UNIVERSITY OF LJUBLJANA
FACULTY OF ECONOMICS

KAJA RANGUS

PROCLIVITY FOR OPEN INNOVATION: CONSTRUCT DEVELOPMENT, DETERMINANTS AND OUTCOMES

DOCTORAL DISSERTATION

Ljubljana, 2014

UNIVERSITY OF LJUBLJANA
FACULTY OF ECONOMICS

KAJA RANGUS

PROCLIVITY FOR OPEN INNOVATION: CONSTRUCT DEVELOPMENT, DETERMINANTS AND OUTCOMES

DOCTORAL DISSERTATION

Ljubljana, 2014

AUTHORSHIP STATEMENT

The undersigned Kaja Rangus, a student at the University of Ljubljana, Faculty of Economics, (hereafter: FELU), declare that I am the author of the doctoral dissertation entitled Proclivity for open innovation: Construct development, determinants and outcomes (Nagnjenost k odprtemu inoviranju: Razvoj konstrukta, determinante in rezultati), written under supervision of prof. dr. Mateja Drnovšek and co-supervision of assistant prof. dr. Alberto Di Minin.

In accordance with the Copyright and Related Rights Act (Official Gazette of the Republic of Slovenia, Nr. 21/1995 with changes and amendments) I allow the text of my doctoral dissertation to be published on the FELU website.

I further declare

- the text of my doctoral dissertation to be based on the results of my own research;
- the text of my doctoral dissertation to be language-edited and technically in adherence with the FELU's Technical Guidelines for Written Works which means that I
    - cited and / or quoted works and opinions of other authors in my doctoral dissertation in accordance with the FELU's Technical Guidelines for Written Works and
    - obtained (and referred to in my doctoral dissertation) all the necessary permits to use the works of other authors which are entirely (in written or graphical form) used in my text;
- to be aware of the fact that plagiarism (in written or graphical form) is a criminal offence and can be prosecuted in accordance with the Copyright and Related Rights Act (Official Gazette of the Republic of Slovenia, Nr. 55/2008 with changes and amendments);
- to be aware of the consequences a proven plagiarism charge based on the submitted doctoral dissertation could have for my status at the FELU in accordance with the relevant FELU Rules on Doctoral Dissertation.

Date of public defense: 8.7.2014
Committee Chair: prof. dr. Miha Škerlavaj
Supervisor: prof. dr. Mateja Drnovšek
Co-supervisor: Assistant prof. dr. Alberto Di Minin
Member: prof. dr. Marko Jaklič
Member: Adjunct prof. dr. Henry Chesbrough

Ljubljana, _____ Author's signature: _____

ACKNOWLEDGEMENTS

Operation part financed by the European Union, European Social Fund.

I would like to thank Violeta Bulc for her generous invitation to join her team, for showing me endless business opportunities and for her unconditional support of my research.

I want to express sincere appreciation as well to my mentor prof. dr. Mateja Drnovšek for her time, valuable recommendations, and constant words of encouragement. Likewise, I thank my co-supervisor assistant prof. dr. Alberto Di Minin for his helpful suggestions and ideas.

Deep thanks to my family and friends for bearing with me during my challenging PhD days and for supporting me all the way on my journey.

NAGNJENOST K ODPRTEMU INOVIRANJU: RAZVOJ KONSTRUKTA, DETERMINANTE IN REZULTATI

POVZETEK

Koncept odprtega inoviranja se v zadnjem času uvršča med enega od najaktualnejših konceptov s področja managementa inovacij (Chiaroni, Chiesa & Frattini, 2010; Huizingh, 2011) in pridobiva na pomembnosti že od objave prve knjige prof. dr. Chesbrougha (2003b). Glavna ideja tega koncepta je odprtost procesa inoviranja do drugih podjetij, posameznikov, raziskovalnih laboratorijev, univerz, kupcev, dobaviteljev (Chesbrough, 2006b), z namenom omogočiti nemoten pretok idej znotraj in zunaj organizacije ter tako izkoristiti prednosti notranjih in zunanjih virov (Chesbrough, 2003b).

Doktorska disertacija obravnava tri glavne raziskovalne probleme. Prvič, čeprav je literatura na temo odprtega inoviranja poglavitno prispevala k razumevanju pomena odprtega inoviranja v organizacijah, ostaja vprašanje, katere organizacijske aktivnosti so v središču odprtega inoviranja, nenaslovljeno. Obstoječe mere za merjenje odprtega inoviranja ne upoštevajo večdimenzionalnosti omenjenega konstrukta; ne vključujejo specifikacije dimenzij in elementov odprtega inoviranja, zaradi česar je omejeno sistematično raziskovanje tega koncepta. Literatura, vezana na odprto inoviranje, tako potrebuje veljavno in empirično testirano mero za odprto inoviranje. Drugič, čeprav številne predhodne študije nakazujejo pozitiven vpliv odprtega inoviranja na inovativnost podjetij, v literaturi primanjkuje dokazov o mehanizmih, ki bi pojasnili omenjena razmerja. Vpeljava konstrukta odprtega inoviranja v strukturni model z drugimi organizacijskimi sposobnostmi bi tako pokazala, kako odprto inoviranje vpliva na druge konstrukte v teoretičnem modelu. Tretjič, študije na temo odprtega inoviranja večinoma obravnavajo le posamezen vidik omenjenega koncepta, zaradi česar so dokazi o pomembnosti in vplivu posamezne dimenzije odprtega inoviranja razdrobljeni po različnih študijah. Dosedanje raziskave na temo odprtega inoviranja ne prispevajo teoretične in empirične podlage za odgovore na pomembnejša vprašanja, vezana na praktične implikacije odprtega inoviranja, kot je npr. vprašanje, katera dimenzija odprtega inoviranja bolj pomembno vpliva na inovativnost podjetij. Poleg tega dosedanje študije ne dajejo informacije o tem, kako implementirati posamezno dimenzijo z upoštevanjem ključnega elementa za uspešno implementacijo, tj. človeške naravnanosti. Ta informacija bi bila v veliko pomoč managerjem pri odločitvah o razdelitvi (redkih) organizacijskih virov po posameznih aktivnostih odprtega inoviranja.

Doktorska disertacija obravnava opredeljene raziskovalne probleme v treh ločenih poglavjih:

Prvo poglavje doktorske disertacije opisuje razvoj mere za nagnjenost podjetij k odprtemu inoviranju. Prvi korak se nanaša na pregled literature na temo odprtega inoviranja, ki je podlaga za konceptualizacijo nagnjenosti k odprtemu inoviranju ter za razvoj veljavnega in zanesljivega merskega inštrumenta. V naslednjem koraku z osebnimi intervjuji s številnimi strokovnjaki s področja odprtega inoviranja iz različnih strok (profesorji, raziskovalci, direktorji itd.) pregledamo in prečistimo potencialne elemente za konstrukt nagnjenosti k odprtemu inoviranju (ki so bili identificirani na podlagi literature). Sledi pilotna študija, opravljena med 30 proizvodnimi in storitvenimi podjetji. Nadaljujemo z validacijo mere na dveh velikih vzorcih iz dveh različnih držav.

V drugem poglavju doktorske disertacije konstrukt nagnjenosti k odprtemu inoviranju obravnavamo kot formalni konstrukt ter empirično preverimo njegov vpliv na inovativnost podjetij. Namen tega dela disertacije je raziskati, s katerimi organizacijskimi sposobnostmi

nagnjenost k odprtemu inoviranju vzajemno vpliva na inovativnost podjetja. Predpostavljamo, da ima absorpcijska sposobnost vlogo mediatorja v razmerju med nagnjenostjo podjetja k odprtemu inoviranju in inovativnostjo podjetja. Podano hipotezo neposrednega in posrednega vpliva nagnjenosti k odprtemu inoviranju in absorpcijske sposobnosti na inovativnost podjetja preverimo na vzorcu 421 podjetij iz različnih dejavnosti.

V tretjem poglavju želimo z različnimi statističnimi analizami na velikem vzorcu podjetij iz treh različnih držav prispevati teoretično in empirično podlago za odgovore na nekatera pomembna vprašanja, ki se pojavljajo v literaturi o odprtem inoviranju, kot na primer: Ali imajo različne dimenzije odprtega inoviranja različen vpliv na inovativnost podjetij? Ali obstajajo različni načini odprtega inoviranja? Kako implementirati različne dimenzije odprtega inoviranja? Ali so podjetja, ki so bolj odprta v vseh dimenzijah odprtega inoviranja, bolj inovativna? S tem želimo pomagati managerjem pri odločitvah o tem, katere dimenzije odprtega inoviranja morajo najbolj spodbujati ter kako uspešno implementirati omenjeni koncept v svojem podjetju.

Disertacija prispeva k znanosti v več pogledih. Prvič, gre za prvo študijo, ki upošteva večdimenzionalnost odprtega inoviranja. Raziskava poda pregled obstoječe definicije nagnjenosti k odprtemu inoviranju in empirično preveri zanesljivost, konvergentno in diskriminantno veljavnost. Drugič, veljavna in empirično testirana mera za nagnjenost k odprtemu inoviranju je odskočna deska za prihodnje kvantitativne raziskave s področja odprtega inoviranja. Omogoča nadaljnjo proučevanje vloge nagnjenosti odprtega inoviranja v teoretičnem modelu z drugimi organizacijskimi korelati. Tretjič, konstrukt nagnjenosti k odprtemu inoviranju smo postavili v teoretični model soodvisnosti z drugimi organizacijskimi konstrukti in empirično testirali njegov vpliv na uspešnost podjetja. V drugi raziskavi smo konceptualizirali in empirično testirali model s konstrukti nagnjenost k odprtemu inoviranju, absorpcijska sposobnost in inovativnost podjetja. S tem prispevamo k literaturi na temo odprtega inoviranja in k teoriji absorpcijske sposobnosti. Četrtič, s konceptualno integracijo absorpcijske sposobnosti v širši model z nagnjenostjo k odprtemu inoviranju in inovativnostjo podjetja ter empirično preverbo modela prispevamo dokaze za poglavitna vprašanja s področja inovacijskega managementa. Z raziskavo pokažemo, katere organizacijske sposobnosti značilno vplivajo na inovacijske strategije podjetja, in predstavimo mehanizme, preko katerih učinki organizacijskih sposobnosti vplivajo na uspešnost organizacije. Petič, za razliko od obstoječih empiričnih raziskav, ki se osredotočajo le na specifičen vidik odprtega inoviranja, naša raziskava vključuje integrativen pristop in poda obsežen pregled aktivnosti odprtega inoviranja. Poglobljen pregled literature na temo odprtega inoviranja nam omogoči, da lahko primerjamo in ocenimo pomembnost posamezne aktivnosti odprtega inoviranja za doseganje z inovativnostjo povezanih dosežkov v organizaciji. Ob tem prikažemo tudi vpliv posamezne dimenzije odprtega inoviranja na inovativnost podjetja. Šestič, na podlagi rezultatov tretje raziskave in dodatnih poglobljenih intervjujev z direktorji podjetij podamo napotke za uspešno implementacijo odprtega inoviranja v podjetjih, ki upoštevajo tudi človeški faktor omenjenega procesa. Sedmič, z metodološkega vidika uporabimo različne kvalitativne in kvantitativne raziskovalne metode. V treh raziskavah vpeljemo: poglobljen pregled literature, intervjuje, deskriptivne statistike, korelacijske analize, ANOVA-test, teste zanesljivosti, eksploratorno faktorsko analizo, konfirmatorno faktorsko analizo, strukturno modeliranje, regresijo in analizo skupin.

Ključne besede: nagnjenost k odprtemu inoviranju, inovativnost, absorpcijska sposobnost, razvoj merskih lestvic, strukturno modeliranje enačb, analiza skupin

PROCLIVITY FOR OPEN INNOVATION: CONSTRUCT DEVELOPMENT, DETERMINANTS AND OUTCOMES

SUMMARY

Open innovation can be considered one of the most topical concepts in innovation management (Chiaroni et al., 2010; Huizingh, 2011) and has been in the limelight since Chesbrough's (2003b) seminal work. The main idea of open innovation is to open up the innovation process to other firms, individuals, research labs, universities, customers, suppliers, etc. (Chesbrough, 2006b) with an aim to facilitate a smooth flow of ideas inside and outside of organisations and, in this way, derive advantages from the exploration of external and exploitation of internal resources (Chesbrough, 2003b).

The dissertation explores three main research problems. First, while the existing body of literature on open innovation has assisted in better understanding of the role of open innovation in organisations, the question regarding which organisational activities are at the heart of open innovation remains unaddressed. In particular, the multidimensional construct of open innovation has not yet been conceptualised or empirically validated in a coherent manner. Second, although several prior studies have suggested the positive influence of open innovation on firms' innovation performance, there is no evidence of mechanisms that explain such relationships. Hence, integrating the construct of open innovation in a structural model with other firms' capabilities and outcomes may reveal how open innovation influences other correlates in the nomological network. Third, open innovation has been rarely explored in its whole, since existing research mostly has focused on one of its dimensions at a time. This piecemeal approach hinders the understanding of the complexity of the open innovation phenomenon and its activities. In particular, existing studies of open innovation have not provided theoretical and empirical grounds for addressing questions related to practical implications of open innovation, such as which dimension of open innovation may be more important in facilitating innovation performance of organisations. Additionally, existing studies do not include suggestions for how different open innovation activities could be implemented, considering the fundamental element of successful implementation of open innovation (i.e. human centredness). Such evidence is particularly informative to CEOs who allocate (scarce) resources to development of particular open innovation related activities.

The identified research problems are addressed in three chapters in the doctoral dissertation:

The first chapter of the doctoral dissertation describes the development of the measure of proclivity for open innovation. The first step is presentation of a literature review on open innovation that presents the basis for, first, conceptualising the proclivity for open innovation and, second, developing a valid and reliable measurement instrument. The next step is the purification and revision of the potential proclivity for open innovation items (identified in the literature) by personal interviews with several experts in the field from different professions (e.g., professors, researchers, CEOs, etc.). We perform a pilot study of 30 companies in manufacturing and service industries. We continue with validation of the measurement scale on two large cross-cultural samples.

In the second chapter of the dissertation, we use the proclivity for open innovation concept as a formal construct and empirically test its impact on a firm's performance. The purpose of the second part is to explore the organisational capabilities with which proclivity for open innovation mutually influence a firm's innovation performance. We hypothesise that absorptive capacity mediates the relationship between proclivity for open innovation and a

firm's innovation performance. We validate the proposed hypothesis of direct and mediated effects of proclivity for open innovation and absorptive capacity on a firm's innovation performance on a sample of 421 companies from service and manufacturing industries.

The third chapter of the study aims to establish theoretical and empirical grounds for addressing fundamental questions about practical implications of open innovation. These questions include the following: How do different dimensions of open innovation influence innovation performance? Do different modes of open innovation exist? How can different open innovation dimensions be implemented? Are companies that are highly intense on all open innovation dimensions superior innovators? We aim to provide answers to these questions with regression and cluster analyses on a large sample of companies from three countries.

The dissertation contributes to the field of knowledge from several standpoints. First, this study is the first that takes into consideration the multidimensional nature of open innovation. The study revises the existing definition of proclivity for open innovation and empirically validates its reliability and its convergent and discriminant validity. Second, the validated and empirically tested measure of proclivity for open innovation presents robust grounds for quantitative research on open innovation. It is a facilitator of future research examining the role of proclivity for open innovation in a nomological network with other organisational correlates. Third in terms of contribution to the field, we set the newly developed construct of proclivity for open innovation in a nomological network of related constructs and empirically test its influence on a firm's performance. We conceptualise and empirically test a contingency model of proclivity for open innovation, absorptive capacity, and a firm's innovation performance. With this study we contribute to the work on open innovation and to the theory of absorptive capacity. Fourth, by conceptually integrating absorptive capacity into the broader model of proclivity for open innovation and a firm's innovation performance and by empirically testing the model, we provide the evidence for principal questions in innovation management research. We show which organisational capabilities significantly impact the organisation's innovation strategies and present the mechanisms through which effects of organisational capabilities are channelled to impact organisational performance. Fifth, in contrast to existing studies that focus on partial aspects of open innovation, we take an integrative perspective and provide a comprehensive overview of open innovation activities. Drawing from an in-depth literature review of open innovation, we establish grounds to evaluate and compare the utility of each open innovation activity in attaining innovation-related outcomes in organisations. Moreover, we disentangle the relative importance of a particular open innovation dimension for an organisation's innovation performance. Sixth in terms of contribution to the field, based on the results of the analyses and additional interviews with CEOs, we are able to provide guidelines for successful implementation of open innovation that acknowledges human centredness in the open innovation process. Seventh and finally, from a methodological perspective, we incorporate several qualitative and quantitative research methods. We use in-depth literature review, interviews, descriptive statistics, correlations analyses, ANOVA, reliability tests, exploratory factor analysis, confirmatory factor analysis, structural equation modelling, regression analysis, and cluster analysis.

Key words: proclivity for open innovation, innovation, absorptive capacity, scale development, structural equation modelling, cluster analysis

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

"No company has the brainpower or budget to go it alone. We need open innovation."
-- John Tau, former vice president of open innovation at Weyerhaeuser (Arndt, 2009)

Open innovation can be considered one of the most topical concepts in innovation management (Chiaroni et al., 2010; Huizingh, 2011) and has been in the limelight since Chesbrough's (2003b) seminal work. The main idea of open innovation is to open up the innovation process to other firms, individuals, universities and research labs, etc. (Chesbrough, 2006b) with an aim to facilitate a smooth flow of ideas inside and outside organisation and in this way benefit from the exploration of external and exploitation of internal resources (Chesbrough, 2003b). The benefits of open innovation include greater access to external expertise, lower costs of technology development and improvements, quicker time to market, and better quality of the products (Wallin & von Krogh, 2010). Organisations open up their innovation process with an aim to integrate the knowledge base, accelerate creativity and flexibility, and attain excellence in knowledge production (Lazzarotti, Manzini & Pellegrini, 2010). The main motives to open up are thus market related: improving the quality of products, keeping up with market developments, and meeting customers demand with a higher order aim of increased growth, superior financial performance, or greater market share (van de Vrande, de Jong, Vanhaverbeke & de Rochemont, 2009).

The increasing use of open innovation for achieving competitive advantage is apparent in business practices. For example, not long ago, ICT multinationals like IBM, AT&T and Merck were the leading research-based companies, but open innovation enabled new smaller companies, such as Intel, Sun and Cisco at that time, to enter the market and gain competitive position by leveraging the research findings of other organisations (Chesbrough, 2004). The competitive advantage of involving external partners in the innovation process is evident also from the case of Apple, which attracted many third-party applications and services that created novel experiences for Apple users (Chesbrough, 2011). Graham Cross from Unilever stressed, "You need to start to develop a culture internally which is appreciative of external capabilities. It needs to become almost a matter of pride to be the one who found something wonderful outside" (van de Vrande, 2006).

Open innovation is a multidimensional construct that joins under one umbrella several organisational activities (Huizingh, 2011), such as customer involvement (e.g. Antikainen, Mäkipää & Ahonen, 2010; Di Gangi & Wasko, 2009; Prugl & Schreier, 2006), external networking (e.g. Asakawa, Nakamura & Sawada, 2010; Tether & Tajar, 2008), licensing of intellectual property (IP), and venturing (e.g. Gruber & Henkel, 2006). Existing research vastly contributed to the understanding of the concept by providing conceptualisation of the open innovation (e.g. Almirall & Casadesus-Masanell, 2010; Chesbrough, 2006b; Chesbrough & Garman, 2009; Mäkipää, Ahonen & Mäntymäki, 2006) and representation of

case studies (e.g. Chesbrough, 2003b; Di Gangi & Wasko, 2009; Langvardt, 2010; Pontiskoski & Asakawa, 2009; Rohrbeck, Holzle & Gemunden, 2009). However, only a handful of studies analysed open innovation-related issues in large-scale studies (e.g. Inauen & Schenker-Wicki, 2011; Lichtenthaler, 2008; van de Vrande et al., 2009), and none of them provided the validity and reliability of the measures used. Despite the fact that numerous scholars and practitioners have emphasised the importance of open innovation for a firm's performance, the literature in this field still lacks the conceptualisation of the construct and the ability to measure it. The literature on open innovation thus needs the empirically verifiable definitions of activities and elements of this multidimensional construct, which would enable grounds for more programmatic research on open innovation and facilitate better generalisability of the findings to the influence of open innovation in organisations.

