less important benefits and risks in future research, which in turn could depend on the size of a company. The study is also based on a low response rate. A return of less than 2% is not satisfying, although the number of participants (236) is acceptable and methodologically unproblematic for this kind of study. Nevertheless, the uneven distribution of enterprise sizes and the number of dropouts also needs to be pointed out. While from large enterprises the answers of 84 participants could be taken into consideration, this only applied to 32 participants from medium-sized enterprises. An additional 65 participants quit before assessing the benefits/risks. Another 16 participants stopped the survey during the assessment, so that not all benefits/risks could be analyzed on the same basis. This also led to the discovery of much less significant differences with rather small effect sizes. However, the aim of the study was not to examine assumed differences. Rather, the intention was to demonstrate the possible influences of enterprise size. For future surveys, however, an increased and more balanced sample should be sought.

Even though numerous benefits/risks were assessed in the context of the survey, this study does not claim that the presented list of benefits and risks is complete. Certainly, other benefits

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and risks are conceivable or can be found in the literature. On the other hand, some of the identified benefits and risks could also be aggregated based on existing similarities in terms of content. Another limitation could be the rather general formulation of the specified risks. This may have led to difficulties in answering the survey. A revised version with concrete examples would certainly be useful in further research.

Future research may involve the comparison of regional differences in the assessment of benefits and risks by conducting the same survey in different regions such as Asia, North America, Africa, or the Middle East. In this way, some light could be shed on regional or even culturally-based assessment differences and the resulting implications for OI. The survey data could also be used to create stylized facts regarding the benefits and risks of OI projects, however the sample size would need to be increased. The present study could therefore be a starting point for the creation of such stylized facts.

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Appendix

A1. Perception of organizational benefits according to enterprise size.

Organizational benefits	Agreement by enterprise size in % (*by number of employees*)			Average agreement
	>50	50 – 250	250>	
Inclusion of external experiences	96.4	96.8	97.6	97.1%
Expansion of the enterprise?s knowledge base	94.5	93.5	95.2	94.7%
Filling of internal knowledge gaps	92.7	83.9	91.7	90.6%
Access to new product and production technologies	92.7	83.9	86.9	88.2%
Improvement of market knowledge and market requirement detection	72.7	93.8	89.3	84.8%
Technological synergy effects	81.8	81.3	85.7	83.6%
Extension of the range of products and services	85.5	78.1	82.1	82.5%
Benefits from the partner's network	78.2	74.2	88.1	82.4%
Advantages in technology transfer	76.4	75.0	83.3	79.5%
Higher market acceptance through reference effects	70.9	84.4	77.4	76.6%
Use of the partner's intellectual property as a strategic asset	70.9	62.5	75.0	71.3%
Improvement of the organizational culture	61.8	61.3	71.4	66.5%
Better forecasting of future developments	56.4	78.1	66.7	65.5%
Easy benchmarking of competitors	58.2	78.1	44.0	55.0%
Benefits from foreign cultures	38.2	41.9	69.0	54.1%
Risk diversification	47.3	58.1	53.6	52.4%
Use of competitive synergies	49.1	67.7	46.4	51.2%
Enforcement of standards and designs for new products	50.9	53.1	45.2	48.5%
Synergy gains by patent pooling	38.2	41.9	69.0	46.5%

A2. Perception of process-related benefits according to enterprise size.

Process-related benefits	Agreement by enterprise size in % (*by number of employees*)			Average agreement
	>50	50 – 250	250>	
Availability of external experts	88.7	96.8	96.3	93.9%
Increased innovation performance	84.9	96.8	92.5	90.9%
Improvement of products or services	86.8	87.1	87.5	87.2%
Identification of further potentials during the innovation process sequence	71.7	96.8	86.3	83.5%
Enrichment of project evaluations with various facets	58.5	58.1	61.3	59.8%
Establishment of multifaceted decision making	60.4	61.3	56.3	58.5%
Shorter product development times	45.3	67.7	61.3	57.3%
Process improvements through process design by the partner	50.9	58.1	46.3	50.0%
Faster time to market	32.1	54.8	51.3	45.7%
Use of the advantages of external IT infrastructures	32.1	25.8	33.8	31.7%

A3. Perception of organizational risks according to enterprise size.

Organizational risks	Agreement by enterprise size in % (*by number of employees*)			Average agreement
	>50	50 – 250	250>	
Selection of the wrong partners	82.7	73.3	81.6	80.4%
Unclear communication of OI goals	78.8	70.0	76.3	75.9%
Insecurities over including the external partner	59.6	66.7	71.1	66.5%
Unintended knowledge drains	59.6	63.3	67.1	63.9%
Coordination problems	61.5	63.3	63.2	62.7%
Partner-specific threats	50.0	76.7	64.5	62.0%
Lack of cultural values	55.8	70.0	61.8	61.4%
Integration of security-critical partners	55.8	70.0	55.3	58.2%
Rejection of the process opening by employees	46.2	50.0	61.8	54.4%
Inefficient resource allocation	57.7	53.3	51.3	53.8%
Submergence of enterprise and OI strategy	46.2	60.0	53.9	52.5%
Opening of enterprise boundaries	48.1	63.3	46.1	50.0%
Dependence on external alliances	44.2	53.3	39.5	43.7%
Increased employee needs for training and motivation	44.2	36.7	40.8	41.1%
Monetary inefficiency	46.2	46.7	32.9	39.9%
Information overload	34.6	40.0	28.9	32.9%
Financial bottlenecks	28.8	16.7	17.1	20.9%

A4. Perception of process-related risks according to enterprise size.

Process-related risks	Agreement by enterprise size in % (*by number of employees*)			Average agreement
	>50	50 – 250	250>	
Delays with effects on the project progress	67.3	51.7	64.9	63.2%
Inefficient integration of internal and external IT systems	44.2	37.9	33.8	49.0%
Insecure and inaccurate decision making through more complex decision structures	46.2	48.3	47.3	47.1%
Unused result potentials	40.4	41.4	43.2	41.9%
Non-consideration of innovation potentials during the process sequence	48.1	44.8	33.8	40.6%
Pursuit and realization of unattractive ideas	50.0	37.9	35.1	40.6%
Slower product development	44.2	41.4	33.8	38.7%
Outflow of employees with expert knowledge to the partner	44.2	37.9	33.8	38.1%
Deficits in project evaluation through wasted potentials	40.4	34.5	29.7	34.2%
Inefficiencies in production and distribution	34.6	27.6	35.1	33.5%
Decreasing innovation capability	23.1	34.5	17.5	22.6%

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