Moreover, more quantitative analyses are needed to build path models, formally test for context dependencies, and provide the evidence on the relationships between open innovation and other important organisational correlates (Huizingh, 2011). Researchers (e.g. Hughes & Wareham, 2010; Spithoven, Clarysse & Knockaert, 2010) have suggested that absorptive capacity is needed to successfully exploit external knowledge and information for innovation outcomes; however, the results of current large-scale studies on this topic are inconsistent. In these three studies, three different roles of absorptive capacity in relation to open innovation were identified: a substitution effect (Laursen & Salter, 2006), a moderating effect (Escribano, Fosfuri & Tribó, 2009), and a mediating effect (Fosfuri & Tribó, 2008). The variation of the results may be due to the use of proxy measures based on predeveloped statistical instruments, such as Community Innovation Surveys (CIS). According to Lane, Koka and Pathak (2006), absorptive capacity should be measured in non-research and development (R&D) contexts, taking into consideration the multidimensional nature of the construct. Likewise, the measure of open innovation should incorporate different open innovation activities (Schroll & Mild, 2011). The use of proxies may lead to the conflicting and misleading findings (Flatten, Engelen, Zahra & Brettel, 2011), which is why research that uses validated scales are needed.

Furthermore, most studies thus far have examined either inbound (e.g. Buganza & Verganti, 2009; Parida, Westerberg & Frishammar, 2012; Spithoven et al., 2010) or outbound (e.g. Kutvonen, 2011; Lichtenthaler, 2009) open innovation or studied particular open innovation activity. Yet, the multidimensional phenomenon has been rarely explored in its whole, which hinders our understanding of how different dimensions of open innovation could be combined and jointly impact various organisational outcomes. In addition, existing empirical studies do not provide evidence on which dimension of open innovation most influence a firm's innovation performance. Evidence on the influence of individual dimensions on a firm's performance would be an asset to managers in deciding which open innovation activity to nurture. Moreover, most studies so far have examined the execution of a firm's open innovation activities without taking into consideration the human side of the open innovation processes. Several studies in human resource management (e.g. García-Morales, Jiménez-

Barrionuevo & Gutiérrez-Gutiérrez, 2012; Yoshida, Sendjaya, Hirst & Cooper, In Press), however, have emphasised the importance of proactive leaders in successful innovation.

Research problem and purpose

The dissertation explores three main research problems. First, while the existing body of literature on open innovation has assisted in better understanding of the role of open innovation in organisations, the question regarding which organisational activities are at the heart of open innovation remains unaddressed. In particular, the multidimensional construct of open innovation has not yet been conceptualised or empirically validated in a coherent manner. Second, although several prior studies have suggested the positive influence of open innovation on firms' innovation performance, there is no evidence concerning mechanisms that explain such relationships. Hence, integrating the construct of open innovation in a structural model with other firms' capabilities and outcomes may reveal how open innovation influences other correlates in the nomological network. Third, open innovation has been rarely explored in its whole, since existing research mostly has focused on one of its dimensions at a time. This piecemeal approach hinders the understanding of the complexity of open innovation phenomenon and its activities. In particular, existing studies of open innovation have not provided theoretical and empirical grounds for addressing the questions related to practical implications of open innovation, such as which dimension of open innovation may be more important in facilitating innovation performance of organisations. Additionally, existing studies do not include suggestions for how different open innovation activities could be implemented, considering the fundamental element of successful implementation of open innovation (i.e., human centredness). Combination of different statistical analyses, such as in-depth literature review, regression analysis, cluster analysis, and structured interviews, may provide the evidence on these aspects.

In the dissertation, identified research problems are addressed with three main purposes: (1) to define, operationalise, and validate the scale for measuring firm's intention to perform different open innovation activities, labelled proclivity for open innovation, taking into consideration the multidimensional nature of open innovation; (2) to set a newly developed measure of proclivity for open innovation into a nomological network with other organisational correlates and show how organisational capabilities mutually influence firm's innovation performance; and (3) to provide a comprehensive overview of open innovation activities, the benefits of each of them, and their influence on a firm's innovation performance and to provide guidelines for successful implementation of open innovation that acknowledges human centredness of open innovation process. These three issues are in more detail discussed in the next paragraphs.

The first chapter of the doctoral dissertation describes the development of the measure of proclivity for open innovation. The first step is to provide a literature review on open innovation that presents the basis for, first, conceptualising the proclivity for open innovation

and, second, developing a valid and reliable measurement instrument. The next step is the purification and revision of the potential proclivity for open innovation items (identified in the literature) by personal interviews with several experts in the field from different professions (such as professors, researchers, and CEOs). We perform a pilot study among 30 companies in manufacturing and service industries. We continue with validation of the measurement scale on two large cross-cultural samples.

In the second chapter we use the proclivity for open innovation concept as a formal construct and empirically test its impact on a firm's performance. The purpose of the second part is to explore the organisational capabilities with which proclivity for open innovation mutually influence a firm's innovation performance. We hypothesise that absorptive capacity mediates the relationship between proclivity for open innovation and a firm's innovation performance. We validate the proposed hypothesis of direct and mediated effects of proclivity for open innovation and absorptive capacity on a firm's innovation performance on a sample of 421 companies from service and manufacturing industries.

The third chapter of the doctoral dissertation provides a comprehensive overview of open innovation activities, including the benefits of each of them, different ways to implement them, and their influence on a firm's innovation performance. By executing cluster analysis on a large sample of companies from three countries, we identify different modes of open innovation (i.e. different combinations of open innovation activities). Based on the structured interviews with the CEOs of the representative company for each cluster, we describe ways and reasons why they implement specific open innovation dimension. Moreover, with additional analysis comparing the best 25% of the companies with the worst 25% according to their score on innovation performance, we try to provide an answer as to whether implementation of more open innovation dimensions leads to superior innovation performance. Finally, we provide some steps to be followed when implementing open innovation, considering the human centredness of open innovation process.

Research questions

The dissertation addresses several research questions derived from the presented research problems and purposes. The first group of research questions refers to the development of the proclivity for open innovation scale, as follows:

Research question 1: How many facets compose proclivity for open innovation?
Research question 2: Which items constitute the dimensions of proclivity for open innovation?
Research question 3: Do the proposed dimensions have discriminant and convergent validity?
Research question 4: How can proclivity for open innovation be conceptualised and operationalised?

The second group of research questions explores the influences of proclivity for open innovation on other correlates in the nomological network:

Research question 5: How does proclivity for open innovation influence a firm's innovation performance?
Research question 6: How does proclivity for open innovation influence absorptive capacity?
Research question 7: What is the relationship between proclivity for open innovation, absorptive capacity, and a firm's innovation performance?

The third part of the research questions tries to provide better understanding on how aspects of open innovation are implemented in companies and how they correlate with a firm's innovation performance. Thus, the research questions are as follow:

Research question 8: How do different dimensions of open innovation influence innovation performance?
Research question 9: Do different modes of open innovation exist?
Research question 10: How can different open innovation dimensions be implemented?
Research question 11: Are companies that are highly intense on all open innovation dimensions superior innovators?

Research goals

The aim of the dissertation is to contribute to the better understanding of the concept of open innovation. The research goals are as follows:

Research goal 1: To define the dimensions and their items that compose the construct of proclivity for open innovation.
Research goal 2: To conceptualise and operationalise the construct of proclivity for open innovation.
Research goal 3: To ensure the reliability and validity of the measure of proclivity for open innovation.
Research goal 4: To support the generalisability of the new measure of proclivity for open innovation.
Research goal 5: To determine the relationship between proclivity for open innovation, absorptive capacity, and a firm's innovation performance.
Research goal 6: To provide evidence on the connectedness of separate dimensions of open innovation with a firm's innovation performance.
Research goal 7: To indicate different modes of open innovation.
Research goal 8: To describe how different open innovation dimensions can be implemented.
Research goal 9: To denote the human centredness of the open innovation process.

Theoretical and practical contributions

The dissertation contributes to the field of knowledge from several standpoints.

First, this is the first study that takes into consideration the multidimensional nature of open innovation. The proposed conceptual model of proclivity for open innovation combines all main open innovation activities. The study revises the existing definition of proclivity for open innovation and empirically validates its reliability and convergent and discriminant validity. The originality of the proposed framework of proclivity for open innovation is in its focus on a specified scope of open innovation activities, which are regarded as independent yet related processes that jointly influence the overall open innovation outcomes of an organisation. Additionally, we reveal how different dimensions of open innovation are interrelated.

Second, the validated and empirically tested measure of proclivity for open innovation presents a resilient basis for quantitative research on open innovation. It is a facilitator of future research in examining the role of proclivity for open innovation in a nomological network with other organisational correlates. Moreover, by defining the dimensions of proclivity for open innovation and presenting various ways of implementing open innovation, we also make important practical contributions. The research can be of great help to managers seeking to identify the potential a firm has in exploiting internal knowledge and exploring external knowledge and technology.

Third, we set the newly developed construct of proclivity for open innovation in a nomological network of related constructs and empirically test its influence on a firm's performance. We conceptualise and empirically test a contingency model of proclivity for open innovation, absorptive capacity, and a firm's innovation performance. This study is the first to incorporate validated perceptual measures of proclivity for open innovation and absorptive capacity. In this way we contribute to the literature on open innovation by identifying organisational capabilities with which proclivity for open innovation jointly affect a firm's innovation performance. Moreover, by showing how proclivity for open innovation influences absorptive capacity, we contribute to the theory of absorptive capacity that lacks evidence on the antecedents of this capability (Jansen, Van Den Bosch & Volberda, 2005). By setting the dynamic capabilities in a nomological network and showing how they mutually impact a firm's innovation performance, we contribute to the dynamic capabilities perspective, which lacks empirical evidence based on quantitative research (C. L. Wang & Ahmed, 2007); consequently, it is unclear in the current literature how dynamic capabilities operate in combination with each other (Ambrosini & Bowman, 2009).

Fourth, by conceptually integrating absorptive capacity into the broader model of proclivity for open innovation and a firm's innovation performance and empirically testing the model, we provide the evidence for the principal questions in the innovation management research.

We show which organisational capabilities significantly impact innovation strategies and present the mechanisms through which effects of organisational capabilities are channelled to impact organisational performance.

Fifth, we provide a systematic overview of different dimensions of open innovation, their benefits, and their impact on a firm's innovation performance. This overview may help managers ascertain the potential and ample opportunities of open innovation. We present different modes of open innovation (i.e. determine different combinations of open innovation dimensions), which may help managers when struggling which open innovation activities to combine.

Sixth, our analysis reveal that the more open innovation dimensions a firm implement, the higher possibility of superior innovation performance. This result should stimulate managers to implement as much open innovation activities as possible.

Seventh, we provide steps to be followed when implementing open innovation, underscoring the importance of human centredness in the open innovation process. Successful implementation of open innovation is based on open mind-sets of leaders, employees, and external partners; such open mind-sets have to be stimulated internally and externally. In addition, our study indicates the importance of employee involvement. Therefore, besides exploration of external resources, managers should devote more attention also to the personal development of employees.

Eight, from the methodological perspective, we incorporate several methodological approaches. We start with an in-depth literature review in the field of open innovation. Qualitative methods are furthermore incorporated in the form of interviews with an aim of purifying the scale and testing the measurement instrument. The interviews are also used in the third study with an aim towards achieving a clearer picture of the activities of the representative companies for each cluster. Quantitative methods are used for testing and validating the measure of proclivity for open innovation and the proposed structural model by incorporating exploratory factor analysis (EFA), confirmatory factor analysis (CFA), structural equation modelling, and other methods. Besides validating the measure of proclivity for open innovation in two national contexts, the generalisability of the scale is further supported on two additional samples of companies. Moreover, we use regression and cluster analysis in the third study to group the companies according to the proclivity for open innovation dimensions and to show how they separately influence a firm's innovation performance.

Structure of the dissertation

The doctoral dissertation is structured in the form of a collection of scientific papers and is divided into three main chapters and concluding remarks. After the introduction, Chapter 1 focuses on the proclivity for open innovation scale development and cross-cultural validation. Chapter 2 examines the mediating effect of absorptive capacity on the relationship between proclivity for open innovation and a firm's performance. Chapter 3 explores how aspects of open innovation are implemented in companies and how they correlate with a firm's innovation performance. The conclusion includes a review of main findings and implications and limitations of the dissertation, which are followed by the references section and appendices. The dissertation concludes with an extended summary of the dissertation in Slovene language.

1 PROCLIVITY FOR OPEN INNOVATION: CONSTRUCT DEVELOPMENT AND CROSS-CULTURAL VALIDATION[1]

1.1 Introduction

Academics and business practitioners concur that open innovation is instrumental for sustained competitive advantage in innovation and overall organisational competitiveness. For example, former CEO of Procter & Gamble (P&G) Allen George Lafley asserted that the majority of P&G's best innovations had come from connecting ideas across internal businesses, as half of their new products came from their own labs and half of them came through them (Huston & Sakkab, 2006). Open innovation is considered to be one of the most contemporary concepts in innovation management (Chiaroni et al., 2010; Huizingh, 2011). Scholars and practitioners have started to show interest in the concept since the publication of Chesbrough's (2003b) seminal work. The main idea of open innovation is to open up the innovation process to other firms, individuals, research labs, etc. (Chesbrough, 2006b), which can enable companies to reduce the costs of technology development and improvements, accelerate time to market, improve the quality of the products and increase access to external expertise (Wallin & von Krogh, 2010). Graham Cross from Unilever succinctly points to the essence of open innovation process: "You need to start to develop a culture internally which is appreciative of external capabilities" (van de Vrande, 2006). Open innovation is a multi-faced phenomenon that has been considered both by Chesbrough (2003b) and his followers (e.g. Chesbrough & Crowther, 2006; Teirlinck & Spithoven, 2008; van de Vrande et al., 2009) to be an umbrella paradigm of specific organisational activities. In that sense, open innovation can be considered the result of a coherent strategy as well as the combination of sub-strategies in many aspects of a company's management, including R&D management, technology, business development, organisation, human resource management and similar.

While the existing body of literature on open innovation has assisted tremendously in better understanding of the role of open innovation in organisations, the question regarding which organisational activities are at the heart of open innovation remains unaddressed. Organisational activities concern various boundary spanning activities that include actively engaging with external partners. Systematic research evidence on boundary spanning activities in organisations is fragmented, since existing research has focused either on inbound (e.g. Parida et al., 2012; Spithoven et al., 2010) or outbound (e.g. Inauen & Schenker-Wicki, 2012) activities independently, or examined specific facets of open innovation dimensions, such as customer involvement (e.g. Di Gangi & Wasko, 2009) and external networking (e.g. Asakawa et al., 2010). The lack of coherent evidence on various types of open innovation

[1] This chapter of the dissertation was presented as a working paper at the ABSRC 2011 conference, at the RENT 2012 conference and at the AOM 2013 conference.
The paper is under Revise and Resubmit process in a peer-reviewed journal.
The paper is written in co-autorship with prof. dr. Mateja Drnovšek and assistant prof. dr. Alberto Di Minin.

hinders a more systematic approach to building a cumulative body of knowledge on open innovation.

Second, the multidimensional construct of open innovation has not yet been conceptualised or empirically validated in a coherent manner. Prior research focused on representing anecdotal evidence on open innovation primarily based on case studies (e.g. Chesbrough, 2003b; Dodgson, Gann & Salter, 2006; Rohrbeck et al., 2009), and only a handful of studies analysed open innovation-related issues in larger sets of empirical data (Schroll & Mild, 2011; Teirlinck & Spithoven, 2008; van de Vrande et al., 2009). While these studies have largely contributed to quantifying the phenomenon of open innovation, none of these researchers tested the validity and reliability issues of the measures they used. Given the lack of psychometric evidence (e.g. validity and reliability) of the existing scales of open innovation, the overall generalisability of findings and implications from such studies is limited. In order to progress our knowledge on how open innovation impacts organisational performance and how it correlates in the broader nomological network of other important organisational constructs we need scales that are reliable and valid representations of the constructs they are supposed to measure (Netemeyer, Bearden & Sharma, 2003). Such evidence is not only important to researchers of open innovation but also to practitioners' strategic decision-making processes (Lichtenthaler, 2011).

With this paper we aim to conceptualise and validate proclivity for open innovation measure building from the qualitative work of Hung and Chiang (2010), who first defined proclivity for open innovation by drawing from Chesbrough's (2003b) initial descriptions of what open innovation stands for. These authors claim that proclivity for open innovation "assesses the company's inclination to integrate external ideas to complement its business model to pursue innovation success and gauges the company's tendency to profit from outsiders' use of its underutilised intellectual property" (Hung & Chiang, 2010, p. 258). Despite the fact that this conceptualisation integrates inbound and outbound aspects of open innovation, it remains very abstract. By proposing the multidimensional proclivity for open innovation measure, we contribute to the stream of the literature by defining the measure that evaluates a range of aspects concerning a firm's tendency towards open innovation. Our proclivity measure thus measures strength of a firm's future intentions to engage in open innovation in the spirit of "the stronger the intention to engage in a behavior, the more likely should be its performance" (Ajzen, 1991, p. 181). Since the implementation of open innovation requires time (Lichtenthaler, 2011), and open innovation is an evolving concept (Huizingh, 2011), we found it more reasonable to assess a firm's future performance rather than its past behaviour. Additionally, in this way the measure is also applicable to smaller companies, which due to size are unable to perform some open innovation activities (e.g. venturing); this inability on the part of small firms, however, does not imply that such firms are closed innovators. In fact, the evidence on the implementation of open innovation among SMEs revealed that more formalised open innovation practices such as IP licensing, venturing, and external participation are employed only by a minority of SMEs because they require financial

investments, formalised contracts and a structured innovation portfolio approach to manage the risks (van de Vrande et al., 2009).

In summary, the aim of this research is first to integrate dimensions of open innovation from the existing literature into a coherent construct of proclivity for open innovation. Second, we empirically validate the construct on two cross-cultural samples and establish reliability and convergent and discriminant validity. We define proclivity for open innovation as the firm's predisposition to perform different open innovation activities and describe different possibilities of implementing open innovation in organisations.

In the following sections, we continue by integrating existing literature to establish solid grounds for first conceptualising the proclivity for open innovation and second, developing a valid and reliable measurement instrument. We propose the conceptual framework of proclivity for open innovation for which we in turn develop empirical measures. During the scale development process of proclivity for open innovation, we generate and purify items from prior literature by revising and expanding the list of items based on personal interviews with several experts in the field from different professions (such as professors, researchers, CEOs, etc.). We perform a pilot study among 30 companies in manufacturing and service industries. We continue with EFA and CFA on a sample of 338 Slovenian companies. The item structure of proclivity for open innovation is then cross-validated on a sample of 97 companies from Italy. Finally, we conclude by discussing implications of the scale for use in future research, theory and practice, and point to limitations of this research.

1.2 Theory and hypotheses

1.2.1 The emergence of open innovation in organisations

The first recorded evidence of open innovation dates back to the 1920s, when Columbia Steel outperformed its major competitor by using an open pattern of cooperation with equipment suppliers (Aylen, 2009). Nowadays, open innovation practices can be seen in any type of an organisation and any type of industry (Chesbrough & Crowther, 2006). For example, practices of open innovation are increasingly identified in the biopharmaceutical industry in which firms use different organisational modes (e.g. licensing agreements, non-equity alliances and supply/provision of technical and scientific services) of open innovation to exchange knowledge and technology with different types of partners (Bianchi, Cavaliere, Chiaroni, Frattini & Chiesa, 2011). Other more traditional industries are also familiar with open innovation activities, for instance, in the food industry Sarkar and Costa (2008), found that food companies teamed up with customers, suppliers or other actors inside and outside the value chain to generate new products that differentiate them from other players in the agri-food markets. While with the case from automotive industry, Di Minin, Frattini and Piccaluga (2010) demonstrated how open innovation provided a strategic approach that enabled a firm to protect its innovation capabilities from the risk of severe resource rationalisations during a

period of economic crisis and to successfully exploit its technological capabilities when the downturn was over. There is an enormous diversity of open innovation activities of multinational organisations; for instance, P&G connects with internet-based brokers who help them identify potential partners for technology development (Dodgson et al., 2006), Dell created a user innovation community to benefit from ideas and innovations of end users (Di Gangi & Wasko, 2009); Lego established a platform on which users can co-create, co-design and, in the end, also buy their unique models and designs (Piller & Ihl, 2009); and Apple shares its profit and reputation with outside inventors who develop applications for Apple's products (Rufat-Latre, Muller & Jones, 2011).

1.2.2 Overview of prior theories and measures of open innovation

The conceptual origins of this research are in early work of Chesbrough (2003, 2006). The major implications from his open innovation perspective are that companies should use internal and external ideas for creating value, as well as internal and external paths to market for more effective commercialisation of these ideas. In turn, the boundaries between the internal and external environments of the company are loosened, and the flow of knowledge and ideas from inside and outside the organisation becomes smoother. By opening the innovation process, firms profit from reduced costs of technology development and improvements, such as accelerated time to market, improved quality of the products, and better access to external expertise (Wallin & von Krogh, 2010).

One of first studies that gathered empirical evidence on the effects of open innovation from a large dataset of firms was by Laursen and Salter (2006). In operationalising the open innovation construct, these authors do not distinguish among different open innovation dimensions; rather, their measure is limited to evaluating the breadth and the depth of firms' external searches. In defining their measure, they build from the existing statistical instrument that measures (overall) progress in the field of innovation – that is, the CIS, which does not enable adaptability of the measure and provides only a proxy evaluation. Consequently, a researcher does not necessarily measure all the nuances of open innovation phenomenon. Although proxy measures are efficient and parsimonious measures of observed phenomenon, their main disadvantage is a high probability of conflated findings (Flatten et al., 2011). In a later study, van de Vrande et al. (2009) conceptualised open innovation as a multidimensional construct to distinguish between dimensions of technology exploitation and technology exploration in its conceptualisation. However, the authors themselves acknowledge that open innovation dimensions in their measure should be more narrowly defined to offer researchers a more comprehensive approach to open innovation.

Recently, Hung and Chiang (2010) empirically examined a proclivity for open innovation in a sample of electronic product manufacturing firms. Based on the measurement data they report, it seems that the content validity of the scale is somewhat limited. The scale incorporates a firm's intentions regarding open innovation using eight items to evaluate the

breadth, such as collaboration and selling/buying of IP. The scale, however, excludes several other activities that have been emphasised by prior open innovation literature, such as external participation, employee and customer involvement, and venturing. The lack of multidimensionality of this measure motivated us to systematically upgrade the measure, taking into consideration the multidimensional nature of open innovation and more strongly relating it to a firm's actual behaviour.

Overall, in closely examining measures of open innovation currently available in the literature, we noticed a lack a comprehensive approach to open innovation process. Table 1 summarises the measures of open innovation that were previously used in the literature and the limitations related to measurement issues.

In proposing the conceptualisation and measurement scale of proclivity for open innovation, we draw from existing work in the field that emphasises the view that open innovation has many faces (Huizingh, 2011) because of complex social interactions among stakeholders involved in the open innovation process (Sorensen, Mattsson & Sundbo, 2010). Drawing from prior literature's experience, we decided that the approach of measuring proclivity for open innovation may be more effective than directly measuring a firm's open innovation. In fact, the structure of items that we use in assessing a firm's proclivity for open innovation draws from Ajzen's (1991) theory of planned behaviour suggesting that attitudes towards the behaviour, subjective norms, and perceived behavioural control predict intentions, which are a good reflection of actual behaviour. To secure a strong orientation towards action, the share of scale items evaluating actual activities of open innovation by a firm is higher than the share of items evaluating attitudes and tendencies regarding open innovation of responding firms. The proposed concept of proclivity for open innovation integrates what is already known in the field of open innovation by providing an integrative measurement scale that assesses a firm's readiness for open innovation in domains that have been previously associated with open innovation activities.

Table 1. Different measures of open innovation

Aspects of open innovation	Author(s)	Scale origin	Domain/dimensions of open innovation	Number of items	Shortages of the measure
Degree of openness	Barge-Gil (2010)	Community innovation survey (CIS)	• Open innovation • Semi-open innovation • Closed innovation	2	The measure is based on two questions from the CIS.
	Lazzarotti, Manzini and Pellegrini (2010)	New measure	• Partner variety • Innovation phase variety	14	The scale measures only partner and phase variety.
	Teirlinck and Spithoven (2008)	Community innovation survey (CIS)	• In house innovation • Outsourcing innovation • Co-developing innovation	1	The measure is based on one question from the CIS.
Open innovation proclivity	Hung and Chiang (2010)	New measure	• Degree of company's access of available external knowledge	8	The measure omits some important open innovation dimensions (e.g. external participation, employee and customer involvement and venturing).
Open innovation climate	Remneland-Wikhamn and Wikhamn (2011)	Measure adapted from Patterson et al.'s (2005)	• Innovation/flexibility • Outward focus • Reflexivity	17	The scale measures organisational climate, i.e. the preconditions for implementing open innovation.
Inbound open innovation	Bahemia and Squire (2010)	New measure (Conceptual model)	• External search breadth • External search depth • Degree of ambidexterity	/	A conceptual model that is not statistically verified.
	Laursen and Salter (2006)	Measure adapted from U.K. innovation survey	• External search breadth • External search depth	16	The measure is based on two variables from the U.K. innovation survey.
	Inauen and Schenker-Wicki (2011)	New measure	• Cooperation intensity with different stakeholders	6	The scale only measures cooperation intensity and omits the other important open innovation dimensions.
Outbound open innovation	Inauen and Schenker-Wicki (2012)	New measure	• Licensing • Open-source innovation • Participation in other companies • Sale and/or divestment • In-house exploitation and/or distribution	5	The measure omits empirical validation of the construct, for e.g. reliability and construct validity.

(table continues)

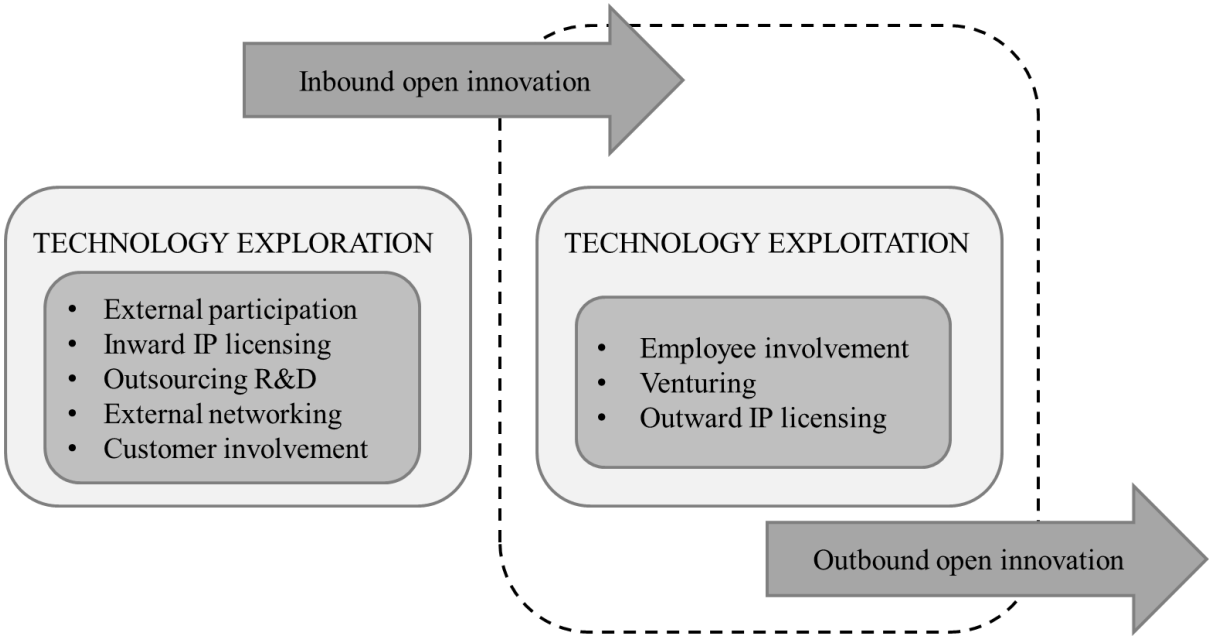
(continued)

Aspects of open innovation	Author(s)	Scale origin	Domain/dimensions of open innovation	Number of items	Shortages of the measure
Outbound open innovation	Lichtenthaler (2009)	Measure adapted from Gambarela 2007	• Commercialisation of technological knowledge	4	The scale only measures a firm's willingness to commercialise technological knowledge.
Open innovation practices	Acha (2008)	Measure adapted from U.K. Innovation Survey	• External sourcing of information • Collaboration • External sourcing of R&D and knowledge	4	The measure is based on four variables from the U.K. Innovation Survey.
	Chesbrough and Crowther (2006)	New measure (Qualitative study)	• Open innovation • External innovation • Sourcing innovation • Innovation licensing • Technology in-licensing • Technology licensing • Technology out-licensing	10 open ended questions	The measure misses empirical validation of the construct.
	Lichtenthaler (2008), Lichtenthaler and Ernst (2009)	New measure	• External technology acquisition • External technology commercialisation	2	The measure is based on two questions.
	Santamaría, Nieto and Barge-Gil (2010)	Spanish Business Strategies Survey (SBSS)	• External sources (external R&D, consultant, hiring personnel) • Hybrid mechanisms (joint ventures, homogeneous alliances, heterogeneous alliances)	6	The measure omits some important open innovation dimensions and empirical validation of the construct.
	Schroll and Mild (2011)	New measure derived based on the existing literature	• Inbound cooperation • Inbound acquisition • Outbound open innovation	16	The measure omits empirical validation of the construct, e.g. reliability and construct validity.
	van de Vrande, de Jong, Vanhaverbeke and de Rochemont (2009)	Measure adapted from EIM Survey database	• Venturing • Outward IP licensing • Employee involvement • Customer involvement • External networking • External participation • Outsourcing R&D • Inward IP licensing	8	The measure omits more narrowly defined elements of the open innovation dimensions and empirical validation of the construct.

1.2.3 Conceptual framework of proclivity for open innovation

Open innovation is defined as "the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and to expand the markets for external use of innovation" (Chesbrough, 2006b, p. 2). Many scholars (e.g. Bianchi et al., 2011; Chesbrough & Crowther, 2006; van de Vrande et al., 2009) differentiate between two parts of a firm's open innovation strategy (presented in Figure 1): technology exploration (or inbound open innovation) and technology exploitation (or outbound open innovation). According to van de Vrande et al. (2009), technology exploration relates to acquiring external sources of knowledge to enhance current technological developments and consists of external participation, inward IP licensing, external networking, outsourcing R&D and customer involvement. In contrast, technology exploitation aims to leverage internal technological capabilities outside a firm's boundaries and is comprised of venturing, outward IP licensing and employee involvement. In the following section, we summarise the literature on these open innovation-related dimensions. Although dimensions of open innovation seem complementary and correlated, we treat them as distinct, as they pertain to different strategic domains of a firm, and have been (in original literature) seen as separate before the literature of open innovation tied them together (Huizingh, 2011). Below, we outline open innovation dimensions in a systematic manner by summarising definitions, emphasising organisational benefits associated with particular dimensions and suggesting organisational practices that firms can use in order to integrate it into its overall strategy.

Figure 1. Inbound and outbound open innovation activities



Source: Own; interpreted from V. van de Vrande et al., 2009, Open innovation in SMEs: Trends, motives and management challenges, p. 428.

1.2.3.1 Technology exploration: External participation

Van de Vrande et al. (2009, p. 428) defined external participation as "equity investments in new or established enterprises in order to gain access to their knowledge or to obtain other synergies". Joint investments in start-ups can provide firms with information about potential new technologies, facilitate the development of complementary innovations (Maula, Keil & Salmenkaita, 2006), and can help companies to deal with technological uncertainty (van de Vrande, Lemmens & Vanhaverbeke, 2006). Therefore, companies can explore external technologies by establishing joint ventures or other similar types of non-equity alliances.

1.2.3.2 Technology exploration: Inward IP licensing

Another way of exploring technology is inward IP licensing, which is defined as "buying or using intellectual property, such as patents, copyrights or trademarks, of other organisations to benefit from external knowledge" (van de Vrande et al., 2009, p. p. 428). If a firm comes to a point of not knowing how to progress in developing a technology, it is often faster and cheaper to look outside for the supplementary technology than to develop it in-house (Chesbrough & Crowther, 2006). Therefore, organisations should not wait for the internal development of technologies; rather, they should access what they need by buying or licensing the external IP (Chesbrough, 2003b). Organisations can also define a formal, systematic way of searching for external technology (Chesbrough & Crowther, 2006).

1.2.3.3 Technology exploration: External networking

External networking is defined as "drawing on or collaborating with external network partners to support innovation processes, for example for external knowledge or human capital" (van de Vrande et al., 2009, p. 428). Openness to external sources enables firms to reach ideas from the outside and in this way exploit new innovative opportunities (Laursen & Salter, 2006). In open innovation, ideas can be acquired from individual inventors, high tech start-ups, academic institutions, and spin-offs of large firms (Chesbrough, 2006b). In many cases, even cooperation with potential competitors contributes to the creation of new knowledge (Bergman, Jantunen & Saksa, 2009; Maula et al., 2006). Thether and Tajar (2008) argued that consultancies can also be a good source of external knowledge.

1.2.3.4 Technology exploration: Outsourcing R&D

In addition to external networking, companies can gain extra technology by outsourcing R&D, which has been described as "buying R&D services from other organisations, such as universities, public research organisations, commercial engineers or suppliers" (van de Vrande et al., 2009, p. 428). Cooperation with research organisations plays an important role in fostering innovation process (Perkmann & Walsh, 2007). Therefore, firms should invest in internal research expertise that will seek, effectively assimilate and exploit university-based

knowledge, which can be reached through collaboration, informal interaction and discussions between researchers (Fabrizio, 2006) and first-rate individual scientists from other labs worldwide (Chesbrough, 2003b). Moreover, organisations can also financially support, mentor and interact with PhD students (Chesbrough, 2006b; Rohrbeck et al., 2009).

1.2.3.5 Technology exploration: Customer involvement

The final dimension of technology exploration concerns customer involvement, which was originally defined as "directly involving customers in your innovation processes, for example, by active market research to check their needs, or by developing products based on customers' specifications or modifications of products similar like yours" (van de Vrande et al., 2009, p. 428). The significance of users in the innovation process was first emphasised by von Hippel (1988), who presented the importance of different sources of innovation. Customers seek products or services that better address their needs, oftentimes facilitating emergence of new technologies (Chesbrough, 2003b). Increasing numbers of organisations are deciding to introduce user innovation communities as a complement to internal innovation processes, where users can post, discuss and review each other's business ideas (Di Gangi & Wasko, 2009). Another type of user involvement presents toolkits for users that enable them to develop new products, simulate or prototype them, test their functioning and improve them until the products match their requirements (von Hippel & Katz, 2002).

Another set of open innovation abilities is needed in the domain of technology exploitation activities, which are discussed below.

1.2.3.6 Technology exploitation: Employee involvement

One of the possible ways of implementing technology exploitation is through employee involvement, which is described as "leveraging the knowledge and initiatives of employees who are not involved in R&D by taking up suggestions, enabling them to implement ideas, or creating autonomous teams to realize innovations" (van de Vrande et al., 2009, p. 428). Employees play a vital part when searching for applicable ideas and technology inside and outside the firm's boundaries. By establishing R&D structures that support effective communications between unrelated groups in the company, organisations foster employee involvement (Dodgson et al., 2006). Organisations can also involve employees in the innovation process by giving them rotational assignments that require interaction with external partners and collaboration across divisions within the organisation, which enables the sharing and borrowing of ideas (O'Connor, 2005). Finally, by educating the researchers about the business side of innovation and rewarding them for identifying patentable ideas within the firm as well as for finding useful IP outside the firm's boundaries (Chesbrough, 2003b), organisations may expect benefits from the higher involvement of their employees.

1.2.3.7 Technology exploitation: Venturing

In addition to employee involvement, a company can commercialise internal technological capabilities with venturing, which is defined as "starting up new organizations, drawing on internal knowledge, and possibly also with finance, human capital and other support services from your enterprise" (van de Vrande et al., 2009, p. 428). Venture capital start-ups are explorers of new markets and often experiment with new and different business models (Chesbrough, 2006a); therefore, they provide vital information about future technologies and market opportunities (Chesbrough, 2003b). Accordingly, one approach of implementing new ideas is to support corporate venturing through the creation of spin-off companies (Gassmann & Enkel, 2004). Additionally, a company obtains an opportunity to explore an area of potential future interest by pursuing new businesses in new industries that are related to its current business or to enter new businesses by offering new lines and products (Zahra, 1993).

1.2.3.8 Technology exploitation: Outward IP licensing

Outward IP licensing refers to "selling or offering licenses or royalty agreements to other organisations to better profit from organisational IP, such as patents, copyrights or trademarks" (van de Vrande et al., 2009, p. 428). Hence, companies can gain additional effects by exploiting their internally generated technologies outside the firm's boundaries (Gassmann, 2006). Firms can employ different approaches to maximise the returns of internal innovation, such as outbound licensing of IP, patent pooling and even giving away technology that stimulates demand for other firms' products (West & Gallagher, 2006a).

Drawing from existing research evidence of open innovation activities and Hung and Chiang (2010)'s view of open innovation proclivity as a company's preference to utilise external ideas and tendency to profit from its IP, we suggest a more integrated view. We propose that proclivity for open innovation is a second-order factor construct that involves the following dimensions: external participation, inward IP licensing, external networking, outsourcing of R&D, customer involvement, employee involvement, venturing and outward IP licensing. Our conceptualisation is aligned with the existing literature on open innovation, cumulative evidence from business practitioners and interviews with key informants in the field.

1.3 Proclivity for open innovation scale development

The first step in the scale development process is grounded in the literature review with the aim of clearly defining the measurement target (DeVellis, 2003; Netemeyer et al., 2003) - the construct, content domain, and its boundaries. In addition to the definition, researchers should also identify the dimensions of the new construct (Haynes, Richard & Kubany, 1995). The next step relates to the generation and judgement of the measurement items based on the techniques usually used in the exploratory research, such as literature review, interviews with experts in the field, focus groups, and so on (Churchill, 1979). After the critical evaluation of the pool of items, empirical testing of the items is the next step, including pilot testing, EFA and CFA, which enable assessment of the dimensionality, internal consistency, and convergent and discriminant validity (DeVellis, 2003; Netemeyer et al., 2003). If the development sample is sufficiently large, it is suggested to split it into two subsamples and perform EFA and CFA on the separate subsamples (DeVellis, 2003). The final step relates to the validation and generalisability of the scale, testing it in different samples (DeVellis, 2003; Netemeyer et al., 2003), and to nomological validity, showing how a newly developed measure relates to the set of other constructs in terms of formal hypotheses derived from theory (Netemeyer et al., 2003; Nunnally & Bernstein, 1994).

In the process of proclivity for open innovation scale development, we followed steps provided by DeVellis (2003). We started with a clear definition of our measurement goal. Based on the in-depth literature review of open innovation practices, we generated the initial pool of potential proclivity for open innovation items. We determined the format for measurement (a 7-point Likert scale) and revised the initial item pool following the guidelines of experts in the field. We administered items to a development sample and evaluated their performance. The last step of the scale development was the optimisation of the scale length and cross-sample validation.

1.3.1 Generation and purification of items

To generate items for the proclivity for open innovation scale, we started with an in-depth literature review of open innovation. Drawing from this evidence, we identified eight potential open innovation proclivity dimensions with 121 potential corresponding items. The reason for including a large number of open innovation proclivity dimensions as well as a great amount of their corresponding items at this stage of the scale development was to secure better internal consistency of the measure and content validity. After critical evaluation of the items, we excluded redundant items, i.e. those that were highly similar and reflected the same aspect of proclivity for open innovation. This process yielded 67 potential items of the proclivity for open innovation scale. The purified list of identified items is presented in Table 2.

Table 2. The purified list of potential proclivity for open innovation items

Item/question	Author(s)
Technology exploration	
• To profit from an innovation, we need to build a good business model utilising some ideas drawn from outside. • To profit from an innovation, we only make use of our internal ideas. (Reverse coded) • To profit from an innovation, we need to cooperate with people outside of our company. • To profit from an innovation, we need to originate all the research by ourselves. (Reverse coded) • To profit from an innovation, we need to utilise external ideas to complement the works of our internal R&D department. • To profit from an innovation, we need to utilise external ideas that create value for us.	Hung and Chiang (2010)
External participation	
• Equity investments in new or established enterprises in order to gain access to their knowledge or to obtain others synergies.	van de Vrande et al. (2009)
• Consulting with venture capitalists.	Chesbrough (2003b), West and Gallagher (2006b)
• Formal ties with venture capitalist trough joint investment in startups and spinoffs. • Informal ties such as participation in advisory boards and other indirect cooperation.	Simard and West (2006)
• Joint ventures and several types of non-equity alliances.	Bianchi et al. (2011), Maula et al. (2006), van de Vrande et al. (2009)
• Funding a young start-up. • Supporting corporate new ventures.	Chesbrough (2003b), Gassmann and Enkel (2004)
Inward IP licensing	
• Buying or using IP, such as patents, copyrights or trademarks, of other organisations to benefit from external knowledge.	van de Vrande et al. (2009)
• Buying or licensing external IP.	Bianchi et al. (2011), Chesbrough (2003b), Chesbrough and Crowther (2006), Gassmann and Enkel (2004)
• To profit from an innovation, we need to use the IP of others.	Hung and Chiang (2010)
• Does your company make a practice of looking to bring in outside IP and technology? • Is this done opportunistically or do you have a formal, systematic to doing so?	Chesbrough and Crowther (2006)

(table continues)

(continued)

Item/question	Author(s)
External networking	
• Drawing on or collaborating with external network partners to support innovation processes, for example for external knowledge or human capital.	van de Vrande et al. (2009)
• How innovations were developed: mainly through collaboration with other entities or mainly by other entities? • How important are different information sources (internal knowledge and ten external sources)?	Barge-Gil (2010)
• A considerable part of the company's technologies is acquired from external sources.	Lichtenthaler and Ernst (2009)
• External search breadth characterised by the number of external sources/parties or search channels.	Bahemia and Squire (2010), Laursen and Salter (2006)
• Indicate the extent of your cooperation with different partners (including customers, suppliers, competitors, government agencies, intermediary institutions, and research organisations).	Zeng, Xie and Tam (2010)
• In the last five years you have collaborated very strongly with the following partner: university and research centres, technical and scientific service companies, governmental institutions, customers, suppliers, competitors, firms operating in different sectors of activity.	Lazzarotti et al. (2010)
• Does Vetco Gray make a practice of bringing in external know-how and/ or technology? Where do this know-how and technology come from (e.g., universities, start-ups, industry groups, parent company, other business units)?	Gronlund, Sjodin and Frishammar (2010)
• Collaboration with individual inventors, high tech start-ups, academic institutions and spin-offs of large firms.	Chesbrough (2006b)
• Collaboration with single creative individuals.	O'Connor (2005)
• Collaboration with potential competitors.	Bergman et al. (2009), Maula et al. (2006)
• Collaboration with consultancies .	Tether and Tajar (2008)
• Collaboration with intermediaries.	Bahemia and Squire (2010), Rohrbeck et al. (2009)
• Collaboration with suppliers.	Chesbrough (2003b)
• Where do you typically look for outside ideas and technology: e.g.: universities, start-ups, competitors, conferences, or companies in peripheral industries?	Chesbrough and Crowther (2006)
• Organisation of innovation days where lead scientists, suppliers, customers and potential partners meet and discuss mutual issues.	Gassmann and Enkel (2004)
Outsourcing R&D	
• Buying R&D services from other organisations, such as universities, public research organisations, commercial engineers or suppliers.	van de Vrande et al. (2009)
• Collaboration with universities. • Publications and dissemination of research (presentation at a conference or publication in scientific journals).	O'Connor (2005)
• Collaboration, informal interaction and discussions between researchers.	Fabrizio (2006)
• Cooperation between university researchers and individuals from the company working on a specific project.	Perkmann and Walsh (2007)

(table continues)

(continued)

Item/question	Author(s)
Outsourcing R&D	
• Financial support, mentor and interact with PhD students. • Active involvement and interaction between the student and assigned employee.	Chesbrough (2003b), Chesbrough (2006b), Rohrbeck et al. (2009)
• Collaboration with private and national research labs. • Collaboration with excellent individual researchers – hosting conferences, research forums and seminars, where informal interaction is established.	Chesbrough (2003b)
Customer involvement	
• Directly involving customers in your innovation processes, for example by active market research to check their needs, or by developing products based on customers' specifications or modifications of products similar like yours.	van de Vrande et al. (2009)
• User innovation communities.	Di Gangi and Wasko (2009)
• Toolkits for users.	von Hippel and Katz (2002)
• Testing new technologies.	Gassmann and Enkel (2004)
• Idea competitions.	Hüsig and Kohn (2011), Piller and Walcher (2006)
• Customer workshops where customers meet up with firm`s employees and get to know to technical, market and industry trends of the firm.	Gassmann and Enkel (2004)
Technology exploitation	
Venturing	
• Starting up new organisations drawing on internal knowledge, and possibly also with finance, human capital and other support services from your enterprise.	van de Vrande et al. (2009)
• Establishing spin-ins and spin-offs.	Chesbrough (2003b)
• Corporate venture investments.	Vanhaverbeke (2006)
Outward IP licensing	
• Selling or offering licenses or royalty agreements to other organisations to better profit from your IP, such as patents, copyrights or trademarks.	van de Vrande et al. (2009)
• To profit from an innovation, we allow others to acquire and use our IP.	Hung and Chiang (2010)
• Selling or licensing of IP.	Chesbrough (2004), Gassmann and Enkel (2004), van de Vrande et al. (2006)
• Publication or donation of IP. • Revealing our technology.	Chesbrough (2006b), West and Gallagher (2006a)
• Spillovers are not regarded as a cost of doing business, but as opportunities that can expand a company`s business model.	Graham and Mowery (2006), Chesbrough (2006b)
• When something is developed internally that doesn't fit with your business model, do you have a practice of taking the IP or technology assets out to the marketplace? • When something that was initially developed internally is deemed 'dead,' are efforts made to find companies or partners that might be interested in it?	Chesbrough and Crowther (2006)
• Does Vetco Gray practice external paths to market for know-how and/or technology that, for various reasons, have been chosen not to be used internally?	Gronlund et al. (2010)

(table continues)

(continued)

Item/question	Author(s)
Employee involvment	
• Leveraging the knowledge and initiatives of employees who are not involved in R&D, for example by taking up suggestions, exempting them to implement ideas, or creating autonomous teams to realise innovations.	van de Vrande et al. (2009)
• Decentralised R&D structure and communication between unrelated groups.	Dodgson et al. (2006)
• Promoting internal idea exchanges.	Huston and Sakkab (2006)
• Rotational assignments and collaboration across divisions.	O'Connor (2005)
• Information exchange both within as well as between the functions.	Chesbrough (2003b)
• Internal "champions" who can cooperate with diverse participants within heterogeneous field of activities.	Chesbrough and Crowther (2006)
• Idea hunters and idea gatherers.	Chesbrough (2006a), O'Connor (2005)
• Is looking outside for technology that can be leveraged everyone's job – or is there a distinct group dedicated to doing this?	Chesbrough and Crowther (2006)
• Educate researchers about business side of the innovation. • Reward employees for identifying patentable ideas within the firm as well as for finding useful IP outside the firm`s boundaries.	Chesbrough (2003b)

The next step in our scale development process was the revision of the initial item pool by 10 experts in the field. Different groups of experts were selected, with the aim of capturing different perspectives of the proclivity for open innovation. The academic view was captured by interviewing professors and PhD students who are active researchers in the field of open innovation, while the directors of consultancy firms consulting in the field of open innovation and representatives of supporting environment represented the group of business practitioners. Further on, we interviewed 10 Slovenian entrepreneurs from different fields of activity to verify the variability and comprehension of the questionnaire. Based on these interviews, we also received feedback regarding whether respondents understood the questions correctly and could provide adequate answers. Based on the large number of initial items, we eliminated those that were poorly clarified, were not highly relevant or were very similar to other items. We concluded this step with the retention of 55 potential items: 12 items from the item pool we worked with at this phase were excluded, four slightly changed and one moderately changed. This step was further elaborated with a personal discussion of the list of items with 16 experts from nine different countries (and different professions such as professors, researchers, CEOs, etc.). The revision of the questionnaire by experts in the field and interviews with directors of companies enabled us to maximise the content validity of the scale.

1.3.2 Pilot study

We pilot tested the initial inventory of 55 open innovation proclivity items on a sample of 30 Slovenian companies in manufacturing and service industries. We asked directors to complete the questionnaire without providing them information that the questions were related to the concept of open innovation in order not to bias their perceptions and candid answers. The questions directly asked them about different activities, such as networking, employee involvement, etc. Based on their responses, we evaluated the performance of each item by examining item-scale correlations, items' variances and items' means. As suggested by DeVellis (2003), we eliminated the items with low variances and items that had means near to one of the extremes. We examined the frequencies of responses by plotting histograms, means and standard deviations for each item, and analysed the distribution via skewness and kurtosis. An important element in deciding whether to keep or eliminate an item was its content, i.e. we did not want to exclude items in such a way that we would lose any of dimensions of open innovation that we identified during the review and synthesis of the existing literature on open innovation. During this phase of the scale development process, we eliminated 10 additional items. The scale of proclivity for open innovation construct to be used in further empirical analysis contained 45 items.

1.3.3 Sampling and data collection

To gather the data for statistical evaluation of the proposed construct, we conducted an online survey in Slovenia and Italy. Two distinct economies have been chosen: Slovenia, a small post-transition economy with a socialist past, and Italy a developed market economy with a Western economic tradition. Although both countries are neighboring, there are specific contextual differences in the business environments among the two, which justify their use for the purposes of scale validation. For example, Hofstede's (2001) research on differences in values, behaviours, institutions, and organisations across nations, points to meaningful differences between the two countries in the dimension of individualism and masculinity. Slovenia scores much lower on the two dimensions than Italy. Moreover, according to World Bank data, the GDP per capita in 2012 in Italy was 50% higher than in Slovenia (Italy $33,07; Slovenia $22,00). The Innovation Union Scoreboard 2013 (European Commission, 2013) classified Slovenia as innovation follower, whereas Italy remained in the group of moderate innovators. This ranking suggests that Slovenia outperformed Italy in 2012 in terms of overall innovation performance. Overall, we believe that such differences provide an opportunity to test the newly developed measure in two distinct environmental settings, which adds to the validity and generalisability of the scale. To reiterate, our aim is to validate the proposed measure in two different contexts rather than analyse and compare the potential differences in the results between the nations.

To ensure the international equality of the items, we followed Brislin's (1970) method of translation and back-translation. The questionnaire was developed based on Dillman, Smyth,

and Christian's (2009) tailored design method. Questionnaires were mailed to top executives in 2000 Slovenian manufacturing and service firms in different industries (e.g. manufacturing, electricity, gas, steam and air conditioning supply, construction, information and communication, professional, scientific and technical activities, etc.) in September 2012. The firms were randomly selected from the Business Directory of the Republic of Slovenia (PIRS). To increase the response rate, a reminder was sent after a week and another one after three weeks. The same procedure was used in October 2012 in Italy, where 1250 Italian companies were randomly selected from the Amadeus database.

We received 340 Slovenian responses, which represents a 17% response rate, and 101 Italian responses, which represents an 8% response rate. The late response bias was assessed comparing the means of the first 25% of responses to the means of the last 25% of responses; no significant differences were identified. We excluded two questionnaires from the Slovenian sample and four from the Italian sample due to a high proportion of missing data (more than 25%) from our research; in other cases, we did not identify any serious missing values. The recognised proportion of the highest missing value per item was 3.6% in the Slovenian sample and 4.1% in the Italian sample. Little's MCAR test was insignificant, implying that the missing data were missing entirely at random (Hair, Black, Babin, Anderson & Tatham, 2010). We used expectation-maximisation method of imputation for replacing all the observations that were missing. The composition of the samples regarding firm size and industry is presented in Table 3.

Table 3. Sample composition

	Slovenian sample	**Italian sample**
FIRM SIZE		
Micro (0-9 employees)	26.4%	23.3%
Small (10-49 employees)	39.1%	27.3%
Medium (50-249 employees)	22.8%	16.2%
Large (250 employees or more)	11.8%	33.3%
FIRM INDUSTRY		
Agriculture and mining	2.1%	
Manufacturing sector	42%	52.5%
Service sector	38.8%	28.3%
Construction	7.7%	4%
Public sector	9.5%	15.1%

Companies in the two samples are relatively equally distributed, although the distribution of the companies regarding firm size is not equal to the distribution of the total population of the countries because the representation of micro companies in the total population is much higher. With an aim to reduce the possibility of the inclusion of the dormant firms, we set the minimum limit of the number of employees to five when preparing the dataset. On the other

hand, the samples in our study provide more equivalent distribution and consequently more comparable representation of companies regarding the size.

1.4 Results

The results of EFA were obtained using SPSS Statistics 20 for Windows; Lisrel 8.80 was used for calculating the CFA that assessed the reliability and construct validity of our scale.

1.4.1 Exploratory factor analysis

We used EFA to assess the dimensionality of the proposed scale. Since our Slovenian sample was sufficiently large, we randomly split it into two subsamples: the first one served as the developmental sample, and the second one was used for the cross-validation of the results. Therefore, EFA was evaluated on a sample of 169 companies. EFA can be a very useful and powerful statistical technique, and can point to interesting relationships that are not necessarily apparent when analysing raw data or correlation matrices (Hair et al., 2010). This was an important initial step in our scale development procedure, and it differentiates our approach from several other studies (e.g. Hung & Chiang, 2010; Inauen & Schenker-Wicki, 2011; Schroll & Mild, 2011) that did not perform this prerequisite step in developing new measures.

The appropriateness of the factor analysis was confirmed by the Kaiser-Meyer-Olkin measure of sampling adequacy, which was 0.831, i.e. much higher than the recommended lowest limit of 0.6. Moreover, the relevance of correlations among the variables was confirmed by the significance of Bartlett's Test of Sphericity (p = 0.000) (Hair et al., 2010). Since we assumed that the underlying dimensions were correlated, we used the maximum likelihood extraction method with promax rotation. Oblique rotations produce more accurate results in the case of correlations between factors (Costello & Osborne, 2005).

We used different criteria for deciding on the number of factors to extract, such as latent roots or eigenvalues, scree plot, communalities, and the percentage of explained variance. We tested the proposed solution with six factors with eigenvalues greater than 1.0. Guidelines suggested by Hair et al. (2010) were followed; therefore, we excluded one-by-one items with factor loadings lower than 0.45 (which is the lowest limit for a sample size between 150 and 200). The analysis resulted in a six-factor solution, with 30 variables (Table 4), representing approximately 54.4% of the total variance. According to Hair et al. (2010), this is a satisfactory value in social science research. Cronbach's alphas of the first five factors (ranging from 0.806 to 0.889) were higher than the generally agreed lower limit of 0.7. Cronbach's alpha of the sixth factor was 0.675, which is somewhat, problematic although Hair et al. (2010) argue that the lowest limit may decrease to 0.60 in exploratory research. Communalities of our variables ranged from 0.352 to 0.866 (Table 4) and suggested that our six-factor solution provided a reasonable amount of variance for each variable. An exception

was the variable "Selling our IP could harm our company" that had a low communality (0.244).

Table 4. Factor loadings, communalities and internal consistency

Item's label	Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Commu-nality
IL1	External knowhow/technology present new opportunities	**0.946**	-0.084	-0.027	-0.025	0.069	-0.094	0.815
IL2	Willing to buy the IP of other companies to support internal development	**0.815**	-0.109	-0.018	0.028	-0.022	0.054	0.638
IL3	Systemic ways of searching for external knowhow/technology	**0.751**	-0.033	0.008	0.080	-0.022	-0.184	0.517
IL4	Buying the IP of others	**0.663**	0.174	-0.127	-0.030	-0.053	-0.071	0.412
IL5	Willing to invest in a new company**	**0.644**	-0.047	0.059	0.074	0.032	0.150	0.614
IL6	External knowhow/technology can significantly contribute to our innovation	**0.615**	0.105	-0.013	0.045	0.240	-0.128	0.615
IL7	Investing in a new joint venture	**0.568**	0.105	0.124	-0.003	-0.161	0.190	0.473
OR1	Acquiring R&D services from knowledge institutions	0.196	**0.825**	-0.031	-0.186	-0.004	-0.155	0.702
OR2	Cooperation with knowledge institutions	-0.140	**0.797**	0.098	-0.109	0.168	-0.136	0.613
OR3	Informal ties with researchers from various laboratories	-0.122	**0.783**	-0.008	0.120	-0.023	0.025	0.599
OR4	Mentoring doctoral students	0.003	**0.639**	0.023	-0.082	-0.081	0.110	0.428
OR5	Cooperation with high-tech start-up companies	0.039	**0.593**	0.078	0.140	-0.085	-0.028	0.407
OR6	Cooperation with competitors*	-0.084	**0.559**	-0.102	0.238	-0.086	0.133	0.396
OR7	Cooperation with consultancy companies	0.156	**0.517**	-0.063	-0.070	0.075	0.009	0.352
CI1	Involvement of clients/end users	-0.033	-0.091	**0.922**	-0.042	0.009	0.030	0.793
CI2	Wishes and suggestions of customers	-0.004	-0.041	**0.919**	-0.082	-0.035	-0.069	0.713
CI3	Cooperation with customers	0.039	0.174	**0.563**	0.036	-0.061	-0.052	0.365
CI4	Users testing new products/services**	-0.077	0.059	**0.488**	0.096	0.095	0.101	0.384
EI1	Encouragement of communication among unrelated groups of employees	-0.086	0.055	0.162	**0.704**	0.049	-0.023	0.624
EI2	Employee rotation*	0.112	-0.168	-0.135	**0.686**	-0.102	0.019	0.409
EI3	Idea seekers*	-0.027	0.123	-0.249	**0.648**	0.087	0.075	0.418
EI4	Informing employees about the importance of innovation to the business	-0.044	0.119	0.138	**0.646**	-0.003	0.007	0.544
EI5	Awards for bringing in useful external knowhow/technology	0.116	-0.056	0.100	**0.493**	0.114	-0.119	0.410
EI6	Considering the suggestions of employees not included in R&D process	0.157	-0.062	0.221	**0.474**	-0.059	-0.124	0.397

(table continues)

(continued)

Item's label	Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Commu -nality
V1	The use external sources of knowhow/technology	-0.010	-0.016	-0.075	0.022	**0.978**	-0.014	0.866
V2	Willing to cooperate with the partners from the outside	0.054	-0.026	0.195	-0.039	**0.682**	0.073	0.713
V3	Cooperate with external partners at launching new products/services	0.045	0.012	0.025	0.042	**0.576**	0.208	0.548
OL1	Willing to sell part of IP**	0.049	0.054	-0.011	-0.045	-0.042	**0.796**	0.652
OL2	Introduction of our products/services through investing into a new joint venture**	0.261	0.095	0.076	-0.035	0.045	**0.582**	0.647
OL3	Selling our IP could harm our company (R)*	-0.222	-0.116	-0.042	0.008	0.130	**0.526**	0.244
Share of variance explained (%)		26.914	9.718	6.252	3.524	4.324	3.623	
Cronbach's alpha after EFA		0.889	0.851	0.808	0.806	0.857	0.675	
Cronbach's alpha after CFA		0.833	0.882	0.783	0.832	0.805	0.800	

Note. Extraction Method: Maximum Likelihood.
Rotation Method: Promax with Kaiser Normalization.
* Items excluded after CFA.
**Items not supported in the IT sample.

The evidence from exploratory factor analysis results gives support to our proposition that the proclivity for open innovation consists of external participation and inward IP licensing (Factor 1), outsourcing R&D and external networking (Factor 2), customer involvement (Factor 3), employee involvement (Factor 4), venturing (Factor 5) and outward IP licensing (Factor 6).

1.4.2 Confirmatory factor analysis: dimensions' analysis

To confirm our model, we conducted CFA on the second half of the sample: all variables, except "Selling our IP could harm our company" (which belonged under the factor "outward IP licensing"), had significant loadings; therefore, we excluded this variable from further calculations. In addition, we also excluded variables "Cooperation with competitors" (factor "outsourcing R&D and external networking"), and "Employee rotation" and "Idea seekers" (factor "employee involvement"), since their standardised loadings were below the lowest limit of 0.5. After performing all other analyses for construct validity, we cross-validated the scale on the Italian sample.

The validation results on the Italian sample generally support the proposed factorial structure. The key difference was in the loading of the sixth factor, i.e. "outward IP licensing". This happened because of a low standardised loading of the variable "Willing to sell part of IP" and a high standardised loading and insignificant error of the second variable "Introduction of our products/services through investing into a joint venture". Moreover, low standardised loadings were identified by two other variables that were excluded from further analysis in the

Italian sample. Since we first performed the analyses on the larger Slovenian sample which supported the six-factor solution, we did not omit this factor from further analysis. Below, we report data on the six-factor solution (with 26 items) for the Slovenian sample and the five-factor solution (with 22 items) for the Italian sample. We believe that the assessment of the robustness of the six-factor or five-factor solution should be the subject of future research.

1.4.3 Construct validity

When we examined the reliability of our dimensions, strong correlations among items generally supported the internal consistency of hypothesised dimensions of the proposed construct. Cronbach's alphas of the model were all above the threshold of 0.7 (Hair et al., 2010) and ranged from 0.783 to 0.882 in the Slovenian sample and from 0.761 to 0.877 in the Italian sample. According to Hair et al. (2010), construct validity is the degree to which a set of items actually replicates the theoretical latent construct that those items are intended to measure, and can be examined using convergent and discriminant validity. We supported convergent validity on both samples by validating the proposed relationships among factors and their variables, whereas all factor loadings were significant (at $p < 0.01$ or better), and the *t*-values were well in excess of 2.58 in absolute terms.

The validity of the proposed construct was also confirmed by measuring the construct reliability (CR), which varied from 0.786 to 0.886 for the six factors in the Slovenian sample and from 0.808 to 0.880 for the five factors in the Italian sample. Furthermore, the squared multiple correlation (SMCs) values or the square of the standardised factor loadings varied between 0.261 and 0.865 in the Slovenian sample and between 0.280 and 0.853 in the Italian sample, which is above the lowest limit of 0.5 of standardised loading estimates suggested by Hair et al. (2010).

Moreover, we evaluated convergent validity by calculating the average variance extracted (AVE) that ranged between 0.424 and 0.689 in the Slovenian sample and between 0.486 and 0.650 in the Italian sample (Table 5). The AVE for factor outsourcing R&D and external networking (0.482 Slovenian sample) and the AVE for factor external participation and inward IP licensing (0.424 Slovenian sample and 0.486 Italian sample) were below the generally agreed lower limit of 0.5, although Netemeyer et al. (2003) suggested a lower limit (0.45) for newly developed scales.

Table 5. Average variance extracted and shared variance

Factor	Slovenian sample						Italian sample				
	Factor 1	**Factor 2**	**Factor 3**	**Factor 4**	**Factor 5**	**Factor 6**	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 4**	**Factor 5**
Factor 1	**0.424**						**0.486**				
Factor 2	0.254	**0.568**					0.107	**0.549**			
Factor 3	0.182	0.062	**0.482**				0.025	0.017	**0.560**		
Factor 4	0.161	0.082	0.379	**0.565**			0.162	0.003	0.287	**0.650**	
Factor 5	0.429	0.106	0.316	0.444	**0.620**		0.555	0.131	0.139	0.159	**0.584**
Factor 6	0.291	0.159	0.125	0.103	0.249	**0.689**					

Discriminant validity is established when there is no correlation between measures of unrelated constructs (DeVellis, 2003), or there is a low correlation between two conceptually similar concepts (Hair et al., 2010). Discriminant validity was assessed comparing AVE and shared variance values. Our results generally support the discriminant validity, since the AVEs of the factors were larger than the shared variance between the factors. There was one potential violation of these decision criteria in the Slovenian sample, i.e. the shared variance between factor-inward IP licensing and external participation and factor venturing was slightly higher (0.429) than the value of AVE for factor-inward IP licensing and external participation (0.424). The same violation occurred in the Italian sample, where the value of the shared variance between the above mentioned factors was 0.555 and the value of AVE for factor-inward IP licensing and external participation was 0.486. In addition, discriminant validity was also supported by a statistically significant chi-square difference test between Model 1 (1st order 1-factor solution) and Model 3 (2nd order 6-factor solution) both in the Slovenian ($\Delta\chi^2 = 1193.831$, df = 6, $p < 0.001$) and the Italian sample ($\Delta\chi^2 = 497.523$, df = 5, $p < 0.001$).

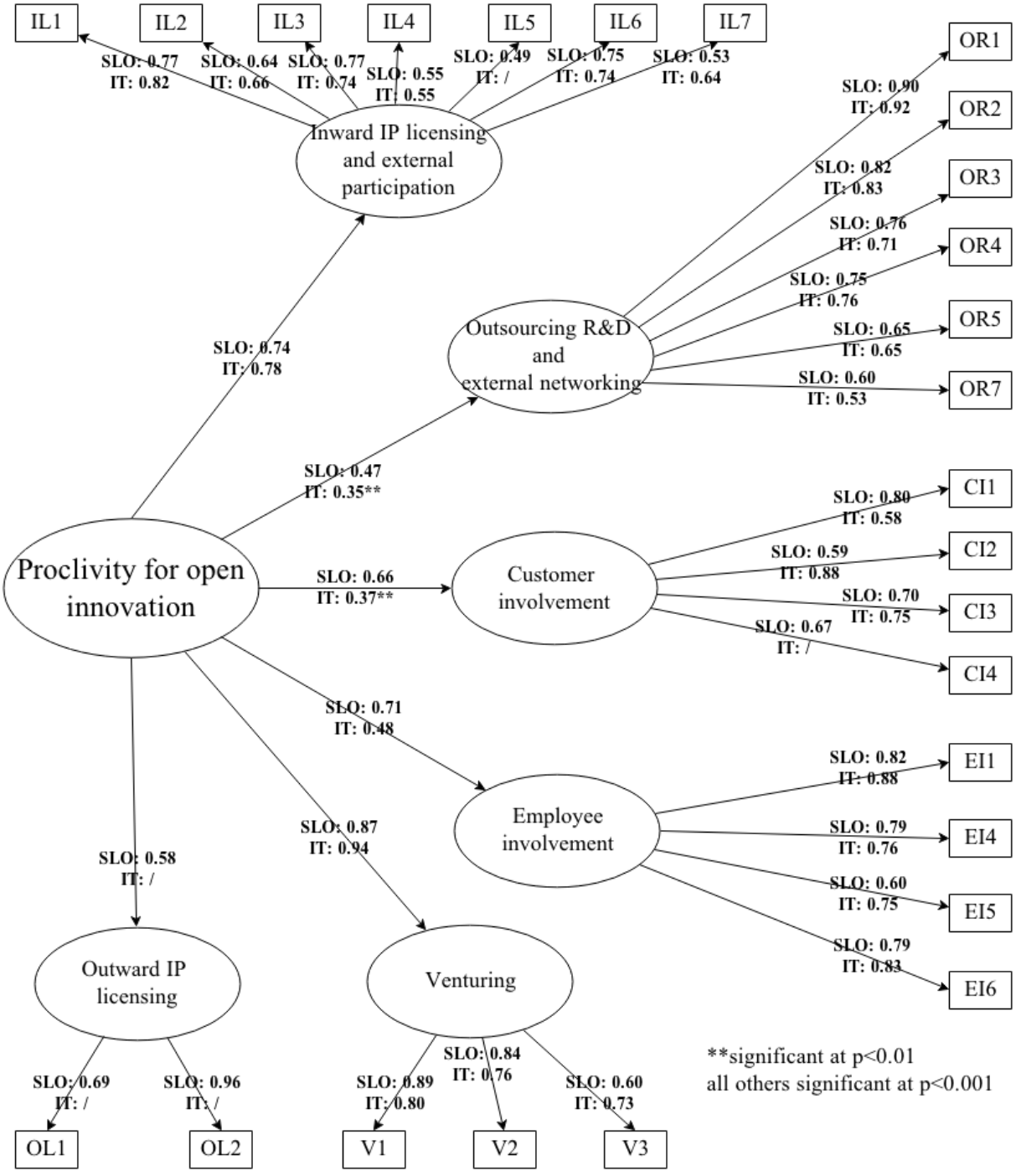
The results from the Slovenian subsample also supported the acceptable fit of the model (Chi-Square/df = 2.36; RMSEA = 0.0900; NFI = 0.887; NNFI = 0.924; CFI = 0.934; IFI = 0.934; SRMR = 0.0817; GFI = 0.765; AGFI = 0.710) and indicated that the model of six factors outperformed the model in which the proclivity for open innovation was assumed to be a single factor measured with 26 items. The acceptable fit of the five-factor model was supported in the Italian sample (Chi-Square/df = 1.82; RMSEA = 0.0815; NFI = 0.836; NNFI = 0.904; CFI = 0.917; IFI = 0.919; SRMR = 0.0838; GFI = 0.764; AGFI = 0.700) and also outperformed the assumed single factor model. The comparison of the described models with different factor solutions is presented in Table 6.

Table 6. Goodness of fit for alternative CFA models

Goodness-of-fit measures	Slovenian sample			Italian sample		
	1st order 1 factor solution	1st order 6 factor solution	2nd order 6 factor solution	1st order 1 factor solution	1st order 5 factor solution	2nd order 5 factor solution
Chi-Square	1909.075 (P=0.0)	670.193 (P = 0.0)	715.244 (P = 0.0)	886.305 (P=0.0)	361.913 (P = 0.0)	388.782 (P = 0.0)
Degrees of Freedom	299	284	293	209	199	204
Chi-Square/df	6.38	2.36	2.44	4.24	1.82	1.91
RMSEA	0.18	0.09	0.09	0.21	0.08	0.09
NFI	0.75	0.89	0.88	0.60	0.84	0.82
NNFI	0.77	0.92	0.92	0.62	0.90	0.90
CFI	0.79	0.93	0.93	0.66	0.92	0.91
IFI	0.79	0.93	0.93	0.66	0.92	0.91
SRMR	0.13	0.08	0.10	0.17	0.08	0.10
GFI	0.53	0.77	0.75	0.48	0.76	0.75
AGFI	0.45	0.71	0.70	0.38	0.70	0.69

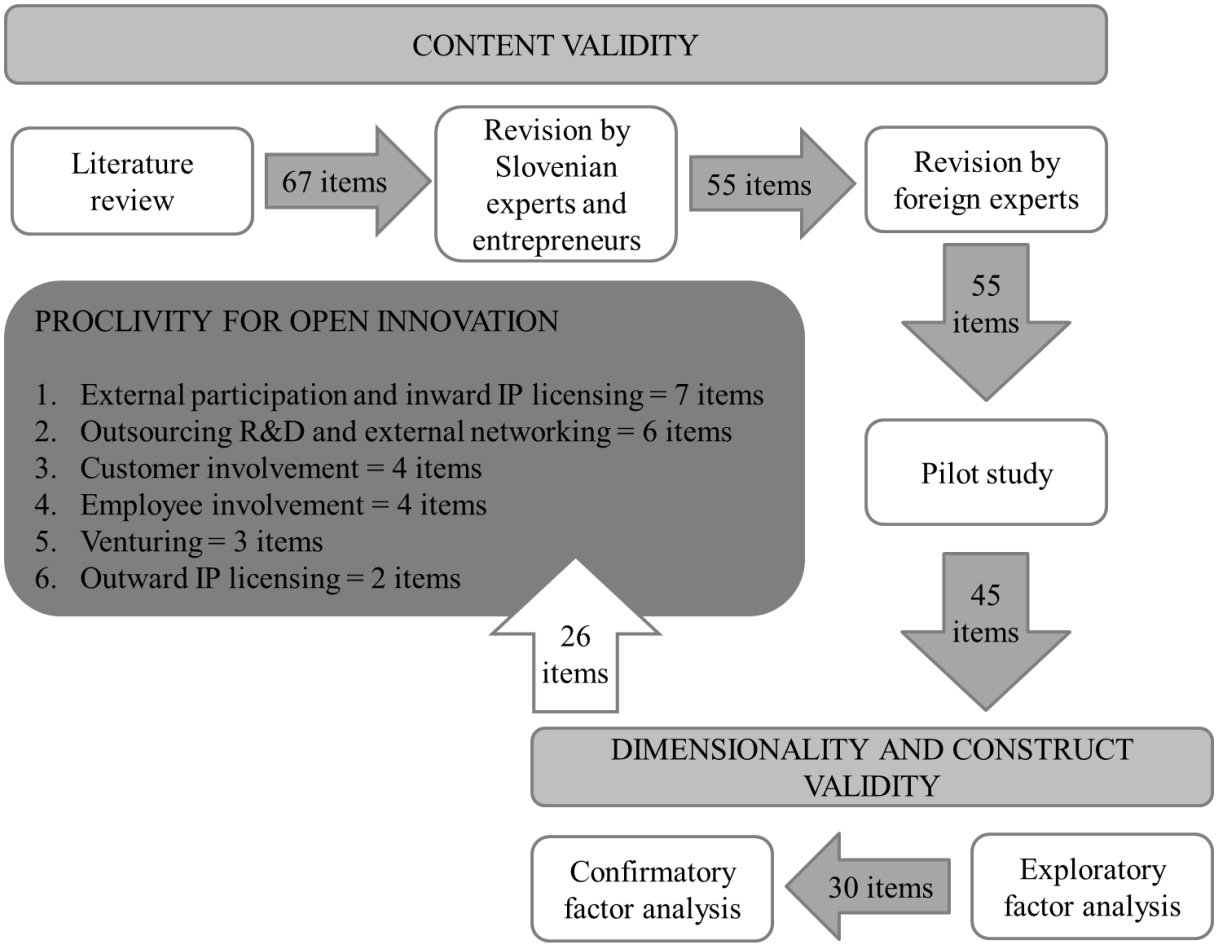
There are many reasons for defining the proclivity for open innovation as a second-order factor construct. First, the second-order solution is already depicted by literature and case studies, which describe and conceptualise open innovation as an umbrella paradigm composed of several dimensions. Second, it permits the co-variation among the first-order factors and in this way accounts for corrected errors, which are problematic in the first-order factor solution (Gerbing & Anderson, 1984). In addition, a second-order factor solution diminishes the multi-collinearity issues, which could appear when using first-order factor solution in structural model (Koufteros, Babbar & Kaighobadi, 2009). The path diagram in Figure 2 depicts the proposed relationships and co-efficients of the first-order and second-order constructs.

Figure 2. The proposed relationships and co-efficients of the first-order and second-order constructs



The described steps in the development and evaluation of the proclivity for open innovation scale are presented in Figure 3, while the complete definitions of items are presented in Table 7.

Figure 3. Steps in development and evaluation of proclivity for open innovation scale



The six-factor solution of proclivity for open innovation scale was supported in the Slovenian sample and exhibited the following psychometric results: reliability (Cronbach's alphas ranged from 0.783 to 0.882), construct validity (CR ranged between 0.786 to 0.886) convergent validity (AVE ranged between 0.424 and 0.689) and discriminant validity (generally the AVE of the factor is larger than the shared variance between the factors, and the chi-square difference test is statistically significant). The construct of proclivity for open innovation was further tested in the Italian sample which supported the five-factor solution, with Cronbach's alphas between 0.761 to 0.877, CR 0.808 to 0.880, and convergent and discriminant validity similar as for the Slovenian sample.

The overall results from psychometric evaluation of the proposed model of proclivity for open innovation support its construct validity and suggest that the proposed measure of proclivity for open innovation is a robust measure that can be used in cross-cultural research.

Table 7. Dimensions, items' names and items' definitions

Dimension	Item's name	Item's definition
Inward IP licensing and External participation	External knowhow/technology present new opportunities	In our company, we believe that the knowhow/technology we have bought can create new opportunities for the company.
	Willing to buy the IP of other companies to support internal development	We are willing to buy the IP of other companies (e.g. patent, trademark) to support our internal development.
	Systemic ways of searching for external knowhow/technology	In our company, we believe it is beneficial to determine systemic and formal ways of searching for external knowhow/technology.
	Buying the IP of others	To ensure successful development of new products/services, we usually buy the IP of other companies.
	Willing to invest in a new company***	In order to acquire new knowhow/technology, we are willing to invest in a new company.
	External knowhow/technology can significantly contribute to our innovation	In our company, we believe the use of knowhow/technology from the outside can significantly contribute to the innovation of our company.
	Investing in a new joint venture	In our company, we believe that investing in a new joint venture could result in new knowhow/technology for our company.
Outsourcing R&D and external networking	Acquiring R&D services from knowledge institutions*	We acquire new knowhow/technology through research and development services provided by knowledge institutions such as universities, faculties, institutes, laboratories, etc.
	Cooperation with knowledge institutions*	In order to acquire new knowhow/technology, we cooperate with knowledge institutions such as universities, faculties, institutes, laboratories.
	Informal ties with researchers from various laboratories*	We acquire new knowhow/technology through informal ties with researchers from various laboratories.
	Mentoring doctoral students*	We acquire new knowhow/technology through mentoring doctoral students.
	Cooperation with high-tech start-up companies*	In order to acquire new knowhow/technology, we cooperate with high-tech start-up companies.
	Cooperation with competitors*, **	In order to acquire new knowhow/technology, we cooperate with our competitors.
	Cooperation with consultancy companies*	In order to acquire new knowhow/technology, we cooperate with consultancy companies.

(table continues)

(continued)

Dimension	Item's name	Item's definition
Customer involvement	Involvement of clients/end users*	Clients/end users are also involved in the process of new product/service development.
	Wishes and suggestions of customers	Our products/services are usually developed in light of customer wishes and suggestions.
	Cooperation with customers	In order to acquire new knowhow/technology, we cooperate with our customers.
	Users testing new products/services***	Our users are involved in the process of testing new products/services.
Employee involvement	Encouragement of communication among unrelated groups of employees	In our company, we actively encourage communication among unrelated groups of employees in the company.
	Employee rotation**	It is a common practice in our company that the employees rotate between different tasks.
	Idea seekers**	Members of our staff include idea seekers who look for potentially useful knowhow/technologies outside the company.
	Informing employees about the importance of innovation to the business	We inform our employees about the importance of innovation to our business.
	Awards for bringing in useful external knowhow/technology	We additionally award our employees if they bring external knowhow/technology that improves our products/services.
	Considering the suggestions of employees not included in R&D process	When developing new ideas, we often consider the suggestions of employees not included in research and development process.
Venturing	The use external sources of knowhow/technology	When developing new activities related to the present operation of our company, we use external sources of knowhow/technology.
	Willing to cooperate with partners from the outside	When developing new activities related to the present operation of our company, we are willing to cooperate with the partners from the outside.
	Cooperate with external partners at launching new products/services	When launching our own new products/services on the market, we cooperate with external partners.
Outward IP licensing	Willing to sell part of IP***	We are willing to sell part of our IP (e.g. patent, trademark).
	Introduction of our products/services through investing into a new joint venture***	We are prepared to introduce products/services we have developed through investing into a new joint venture.
	Selling our IP could harm our company (Reverse coded)**	In our company, we believe that selling our IP could harm our company as it would give competitors access to our knowhow/technologies. (Reverse coded)

Note. Items were evaluated on a Likert scale 1–7 (1 = strongly disagree; 7 = strongly agree).
Items marked with * were evaluated on a Likert scale 1–7 (1 = never; 7 = always).
Items marked with ** were excluded after performing CFA on the Slovenian sample.
Items marked with *** have not been supported in the Italian sample.

1.5 Discussion and conclusions

In this research, we aimed to develop a conceptualisation of the proclivity for open innovation construct grounded in the open innovation theory and to propose its measurement scale. While considerable effort has been made in the existing scholarly literature in capturing open innovation in organisations, researchers of open innovation agree that robust and statistically validated scales of open innovation are needed if this area of research is to progress in the future (Remneland-Wikhamn & Wikhamn, 2011). We respond to this challenge.

Although the body of literature on the role of open innovation has grown substantially in recent years, and open innovation has been positioned as an independent theoretical concept in the literature, the potential for using it in scholarly empirical research has been rather impeded because of several content- and measurement-related limitations of existing open innovation scales. We address these gaps by building a comprehensive conceptual model of proclivity for open innovation that integrates all major open innovation-related practices, and by proposing its empirical operationalisation. Our conceptual framework of proclivity for open innovation is in contrast to existing conceptualisations in the literature in that it focuses on a specified scope of open innovation activities and approaches them as independent yet related processes that work together in contributing to the overall open innovation outcomes of an organisation. We believe that this is a valuable contribution, since business managers see open innovation as a set of interwoven activities within an organisation (Dodgson et al., 2006).

In conceptualising the construct of proclivity for open innovation, we first integrated existing literature on open innovation and acquired insights from business practitioners and other key informants in the broader field of innovation. We continued with a pilot study of a proposed construct on a sample of 30 companies and followed standard psychometric approaches suggested in developing new measures. The dimensionality, reliability and validity of the proposed scale were assessed on a large random sample of companies from different industries and cross-culturally validated. The statistical results supported the internal consistency, convergent and discriminant validity of the proposed scale. By having an empirically validated scale of proclivity for open innovation that can be used in different geographical settings, organisational environments and industries, researchers of open innovation will have better grounds to perform quantitative research related to open innovation and other variables that have been shown to be instrumental contingencies of organisational performance. In our research, we make several important contributions.

1.5.1 Theoretical contributions

Our first contribution is to the growing body of theoretical and empirical work on open innovation. This is the first scale development study in the field that approaches the process in a systematic manner by following all the steps of the scale development process as suggested in psychometric literature. In so doing we build grounds for the future progress of open innovation literature since effective measurement (of a phenomenon) is a foundation of scientific research (DeVellis, 2003; Netemeyer et al., 2003). By proposing a conceptualisation of the proclivity for open innovation construct and developing a robust measure, we open grounds for the programmatic research of the organisation-level determinants of success in innovation. Whereas prior studies of open innovation that explored its role in firm performance tremendously contributed to our initial understanding of the important role that open innovation plays in organisational success, these studies used proxy measures of the construct, which oftentimes produced inconsistent results. For example, in exploring relationships between open innovation and absorptive capacity, there is non-converging evidence from three existing empirical studies. The first study found that absorptive capacity is a substitute of open innovation (Laursen & Salter, 2006). The second study found that absorptive capacity was a mediator of the relationship between open innovation and organisational performance (Fosfuri & Tribó, 2008), while the third study identified absorptive capacity as a moderator in the relation (Escribano et al., 2009). A possible reason for non-converging results may be the use of proxy measures derived from the statistical instruments, such as CIS survey. Therefore, by systematically developing and validating measure of important constructs in the field, future research can expect more consistent and generalisable results of hypothesised relationships. Moreover, conceptualisation of an agglomerate measure is flexible in the sense that it allows flexible examination of particular dimensions of open innovation. In so doing future research may provide valuable evidence on the importance and the comparison of the individual dimensions in achieving a specific goal. The proposed measure of proclivity for open innovation opens grounds for a more complex examination and for new theoretical perspectives in open innovation research. For instance, in examining geographic variations of open innovation in organisations specific hypotheses about cultural impact on dimensions of open innovation can be formulated. By understanding open innovation as a multifaceted process, firms can purposively decide about allocation of available resources to particular aspects of open innovation. Taken altogether, by framing open innovation as a multidimensional construct, we can evaluate what it means for organisations to exhibit an open posture in their innovation processes. Alternatively, by having specific dimensions of open innovation defined, we can also uncover the unique roles played by each of the dimension since differential relationships may exist between a particular dimension and organisational performance.

Our second theoretical contribution concerns stinginess in evaluating open innovation. For instance, drawing from the existing literature on open innovation, our empirical results reveal that activities related to inward IP licensing and external participation (which are treated as

two separate aspects in the existing literature) are in essence reflecting one facet of open innovation. From a scholarly perspective, this finding enhances the parsimony of the observed latent construct. Our research also suggests merging outsourcing R&D and external networking dimensions, which were in prior literature conceptualised as differential aspects of open innovation, into one dimension. This is supported by business practices (e.g. Bianchi et al., 2011; Rohrbeck et al., 2009) suggesting that firms actively collaborate and interact with knowledge institutions, rather than merely buy R&D services from them.

Similarly, we find that there is no clear distinction between technology exploration and technology exploitation dimensions, which in the literature are denoted as two different facets of open innovation. The examination of results in the correlation matrix does not reveal a higher correlation between the two dimensions that belong to the same facet (e.g. technology exploration) as opposed to the correlation among dimensions of different facets. In turn the correlations among all dimensions (regardless of underlying facet) are dispersed across the matrix. This result provides additional support to suggest that open innovation involves multiple activities that are significantly associated with important organisational outcomes. This is in line with van de Vrande et al. (2009) research finding that organisations tend to combine both aspects of open innovation, rather than exclusively focus on technology exploration or technology exploitation. Business practice supports such findings; for instance, Deutsche Telekom accesses external knowledge through co-investing in new firms, by involving users in the service creation through internet platform, and through consortia projects with different partners sharing the costs of the complex research projects. In contrast, the technology exploitation process at Deutsche Telekom happens mainly via spin-out firms, such as Qiro and Zimory (Rohrbeck et al., 2009).

1.5.2 Practical contributions

Our study has important implications for business practitioners. The most important unanswered question that we have identified in prior literature and in our field work concerns practitioners' knowledge of activities at the heart of open innovation and how companies can more effectively organise their processes to facilitate open innovation. By integrating various open innovation dimensions, we provide useful grounds to managers to identify competencies of their organisations to exploit internal knowledge and explore the potential of outside knowledge and technology. We have provided a nuanced description of open innovation activities from which managers may decide which activities of the specific dimension are most appropriate and the easiest to implement in their businesses. Because the study demonstrates coherency of open innovation dimensions, in pursuing performance related to organisational goals, practitioners need to pay attention to any open innovation dimensions, although anecdotal evidence from practice may suggest that some organisations can succeed in open innovation by emphasising only specific aspects of open innovation. In fact, the most successful open innovators are the companies that productively combine inbound and outbound open innovation activities that reside in the separate functional silos of an

organisation (Schroll & Mild, 2011). This natural alliance of different open innovation activities is evident in the business practice. For example, Nokia approaches new product development by integrating networking, outsourcing R&D and inward IP licensing, followed by strategic alliances (external participation) with mobile phone manufactures like Ericsson, Siemens and Motorola when entering new markets (Dittrich & Duysters, 2007). Similarly, networking activities enabled Fiat to develop superior engine technology which facilitated outward IP licensing and partnership with Chrysler (Di Minin et al., 2010).

In summary, business practitioners should keep in mind the importance of encouraging the development of all open innovation proclivity dimensions, which enables maximising the exploitation of internal capabilities and exploration of the knowledge and technology from the outside.

1.5.3 Limitations and future research

This study has several limitations that open avenues for future research on open innovation. We conceptualised the construct and proposed the measure of proclivity for open innovation, which includes a list of open innovation items that are empirically testable. Therefore, future research can continue from this point onward, to further test and refine this important measure.

Secondly, as the data for all the constructs in the research were collected from a single informant using a single survey instrument, the common method variance might potentially influence the results. In order to minimise the common method variance threat, we were especially careful throughout the research design development and implementation phase. For example, during the pre-test phases, when we interviewed managers, we were especially careful in formulating the questions so that the items truly corresponded to firm's activity. Since our data is cross-sectional, longitudinal analyses are needed in the future to assess organisational parameters that tend to vary over time.

Thirdly, our proposed measure of proclivity for open innovation was tested on a sample of companies from two countries. There are some differences in validating the measure between the two national samples, which may to some extent be related to country specificities in organisational practices. Forthcoming research should test the measure in other organisational and ecological settings. Future validity studies could include cluster analyses of the companies (e.g. regarding their size, age, industry) to determine whether there are any differences concerning a firm's proclivity for open innovation among the groups. Results from van de Vrande et al. (2009) revealed that there are differences between open innovation practices dependent on the firm's size, with larger firms more frequently adopting open innovation practices. It would be interesting to explore why smaller firms that are inclined to open innovation do not perform it. One reason may be a lack of implementation capabilities.

The practical applicability of the scale can be further tested by quantitative studies exploring mediating and moderating mechanisms that convey effects of proclivity for open innovation on organisational performance, and to better understand different context dependencies and interactions (Huizingh, 2011). Moreover, such research bears practical implications, since managers need to know which variables contribute the most to innovation efforts (Keizer, Dijkstra & Halman, 2002). Finally, the downsides of open innovation for certain types of organisations could be explored in the future. Indeed, the negative effects of performing too much of open innovation has already been identified by Laursen and Salter (2006) who showed that the relationship between external search breadth, depth and innovative performance is curvilinear (taking an inverted U-shape), meaning that too much external search breadth and/or depth negatively influences firm's performance, since search can be time consuming, expensive, and difficult. An intriguing perspective in investigating the state of open innovation may be from the perspective of product/technology life cycles (Dahlander & Gann, 2010). Last but not least, future research of open innovation could explore how various national governmental policies accelerate development of open innovation in organisations (Herstad, Bloch, Ebersberger & van de Velde, 2010).

2 THE INTERPLAY BETWEEN ABSORPTIVE CAPACITY AND PROCLIVITY FOR OPEN INNOVATION IN IMPACTING INNOVATION PERFORMANCE[2]

2.1 Introduction

In the environments of abundant and widely distributed knowledge, the winning organisations are the ones that know how to creatively combine and exploit internal and external knowledge (Chesbrough, 2003b). To improve innovation capabilities, an increasing number of organisations have shifted from traditional closed R&D processes to more open approaches that enable acquiring ideas and resources from the outside, leveraging multiple paths to market and, in so doing, sustaining competitive advantage (Bianchi et al., 2011; Chesbrough, 2003b; Chesbrough & Crowther, 2006). The key factor in internalising external knowledge is the firm's absorptive capacity (Cohen & Levinthal, 1990) – that is, the firm's ability to recognise and adapt externally acquired technologies (Spithoven et al., 2010; van de Vrande et al., 2006). In this way, the opening of the innovation process can most effectively influence a firm's innovation performance when organisational capabilities are well developed (Christensen, 2006; Lichtenthaler, 2011). Throughout existing scholarship and practitioners' evidence, there is a strong view that the interplay of an organisation's idiosyncratic assets and capabilities impact overall organisational performance (e.g. Huston & Sakkab, 2006; Tsai, 2001).

Although the evidence of the positive role of open innovation in organisations is growing (Dahlander & Gann, 2010), more empirical research is needed in this domain. In particular, the mechanisms that explain the relationship between open innovation and other important organisational correlates have not yet been well defined or researched (Huizingh, 2011). The existing empirical evidence in this domain, however, relies mostly on qualitative case-study representations. For example, Rohrbeck et al. (2009) made a case study of Deutsche Telekom to show how a multinational company can enhance its innovation capacity by integrating different open innovation activities (such as networking, customer involvement, and external participation) in its traditional R&D processes. Moreover, Huston and Sakkab (2006) analysed how P&G boosted its knowledge stock and flow, both contributing to the improved absorptive capacity and more open innovation practices, by establishing the Connect & Develop (C&D) model as a tangible result of a changed organisational culture.

In this research we aim to make two important contributions. Our first goal is to use the proclivity for open innovation concept as a formal construct and empirically support its role in a firm's performance. The proclivity for open innovation is defined as the firm's

[2] This chapter of the dissertation was presented at the IAMOT 2014 conference.
The paper has been submitted to a peer-reviewed journal.
The paper is written in co-autorship with prof. dr. Mateja Drnovšek, assistant prof. dr. Alberto Di Minin and dr. André Spithoven.

predisposition to perform different open innovation activities, such as inward IP licensing and external participation, outsourcing R&D and external networking, customer involvement, employee involvement and venturing (Rangus, Drnovšek & Di Minin, 2013).

For our second goal, we aim to conceptualise and empirically test a contingency model of proclivity for open innovation, organisational capabilities, and the firm's innovation performance. We model a particular organisational capability – absorptive capacity – that has been emphasised in prior studies as an important variable for effective exploitation of external knowledge and information in attaining innovation outcomes (e.g. Hughes & Wareham, 2010; Spithoven et al., 2010). Although many scholars have conceptually supported its salience, the existing empirical findings on its impact are somewhat disparate. Laursen and Salter (2006) found a substitution effect between open innovation and absorptive capacity. Escribano et al. (2009) demonstrated that absorptive capacity was a moderator in the relationship between external knowledge flows and organisational performance. Fosfuri and Tribó (2008) showed that absorptive capacity mediated effects of open innovation on organisational performance, using proxy measures from the CIS. In these three studies, absorptive capacity was shown to play three different roles: It was identified as a substitute for open innovation as well as the moderator and the mediator of the relationship between open innovation and organisational performance. A likely reason for such disparate findings is the varied use of measures of absorptive capacity. In all studies absorptive capacity was measured with a proxy measure using already developed statistical instruments, such as the CIS survey. Several authors (e.g. Lane et al., 2006) suggested that absorptive capacity should be measured in non-R&D contexts to incorporate its multidimensional nature. Similarly the empirical measure of open innovation should be conceptualised to include a variety of open innovation activities (Schroll & Mild, 2011; Spithoven, Vanhaverbeke & Roijakkers, 2013; van de Vrande et al., 2009). We aim to address these recommendations by using perceptual measures of absorptive capacity and proclivity for open innovation.

The use of validated measures of proclivity for open innovation and absorptive capacity is indeed an important advantage of our research. Moreover, we contribute to the literature on open innovation by examining the organisational correlates with which open innovation works in impacting a firm's innovation performance. In addition, we contribute to the theory of absorptive capacity by providing evidence on the antecedents of this capability, which in existing research is poorly represented (Jansen et al., 2005). By conceptually integrating absorptive capacity in the broader model of proclivity for open innovation and a firm's innovation performance and empirically testing the model, we provide theoretical and empirical grounds for addressing central questions in innovation management research, such as the following: What are specific organisational capabilities that significantly impact innovation strategies? What are the mechanisms through which effects of organisational capabilities are channelled to impact organisational performance? In this study we refer to organisational capabilities as "the socially complex routines that determine the efficiency with which firms physically transform inputs into outputs" (Collis, 1994, p. 145), such as strategic

decision making, product development routines, transfer processes, and knowledge creation routines (Eisenhardt & Martin, 2000). However, the most relevant organisational capability when analysing a firm's proclivity for open innovation is absorptive capacity, since it enables firms to identify, assimilate, transform and commercially apply the knowledge acquired from the outside (Zahra & George, 2002). Moreover we contribute to the dynamic capabilities perspective, which lacks empirical evidence based on quantitative research (C. L. Wang & Ahmed, 2007); consequently, it is unclear in the current literature how dynamic capabilities operate in combination with each other (Ambrosini & Bowman, 2009). We set dynamic capabilities in a nomological network and show how their mutual effects influence a firm's innovation performance.

2.2 Theoretical background and hypotheses development

The overall theoretical foundations of our conceptual model are grounded in the dynamic capabilities perspective (Eisenhardt & Martin, 2000; Teece, 2007; Teece, Pisano & Shuen, 1997) that emerged from the resource-based view (Barney, 1986, 1991; Wernerfelt, 1984). Resource-based view foregrounds the role of an organisation's resources in achieving and maintaining a competitive position for a firm (Jiménez-Barrionuevo, García-Morales & Molina, 2011). Valuable, rare, imperfectly imitable and non-substitutable resources enable an organisation's sustained competitive advantage (Barney, 1991). Additional sources of competitive position are network resources, which are accessible to those organisations that preserve regular collaborations with various partners in their contextual environments (Lavie, 2006).

However, the resource-based view does not take into account the rapid and unpredictable changes of organisational environments; under such conditions, dynamic capabilities become the source of competitive advantage (Eisenhardt & Martin, 2000). In a turbulent environment, the resources cannot stay stable and simultaneously persist on value; they must constantly progress and develop in order to remain competitive (Ambrosini & Bowman, 2009). Dynamic capabilities identify, shape and seize technological and market opportunities (Teece, 2007) and are defined as the "firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (Teece et al., 1997, p. 516). In other words, they refer to a "firm's processes that use resources to integrate, reconfigure, gain and release resources to match and even create market change" (Eisenhardt & Martin, 2000, p. 1107). Dynamic capabilities consist of familiar processes, whereas their strategic advantage lies in their ability to alter resources into value-creating strategies (Eisenhardt & Martin, 2000).

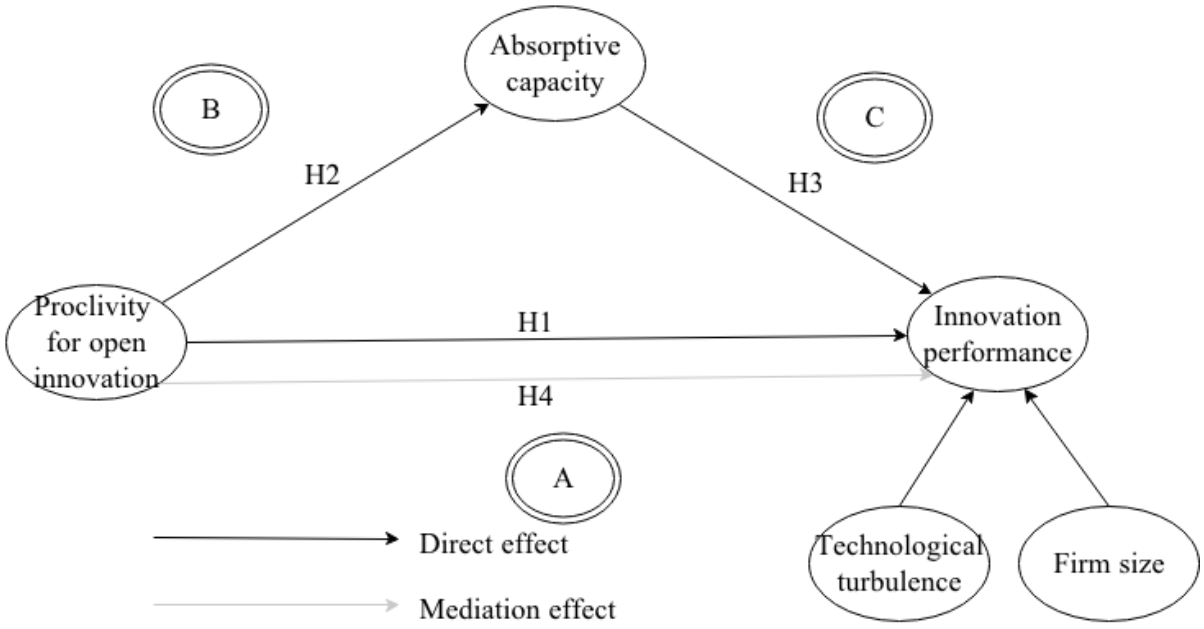
The idea of scanning, searching, and exploring across technologies and markets (Teece, 2007), reaching out, involving external partners, connecting internal and external resources with an aim to sustain competitive position in constantly changing environments is at the heart of proclivity for open innovation. Drawing from the existing literature on dynamic

capabilities, proclivity for open innovation can be seen as a firm's dynamic capability since it integrates the processes needed in adapting to environmental changes. Proclivity for open innovation relates to the firm's ability to perform various open innovation activities (Rangus et al., 2013) to facilitate a smooth flow of ideas inside and outside the organisation in order to capitalise on the exploration of external and the exploitation of internal resources (Chesbrough, 2003b). The potential of internal resources can be maximised by incorporating open innovation activities, such as venturing, employee involvement and outward IP licensing (van de Vrande et al., 2009), all activities that enable the firm to leverage multiple paths to market (Chesbrough, 2003b). Activities that facilitate engagement of external resources involve interaction with customers, networking, external participation, outsourcing R&D and inward IP licensing (van de Vrande et al., 2009).

Absorptive capacity has been recognised as an important component of firms' dynamic capabilities, as it enables firms to learn from partners, reach external information and transform and integrate it with its existing knowledge base (C. L. Wang & Ahmed, 2007). Absorptive capacity is defined as a dynamic capability through which a firm acquires, assimilates, transforms and exploits knowledge with an aim to sustain a competitive advantage (Zahra & George, 2002). Organisations with a high level of absorptive capacity have superior capabilities to target, absorb and deploy new knowledge, which facilitates internal innovation activities (Fosfuri & Tribó, 2008).

In this model (Figure 4) we suggest that proclivity for open innovation activates action both directly and indirectly through absorptive capacity that leads to enhanced innovation performance. The model is grounded in the resource-based view, dynamic capabilities theory, open innovation research and prior research on absorptive capacity. The processes in the model are triggered when proclivity for open innovation is activated, which empowers the exploration of external and exploitation of internal resources. Proclivity for open innovation thus regulates organisational efforts for successful innovation performance. We suggest that proclivity for open innovation leads to increased innovation performance directly (path A in Figure 4) and indirectly (path B/C in Figure 4) through absorptive capacity. Below we review the theoretical arguments that take each proposed path in the model into consideration.

Figure 4. The mediation effect of absorptive capacity on the relationship between proclivity for open innovation and innovation performance



2.2.1 Direct effects of proclivity for open innovation on firm's innovation performance

We hypothesise that proclivity for open innovation has a direct positive effect on innovation performance (path A in Figure 4). Prior literature suggests that organisations can improve their innovation performance by incorporating inbound and/or outbound open innovation activities (Chesbrough & Crowther, 2006). Proclivity for open innovation is a multidimensional construct that involves outsourcing R&D and external networking, customer involvement, inward IP licensing and external participation, employee involvement and venturing related activities. Its measurement scale has been validated in a cross-country study by Rangus et al. (2013). Below we discuss mechanisms that connect a specific dimension of proclivity for open innovation with a firm's innovation performance.

As far as external networking is concerned, prior research suggests that organisations with a greater number of external search channels possess a superior capability to sustain exchanges and collaborations with external partners. In turn, they have access to exploit more innovative opportunities, which positively impacts a firm's innovation performance (Laursen & Salter, 2006). Moreover, by integrating different partners in the innovation process, organisations gain creativity and know-how (Schroll & Mild, 2011) that often lead to implementation of ideas on how to improve products and processes and, consequently, develop market push innovations (Nijhof, Krabbendam & Looise, 2002). Further, customers provide ideas on how to improve existing products and services to better address their needs (Chesbrough, 2003b), and these contributions have been shown to positively affect a firm's innovation performance (Inauen & Schenker-Wicki, 2011). Often organisations involve customers directly in their

innovation processes by providing them toolkits for the development and testing of prototypes to be improved until the requirements are matched (von Hippel & Katz, 2002). When collaborating with universities, organisations access new technological and scientific capabilities through specialised and expertise knowledge of scientists (Bishop, D`Este & Neely, 2011). Enhanced technological and scientific capabilities have been shown to have positive effects on innovation performance (Fabrizio, 2006). Furthermore, when such collaborations are formalised (e.g. in the form of joint venture), the resulting patenting activity also increases (Santamaría, Nieto & Barge-Gil, 2009). This facilitates organisational performance because IP in-licensing saves time and money and opens access to validated technologies that facilitate the development of more complex products (Tao & Magnotta, 2006). Employee involvement likewise facilitates the innovation performance by leveraging the knowledge and initiatives of employees not involved in the R&D process (van de Vrande et al., 2009) through searching for patentable ideas in and outside the firm's boundaries (Chesbrough, 2003b) and through collaborating across divisions within the organisation, which enables the sharing and borrowing of ideas (O'Connor, 2005). Highly qualified employees contribute to innovation activities because they have superior absorptive capacities and the capacities to transmit insights throughout the company (Knudsen, 2007). Finally, a firm's innovation performance can be enhanced through venturing activities to commercialise internal technological capabilities (van de Vrande et al., 2009). In so doing, organisations enter new markets and industries (Block & MacMillan, 1995), gaining access to information about future technologies and market opportunities (Chesbrough, 2003b) that have been shown to improve innovation performance.

Based on the arguments presented above, we propose the following hypothesis:

H1: There is a direct positive relationship between proclivity for open innovation and innovation performance of a firm.

2.2.2 The mediating effects of absorptive capacity

Proclivity for open innovation can enhance a firm's innovation performance because it promotes the emergence of absorptive capacity. In supporting the mediation effect of absorptive capacity on the relationship between proclivity for open innovation and firm's innovation performance, we first provide evidence to support the direct effect of proclivity for open innovation on absorptive capacity (path B in Figure 4) followed by arguments supporting positive impact of absorptive capacity on innovation performance (path C in Figure 4).

Open innovation stimulates the development of absorptive capacity (Tether & Tajar, 2008). Studies have shown that significant antecedents to absorptive capacity involve interaction with external knowledge sources, such as licensing and contractual agreements and collaboration with different partners, including R&D consortia, alliances, and joint ventures

(Zahra & George, 2002), all of which are dimensions of proclivity for open innovation. The greater the interaction with external sources, the more experiential knowledge related to the management of the external information is collected, which in turn helps organisations to develop better routines for understanding and dealing with external knowledge flows (Fosfuri & Tribó, 2008). Moreover employee involvement through different management practices, such as job rotation and problem solving technics, stimulates the exchange, transformation and exploitation of knowledge (Vega-Jurado, Gutierrez-Gracia & Fernandez-de-Lucio, 2008). Interaction among employees causes knowledge sharing and consequently escalates their learning abilities (Liao, Fei & Chen, 2007). When this logic is brought to bear at firm level, we can suggest that interaction with different partners enables organisations to acquire new knowledge that develops and increases their learning abilities. This leads us to propose the following:

H2: There is a direct positive relationship between proclivity for open innovation and absorptive capacity.

In turn, because of superior capabilities to apply new knowledge to commercial ends that firms with higher levels of absorptive capacity possess, higher levels of absorptive capacity lead to better innovation performance (Tsai, 2001). Absorptive capacity enables firms to identify and exploit specific technological knowledge and, therefore, gain first-mover advantage in exploiting new technologies (Cohen & Levinthal, 1989). Extrapolating Tsai's (2001) logic of a firm's unit-level absorptive capacity to the organisation's level, organisations with higher levels of absorptive capacity better harness and transfer new knowledge from external partners and absorb new inputs to generate innovation performance related outputs. Zahra and George (2002) indicated that the realised absorptive capacity, defined as a firm's ability to transform and commercially apply knowledge acquired from outside, positively impacts a firm's innovation performance. This positive impact emerges from a successful integration of external and internal technological information that stimulates new product development (Kyriakopoulos & De Ruyter, 2004). These arguments lead us to propose the following:

H3: There is a direct positive relationship between absorptive capacity and a firm's innovation performance.

Based on the foregoing discussion of the direct effect of proclivity for open innovation on firm's innovation performance and direct effect of absorptive capacity on innovation performance, we propose the following:

H4: Absorptive capacity mediates the relationship between proclivity for open innovation and a firm's innovation performance.

2.3 Methodology and data analysis

2.3.1 Sampling and data collection

To gather data for empirical analysis of the proposed conceptual model, we randomly selected 2000 Slovenian manufacturing and service firms from the PIRS and emailed the survey instrument to the top executives of the firms in May 2013. To ensure enough responses, we sent the first reminder after a week and another one after three weeks. We received 428 responses (21.4% response rate); seven questionnaires were later excluded due to a high proportion (more than 20%) of missing data. The valid response rate was thus 21.1%. We collected data from a wide range of industries, the majority from manufacturing, information and communication, and services.

For the purpose of this research a survey instrument was developed that included validated scales of proclivity for open innovation, absorptive capacity, a firm's innovation performance and technological turbulence (control variable). All measures were adopted from prior research. We tested their validity and reliability in the context of our empirical sample. We used Dillman, Smyth and Christian's (2009) tailored design method for the questionnaire development and a translation and back translation method for translating the questionnaire from English to Slovenian and back to English (to ensure the international equality of the items). The questionnaire was pretested on a sample of 20 CEOs of different Slovenian firms to collect their feedback and experience of completing the questionnaire.

2.3.2 Measures

2.3.2.1 Proclivity for open innovation

Proclivity for open innovation was measured with the scale developed and tested by Rangus et al. (2013); see Table 8. The measure has been cross-culturally validated and consists of five dimensions (external participation and inward IP licensing, outsourcing R&D and external networking, customer involvement, employee involvement and venturing) with 22 corresponding items. All items were evaluated on a 7-point Likert scale (e.g. 1 = *strongly disagree*; 7 = *strongly agree*).

2.3.2.2 Absorptive capacity

We used a scale developed by Kotabe, Jiang and Murray (2011) for measuring absorptive capacity (for detailed description, see Table 8). The scale consists of 9 items and measures a firm's realised absorptive capacity, reflecting knowledge transformation and exploitation. Respondents indicated on a 7-point Likert scale how strong they disagreed/agreed with the statements.

2.3.2.3 Innovation performance

Our key dependent variable innovation outcome was measured with 6 items related to product and process innovation from the Jiménez-Jiménez and Sanz-Valle (2011) innovation scale (see Table 8). To minimise bias from subjective answers, we followed the recommendations of Kraft (1990) and asked respondents to evaluate the company's innovation performance against the major competitors in the industry in last 3 years on a 7-point Likert scale ranging from *much worse than competitors* to *much better than competitors*. When using the measures compared to competitors, the level of competition becomes as disaggregated as possible; organisations have to define their relevant market themselves, and so the degree of competitive pressure is measured as perceived at firm level (Kraft, 1990).

2.3.2.4 Control variables

Two control variables were included in the model. At firm level we controlled for the firm size measured as a construct composed of three variables: logarithm of number of employees, logarithm of total assets and logarithm of total sales following the European Union law recommendation 2003/361 concerning the definition of micro, small and medium-sized enterprises (European Commission, 2003). At industry level we controlled for the technological turbulence that has been documented to influence innovation performance (Zhou, Kin & Tse, 2005). We used Jaworski and Kohli (1993) scale for measuring technology turbulence as the extent of technology changes in the industry (see Table 8).

Table 8. Final scales' items and standardised loadings (based on the CFA)

Scales	Loading
POI: Inward IP licensing and external participation (Rangus et al., 2013) (Strongly disagree/Strongly agree)	0.59
We believe that investing in a new joint venture could result in new know-how/technology for our company.	0.64
We are willing to buy the IP of other companies (e.g. patent, trademark) to support our internal development.	0.61
We believe the use of know-how/technology from the outside can significantly contribute to the innovation outcomes of our company.	0.81
We believe that know-how/technology we have bought can create new opportunities for the company.	0.83
We believe it is beneficial to determine systematic and formal ways of searching for external know-how/technology.	0.78
To ensure successful development of new products/services, we usually buy the IP of other companies.*	
POI: Outsourcing R&D and external networking (Rangus et al., 2013) (Never/Always)	0.37
In order to acquire new know-how/ technology, we cooperate with knowledge institutions such as universities, faculties, institutes, laboratories...	0.75
In order to acquire new know-how/ technology, we cooperate with high-tech start-up companies...	0.59
In order to acquire new knowhow/technology, we cooperate with consultancy companies.*	
We acquire new know-how/technology through research and development services provided by knowledge institutions such as universities, faculties, institutes, laboratories, etc.	0.84
We acquire new know-how/technology through informal ties with researchers from various laboratories.	0.76
We acquire new know-how/technology through mentoring doctoral students.	0.64
POI: Customer involvement (Rangus et al., 2013) (Strongly disagree/Strongly agree)	0.50
Our clients/end users are usually involved in the process of new product/service development.	0.78
Our products/services are usually developed in light of customer/client wishes and suggestions.	0.72
In order to acquire new know-how/technology, we cooperate with our customers/clients … (Never/Always)	0.55
POI: Employee involvement (Rangus et al., 2013) (Strongly disagree/Strongly agree)	0.69
When developing new ideas, we often consider the suggestions of employees not included in research and development process.	0.65
We actively encourage communication among unrelated groups of employees in the company.	0.74
We inform our employees about the importance of innovation to our business.	0.72
We additionally award our employees if they bring external know-how/technology that improves our products / services.	0.68

(table continues)

(continued)

Scales	Loading
POI: Venturing (Rangus et al., 2013) (Strongly disagree/Strongly agree)	0.69
When developing new activities related to the present operation of our company, we are willing to cooperate with the partners from the outside.	0.78
When developing new activities related to the present operation of our company, we use external sources of know-how/technology.	0.86
When launching our own new products/services on the market, we cooperate with external partners.	0.66
Absorptive capacity (Kotabe et al., 2011) (Strongly disagree/Strongly agree)	
We have the capability to adapt acquired new knowledge to fit the firm's development need.	0.85
We have the capability to develop new products/services by using assimilated new knowledge.*	
We have the capability to develop new applications by applying assimilated new knowledge.	0.87
We have the capability to find alternative uses of assimilated new knowledge.	0.89
We have the capability to introduce product/service innovation based on acquired new knowledge.*	
We have the capability to fuse assimilated new knowledge with existing knowledge.	0.90
We have the capability to revise manufacturing/service processes based on acquired new knowledge.	0.78
We have the capability to revise business procedures based on acquired new knowledge.	0.81
We have the capability to revise quality control operations based on acquired new knowledge.	0.81
Innovation performance (Jiménez-Jiménez & Sanz-Valle, 2011) (Much worse than competitors/Much better than competitors)	
In the last 3 years, our firm has performed worse/better than competitors in regard to the number of new products/services launched.	0.80
In the last 3 years, our firm has performed worse/better than competitors in regard to pioneering the introduction of new products/services (you were one of the first to introduce a new product/service).	0.80
In the last 3 years, our firm has performed worse/better than competitors in regard to the effort invested in the development of new products/services, taking into consideration the number of hours, people, teams and trainings.	0.86
In the last 3 years, our firm has performed worse/better than competitors in regard to the number of introduced changes in processes.	0.87
In the last 3 years, our firm has performed worse/better than competitors in regard to pioneering newly introduced processes (you've been one of the first to introduce new processes).	0.85
In the last 3 years, our firm has performed worse/better than competitors in regard to responding to new processes introduced by other companies in your field.	0.80
Technological turbulence (Jaworski & Kohli, 1993) (Strongly disagree/Strongly agree)	
The technology in our industry is changing rapidly.	0.74
Technological changes provide major opportunities in our industry.	0.94
A large number of new product/service ideas have been made possible through technological breakthroughs in our industry.	0.93
Technological developments in our industry are rather minor.*	
Firm size Adapted from European Union law recommendation 2003/361 (EC, 2003)	
Logarithm of number of employees	0.87
Logarithm of total assets	0.89
Logarithm of total sales	0.94

Note. POI = Proclivity for open innovation

Items marked with * were excluded from the analysis.

2.3.3 Data analyses

We first analysed data to determine whether missing data displayed a pattern. The Little's MCAR test showed that data were missing entirely at random (Hair et al., 2010). The highest proportion of missing data per response was 6.4%, and all others were below 3%. Because of the low percentage of missing data, the data were replaced using the expectation-maximisation method, which provides the least bias under conditions of random missing data (Hair et al., 2010).

To minimise the problem of common method bias, we followed the steps recommended by Podsakoff, MacKenzie, Lee and Podsakoff (2003). We took precaution measures early in the process of designing the study by administering pre-tests of the questionnaire that helped us to identify the items that were ambiguous, unclear and hard to answer. We also ensured the anonymity of respondents' answers. Since our survey covered more than 70 items with diverse information, it is very unlikely that respondents could predict our aim and how we want them to respond. We performed the Harman's single-factor test, whereas unrotated factor analysis resulted in a five-factor solution, which accounted for 73.08% of total variance (factor 1 accounted for 33.01% of the variance). Moreover, we employed the one-factor test using CFA. The common method variance poses a serious threat if a simple model (such as single factor model) fit the data well (Korsgaard & Roberson, 1995). The results of the CFA showed that the model with single factor did not fit the data well (Chi-Square/df = 17.22; RMSEA = 0.23; NFI = 0.72; NNFI = 0.70; CFI = 0.73; IFI = 0.73; SRMR = 0.17; GFI = 0.47; AGFI = 0.36). Whereas the null model containing five factors yielded much better fit of the data (Chi-Square/df = 4.69; RMSEA = 0.10; NFI = 0.92; NNFI = 0.93; CFI = 0.94; IFI = 0.94; SRMR = 0.22; GFI = 0.79; AGFI = 0.76). Although these procedures do not exclude the common method variance, they suggest that it is not of great concern (Korsgaard & Roberson, 1995; Verdu, Tamayo & Ruiz-Moreno, 2012).

We checked for the late-response bias, comparing early and late responses on firm industry and total sales, and found no significant differences. We also tested for multicollinearity problems, calculating variance inflation factors (VIF). Due to high value of VIF, we excluded two variables from the construct of absorptive capacity. The excluded variables follow: "We have the capability to develop new products/services by using assimilated new knowledge"; "We have the capability to introduce product/service innovation based on acquired new knowledge."

Before testing the hypothesised relationships, we performed CFA and tested for the convergent and discriminant validity of the constructs using Lisrel 8.80 software. We checked the internal consistency of the constructs using Cronbach's alphas (calculated using IBM SPSS Statistics 20). Based on the performance of the CFA, we dropped two variables from the proclivity for open innovation construct due to low standardised loadings. One excluded variable – "To ensure successful development of new products/services, we usually buy the IP

of other companies" – belongs to factor Inward IP licensing and external participation; the other excluded variable – "In order to acquire new knowhow/technology, we cooperate with consultancy companies" – belongs to factor Outsourcing R&D and external networking. In addition we excluded the variable "Technological developments in our industry are rather minor" from the technological turbulence construct due to the low value of communality with other variables in the construct. The two factors of product and process innovation proved highly correlated; therefore, we used innovation as a one-factor construct.

Since proclivity for open innovation is a second-order construct, we first performed all the analyses for this construct. A second-order factor structure contains two layers of latent constructs, whereas the first-order factors act as indicators of the second-order factor (Hair et al., 2010). Convergent validity was supported, as all factor loadings were highly significant and the *t* values were well in excess of 2.58 in absolute terms. The Cronbach's alphas of the five factors of the construct proclivity for open innovation ranged from 0.721 to 0.848. The AVE varied from 0.479 to 0.594, and the discriminant validity of the construct was supported since the AVEs of the factors were larger than the shared variance between the factors. The results also supported the acceptable fit of the model (Chi-Square/df = 3.04; RMSEA = 0.07; NFI = 0.93; NNFI = 0.95; CFI = 0.95; IFI = 0.95; SRMR = 0.06; GFI = 0.90; AGFI = 0.86). However, with an aim to reduce the data, we used summated scales for building the construct of proclivity for open innovation. The Cronbach's alpha of the construct was 0.710. Convergent validity of the other four constructs (absorptive capacity, innovation performance, technological turbulence and firm size) was also supported: The standardised loadings of all measurement items were highly significant, with the smallest *t* value being 17.23. The Cronbach's alphas of the constructs were as follows: absorptive capacity = 0.945; innovation = 0.929; technological turbulence = 0.896; firm size = 0.920. Standardised loadings of the variables are presented in Table 8. The results of AVE and shared variance presented in Table 9 in general support the convergent and discriminant validity among the constructs. Correlations among the constructs are presented in Table 10.

Table 9. Average variance extracted and shared variance

	1	2	3	4	5
1. Proclivity for open innovation	0.34				
2. Absorptive capacity	0.20	0.71			
3. Innovation	0.39	0.31	0.69		
4. Technological turbulence	0.08	0.12	0.21	0.76	
5. Firm size	0.01	0.01	0.03	0.01	0.81

Note. The numbers on the diagonal show average variance extracted.

Table 10. Correlation matrix

	Mean	*SD*	1	2	3	4	5
1. Proclivity for open innovation	4.85	0.82	1.00				
2. Absorptive capacity	5.93	0.97	0.63	1.00			
3. Innovation	4.88	1.14	0.56	0.45	1.00		
4. Technological turbulence	5.05	1.49	0.46	0.29	0.35	1.00	
5. Firm size	4.48	0.67	0.18	0.12	0.12	0.08	1.00

2.4 Results

We tested the hypothesised relationships using Lisrel 8.80. We performed three tests for checking for the mediation effect of absorptive capacity. We first employed step-by-step inclusion of the paths to assess the best fitting model. Second we tested for the Sobel, Aronian and Goodman tests, and finally we followed the steps recommended by Baron and Kenny (1986).

The results suggest that the proposed model with the mediation effect represents a good model fit (Chi-Square/df = 3.48, RMSEA = 0.08, NFI = 0.95, NNFI = 0.96, CFI = 0.96, IFI = 0.96, SRMR = 0.06, GFI = 0.85, AGFI = 0.81). The model fit of the null model with no relations between the constructs has a significantly poorer fit than alternative models. Table 11 presents the results of the proposed and alternative models.

The results support Hypothesis 1, which proposes a direct positive relationship between proclivity for open innovation and innovation performance ($\beta = 0.47$, $p < 0.001$). Hypothesis 2, which suggests that there is a relationship between proclivity for open innovation and absorptive capacity ($\beta = 0.63$, $p < 0.001$), and Hypothesis 3 proposing the positive effect of absorptive capacity on innovation performance ($\beta = 0.17$, $p < 0.01$) are also supported. Moreover, the results of the Sobel, Aroian and Goodman tests supported Hypothesis 4 predicting that absorptive capacity mediates the relationship between proclivity for open innovation and innovation performance ($\beta = 0.11$, $p < 0.01$, Sobel test = 2.603, Aroian test = 2.594, Goodman test = 2.613). Twenty percent of the influence is attributed to the indirect effect, and eighty percent to the direct effect.

Table 11. Goodness of fit statistics for step by step analyses

	Model 0	Model 1	Model 2
χ^2	1180.68	834.60	848.30
DF	252	242	244
RMSEA	0.10	0.08	0.08
NFI	0.92	0.95	0.95
NNFI	0.93	0.96	0.96
CFI	0.94	0.96	0.96
IFI	0.94	0.96	0.96
SRMR	0.22	0.06	0.06
GFI	0.79	0.85	0.85
AGFI	0.76	0.81	0.81

Following the Baron and Kenny (1986) recommendations, we tested for significant variation between the independent and the mediation variables, the mediation and the dependent variables and the independent and the dependent variables. As presented in Table 12, all direct effects were significant. Moreover, we checked to determine whether the effect between the independent and the dependent variables decreased when including the mediator. The direct effect of proclivity for open innovation on innovation performance decreased from $\beta = 0.47$ ($p < 0.001$) to $\beta = 0.40$ ($p < 0.001$); therefore, the mediation effect of absorptive capacity was supported.

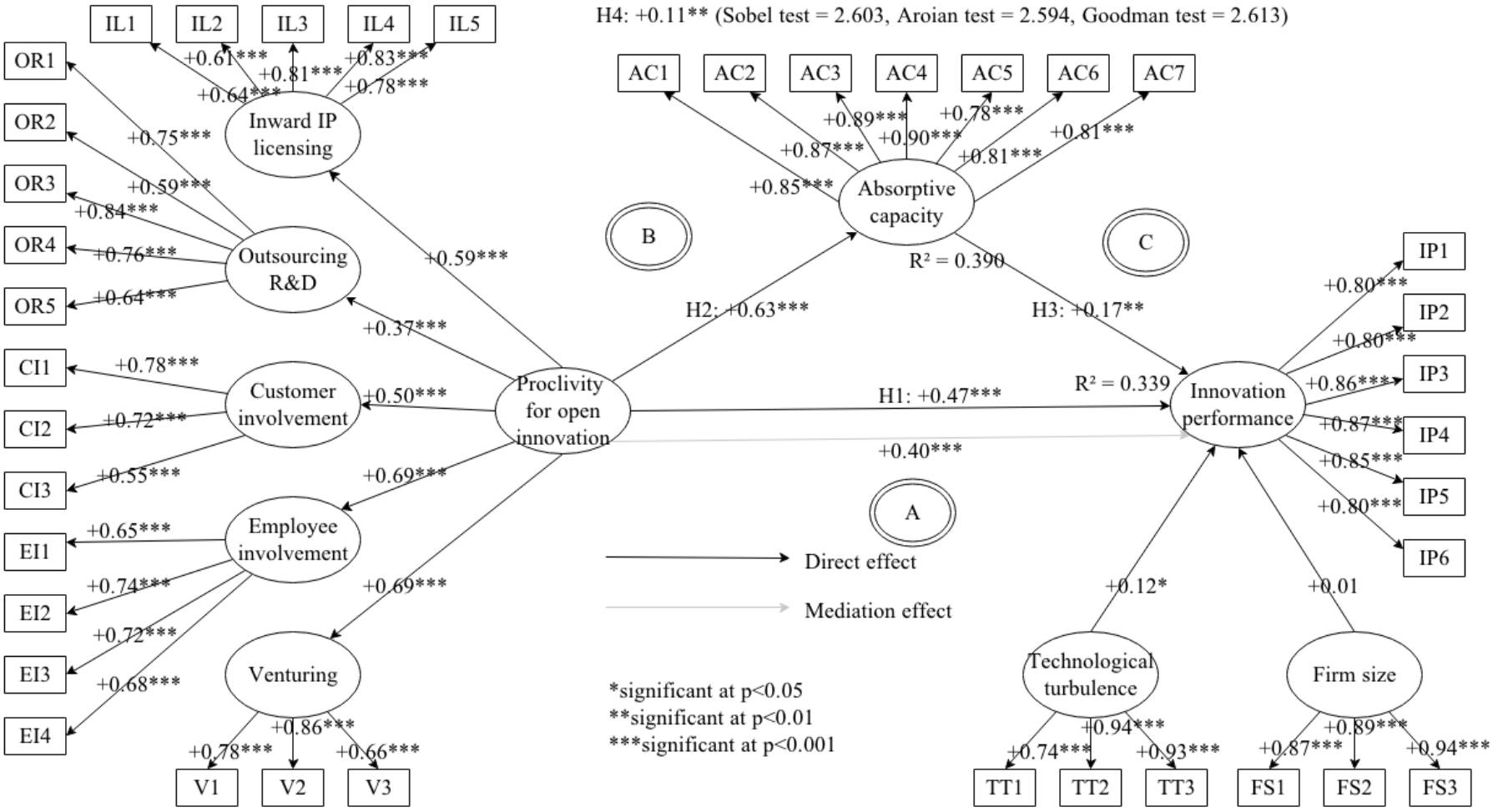
Table 12. Decomposition of effects among variables

	Total	Direct	Indirect
No mediation			
Proclivity for open innovation → Innovation	0.47***	0.47***	-
Technological turbulence → Innovation	0.15**	0.15**	
Firm size → Innovation	-0.03	-0.03	
Mediation			
Proclivity for open innovation → Absorptive capacity	0.63***	0.63***	-
Absorptive capacity → Innovation	0.17**	0.17**	-
Proclivity for open innovation → Innovation	0.50***	0.40***	0.11**
Technological turbulence → Innovation	0.12*	0.12*	
Firm size → Innovation	0.01	0.01	

Note. *significant at $p<0.05$; **significant at $p<0.01$; ***significant at $p<0.001$

Our empirical results also indicated that the control variable technological turbulence was significantly positively related to innovation performance of a firm. In particular, when technological changes in the industry increase, firms may opt to fight this uncertainty with the rise in product and/or process innovation.

Figure 5. Results for the structural model (direct and indirect effects)



To summarise, the overall results (presented in Figure 5) support all the hypothesised causal relationships. We find that absorptive capacity mediates positive effects of proclivity for open innovation on a firm's innovation performance.

2.5 Discussion and implications

Although the body of prior research examining determinants of a firm's innovation performance is extensive, the understanding of how a firm's open-innovation-related activities impact its capacity to absorb external knowledge is somewhat disparate. The main reason for discrepancies in the existing findings is due to the limitations in operationalisation of measures used. Most prior studies in open innovation relied on proxy measures of open innovation and other innovation performance determinants. Drawing on the resource-based view and dynamic capabilities perspective, the main objective of the paper was to conceptualise and empirically test a model of a firm's innovation performance and its key determinants: proclivity for open innovation and absorptive capacity. We find that proclivity for open innovation impact innovation performance directly and indirectly through organisational absorptive capacity.

While several studies in innovation management have emphasised the role of absorptive capacity for effective performance (e.g. Cohen & Levinthal, 1990; George, Zahra, Wheatley & Khan, 2001), our study is one of a few that empirically analyses the mediating role of absorptive capacity in effective innovation performance. Specifically, while Zahra and Hayton (2008) previously found that the relationship between international venturing and firms' profitability is contingent upon firms' absorptive capacity, we build on this work by examining the role of absorptive capacity in mediating the relationship between proclivity for open innovation and innovation performance. Furthermore, divergent to existing research, our model takes into consideration the multidimensionality of the constructs, incorporating different dimensions and elements that embrace the complexity of the firm's level innovation performance. In so doing, we advance the literature on open innovation, which mostly relies on anecdotal and qualitative representations of organisational open innovation. We are one of a few studies that, in a large dataset, empirically analyse organisational-capabilities-related mechanisms that influence the relationship between proclivity for open innovation and innovation performance. The results of the structural equation modelling support our main hypothesis that realised absorptive capacity mediates the relationship between proclivity for open innovation and innovation performance. Our empirical research provides several important contributions.

2.5.1 Theoretical implications

Our findings contribute to the existing literature on the role of organisational capabilities in influencing a firm's innovation performance in several ways. First, this study complements the evidence that a firm's internal capabilities impact its innovation performance (Tsai, 2001)

but goes beyond existing findings by explaining why some organisations are more effective innovators than others. Our main findings suggest that to be successful in innovation, organisations should open their innovation processes and nurture their absorptive capacity. While a considerable part of the literature in the field focused on direct effects of absorptive capacity on innovation performance (e.g. Chen, Lin & Chang, 2009; Murovec & Prodan, 2009) or studied moderating effects of absorptive capacity on the relationship between determinants and innovation performance (e.g. Escribano et al., 2009; C. Wang & Han, 2011), this study focused on understanding how absorptive capacity mediates positive effects of proclivity for open innovation on a firm's innovation performance. We contribute to the theory of absorptive capacity by providing evidence on the antecedents of this capability that can be triggered with a firm's proclivity for open innovation (Fosfuri & Tribó, 2008). Moreover, we contribute to the literature on open innovation, taking into consideration the multidimensional nature of the concept (Spithoven, 2013). By examining the context dependencies of proclivity for open innovation, we provide the evidence on the chain of effects of the organisational correlates in impacting a firm's innovation performance.

Second, in line with the resource-based view (Barney, 1991), our study corroborates the importance attached to internal resources in achieving superior innovation performance, especially in the form of employee involvement. Our research revealed that leveraging the knowledge of employees who are not involved in R&D activities and their collaboration across divisions and searching for ideas inside and outside of the organisation facilitates innovation performance. In line with the proposition of the extended resource-based view (Lavie, 2006), our results supported the salience of network resources in achieving and maintaining a firm's competitive position. We showed that firms that pose a proclivity for open innovation are embedded in different networks, preserve regular collaborations with various partners and, in this way, leverage their knowledge and technology in ways that can enhance their innovation performance. Results from this study indicated that superior innovation performance can be achieved through networks established via external participation, outsourcing R&D or customer involvement.

Finally, we contribute to the dynamic capabilities framework. Most prior studies on dynamic capabilities used longitudinal and qualitative research with an aim of theory building that did not reveal under which circumstances and how firms should direct their resources and capabilities (C. L. Wang & Ahmed, 2007). Our study set dynamic capabilities in a nomological network and showed how they jointly affect a firm's innovation performance. Firms that have the capabilities to perform different open innovation activities can achieve superior innovation performance. Our results revealed, however, that a successful employment of externally acquired knowledge and technology significantly depends also on a firm's absorptive capacity. To fully benefit from organisational capabilities, firms have to acknowledge the positive and/or negative interactions among them. Thus, our study underlines the importance of the relations of different organisational capabilities when striving for superior firm performance.

2.5.2 Managerial implications

From a managerial point of view, our results emphasise the salience of networks as a bridge to resources of other firms. Building and sustaining relationships with different partners enable access to a broader set of resources, which in turn positively influence innovation performance. A documented company that successfully enhanced its innovation capacity by embracing external sources of knowledge is Deutsche Telekom. Specifically, collaborating with universities helped them to keep up with the state-of-the-art research activities; Internet platforms enabled them to find and connect with the appropriate partners in the development phase; and incorporation of different customers' insights tools enabled them to generate hundreds of new ideas (Rohrbeck et al., 2009). Our study reported supporting evidence that using external knowledge spurs innovation performance. Moreover, our study supports the argument that implementing open innovation requires additional internal strengths to fully influence the innovation performance, as put forward by Cassiman and Veugelers (2006). It is not enough to open up innovation process and search for external knowledge and ideas; firms have to possess the capability to modify and connect newly acquired knowledge with the existing knowledge base and efficiently exploit it. If we generalise our findings, managers should bear in mind that firms' capabilities are interconnected, and the stimulation of one capability may positively or negatively influence others. P&G makes a good case in point. In the late 1990s several factors – the increasing cost of investments in R&D, technology and innovation and lower than expected sales growth – triggered a change in the organisational culture towards one in which employees are stimulated to search for new ideas, bring in external ideas and has enough flexibility in developing new products (Dodgson et al., 2006). By establishing the C&D model as a tangible result of a changed organisational culture, they boosted their knowledge stock and flow, both contributing to the improved absorptive capacity and more open innovation practices (Huston & Sakkab, 2006). Organisations that have integrative structures, motivate diversity, structural linkages between participants inside and outside its boundaries, emphasise open communication, more freedom, collaboration and teamwork will most likely produce more innovation (Kanter, 1996). The decision which resources should be developed should also depend on the environmental situation in which organisation is settled.

2.5.3 Limitations and future research

There are several limitations to this study, which open possible avenues for future research. Our research design relies on the use of cross-sectional data which somewhat limits our inferences about causalities in the hypothesised relationships. Future research will profit from longitudinal designs that provides additional insights about the hypothesised relationships in the model. Second, the survey was conducted in one national context. Hence, the replication of the model in other countries could deliver further insights and support the generalisability of the results. Prior research indeed revealed that open innovation practices might have different impacts in different countries (Spithoven, 2013). Although the model was prepared

with caution, we only included absorptive capacity, whereas other potential moderation and mediation effects may be present in the relationship between proclivity for open innovation and firm's innovation performance. Therefore future research should test for other internal and external organisational mechanisms which influence this relationship. As already mentioned an interesting avenue for future research would be the analysis of the role of organisational culture and structure on the relationship between proclivity for open innovation and innovation performance. On the other hand, firm's pro-activeness in form of enhanced competitiveness, aggressiveness and risk taking (Antoncic & Hisrich, 2001) may be a potential moderator on the relation between these two constructs. Finally, open innovation is not all about the organisational culture, structure and management. It greatly also depends on the attitudes of individual employees (Lichtenthaler, 2011). So, to fully understand the influence of open innovation on organisational performance, future studies should also include the role of individuals (top management as well as employees) in the model. An interesting examination would be a large scale study which would show how employees' readiness for change influences firm's proclivity for open innovation. Since the evidence of the negative effect of the not-invented-here (NIH) syndrome of employees is only theoretical and anecdotal in nature (e.g. Chesbrough, 2003b). Moreover the cases from P&G (Huston & Sakkab, 2006) and Fiat (Di Minin et al., 2010) showed that the success behind open innovation has relied on visionary leaders who saw the opportunity of opening up the innovation processes and saving their companies from a downturn. Therefore, we suggest using a multilevel approach with cross-level interactions to examine the relationship between management style and open innovation that identifies which managerial characteristics are the most important when implementing and integrating different open innovation activities. Further, a multilevel approach incorporating organisational teams could show what kind of team attributes are needed to support open innovation activities, how the use of external knowledge and technology influences innovation performance at team level and what kind of information is shared among members within and among teams.

3 DIFFERENT MODES OF OPENNESS AND THEIR INFLUENCE ON FIRM'S INNOVATION PERFORMANCE[3]

3.1 Introduction

P&G has in the last decade recorded incredible boosts of innovation performance due to the creation of an open business model C&D. The C&D was established in 2000 with an aim to save the company from downturn and accelerate business growth (Chesbrough, 2007). The goal of C&D has been to find good ideas, bring them inside to enrich and exploit internal capabilities, explore external resources and consequently create new products, connecting what was not obvious (Huston & Sakkab, 2006). As P&G's Dr. Mike Addison stated: "Innovation is all about making new connections. Most breakthrough innovation is about combining known knowledge in new ways or bringing an idea from one domain to another" (Dodgson et al., 2006, p. 337). The success of C&D has been in addition to the other aspects of innovation – those related to product costs, design and marketing evident also in the productivity of P&G's R&D activities, which has improved almost by 60%; the success in innovation has more than doubled, and the R&D investment has dropped by 30% (Huston & Sakkab, 2006). The competitive advantage of involving the external partners in the innovation process is apparent also in the case of Apple, which attracted many third-party applications and services that created novel experiences for Apple users; "even perfectionist Steve Jobs realised the value of letting others into the Apple innovation process" (Chesbrough, 2011, p. 19). The idea of collaboration with external partners, exploration of their knowledge and technology and exploitation of internal resources is at the heart of open innovation (Chesbrough, 2003b, 2006b).

However, open innovation is not a dichotomous phenomenon (Chesbrough, 2003b; Dahlander & Gann, 2010). In fact, it has several distinct dimensions, including collaboration with various partners, customer involvement, venturing, IP in-licensing, and IP out-licensing (Chesbrough, 2003b; van de Vrande et al., 2009). Despite these multiple dimensions, the multidimensional phenomenon of open innovation has been rarely explored in its whole. Instead, existing research mostly has focused on one of its dimensions. Although prior research contributed to our understanding of the role of open innovation in facilitating organisations' innovation performance, its dominant focus on analysing independent effects of specific dimension has hindered our understanding of how different dimensions of open innovation could be combined and how they jointly impact various organisational outcomes. Moreover, findings from empirical studies of open innovation do not inform us as which dimensions may be more important in facilitating innovation performance of organisations. Such evidence is especially informative for CEOs when allocating (scarce) resources to development of particular open innovation related activities.

[3] This chapter of the dissertation was presented at the R&D management 2014 conference.
The paper will be submitted to a peer-reviewed journal.
The paper is written in co-autorship with prof. dr. Mateja Drnovšek and assistant prof. dr. Alberto Di Minin.

Furthermore, a majority of existing studies of open innovation are interested in how effectively open innovation activities are implemented within organisations' processes (e.g. Bianchi et al., 2011; Schroll & Mild, 2011), neglecting the human side of those processes. Indeed, an abundance of studies in human resource management have emphasised the critical role of proactive leaders in successful innovation (e.g. García-Morales et al., 2012; Yoshida et al., In Press). The impact of forward-thinking leaders has been evident also in business practice, as in the case of Steve Jobs who turned around the innovation process in Apple and succeeded in creating a more than 9,000% increase of the company's stock price. He had a clear vision and desire to deliver an outstanding customer experience (Chesbrough, 2011), driven by his management style and affiliated employees. Open innovation can uncover totally new aspects of existing business, bring fresh ideas and enabling entrance to new markets (Chesbrough, 2003b). However, open innovation activities have to be properly organised and managed; new ideas must be afforded proper value and evaluation, which in turn require competent and visionary leaders as well as open-minded employees open to leaders' suggestions and ideas. Proactive leadership is essential to successful implementation of open innovation. As indicated by Dr. Frank Piller, Professor at RWTH Aachen University, and Moises Norena, Director of Global Innovation at Whirlpool Corporation: "An important part plays organisation's open innovation readiness, which includes passionate, focused open innovation leaders who drive a change in their teams and a shift in mentality to do experimentation" (Cuccureddu, 2011).

With this study we aim to contribute to the existing knowledge on open innovation in organisations in the following ways. First, in contrast to existing studies that focus on partial aspects of open innovation, we take an integrative perspective and provide a comprehensive overview of open innovation activities. Drawing from an in-depth literature review of open innovation, we have grounds to evaluate and compare the utility of each of activity in attaining innovation-related outcomes in organisations. We provide a systematic description of the multidimensional construct of open innovation and in this way help managers to understand the complexity of this phenomenon and its activities, which have been fragmented and dispersed across several studies.

Second, in assessing an organisation's open innovation, we take a bottom-up perspective. We use an integrative measure of open innovation based on evaluating a proclivity (e.g. attitude) that a CEO of an organisation has towards various open innovation activities. The measure identifies the potential and willingness of organisations to become open innovators. Instead of evaluating purely open innovation outcomes and activities, the measure incorporates the firm's beliefs and intentions to perform a specific open innovation activity. In this way this integrative measure is applicable also to smaller companies, which due to the liability of their smaller size are unable to perform some open innovation activities (e.g. venturing). That smaller firms are not active in the venturing aspect of open innovation, however, does not mean they are closed to other innovation activities. The proclivity for open innovation scale was developed and validated in a cross-country study by Rangus et al. (2013). We apply this

measure in a large sample of companies from three countries to disentangle the relative importance of a particular open innovation dimension to an organisation's innovation performance. Understanding contributions of individual open innovation dimensions is important in implementing effective decision making processes in organisations, specifically by CEOs in those organisations who compete in dynamic business environments in which the innovation imperative is even more important (Zhou et al., 2005).

Moreover, we cluster analyse the companies in the sample to obtain information on the frequency with which firms from each cluster pursue different open innovation dimensions. The aim of the cluster analysis is to identify different modes of open innovation – that is, to ascertain different combinations of open innovation dimensions that may be related to specific firm size and/or industry. Identification of different modes of open innovation may be of a great help for managers who are at the beginning of the implementation of open innovation and do not know which dimension to stimulate first or how to combine different open innovation activities. In the term open innovation "mode", we refer to a recognisable pattern of open innovation activities of a firm, and we identify the following modes: open innovators, systems engineering companies, R&D outsourcers, and customer oriented. With the description of the representative company for each open innovation mode, managers may identify with one of the presented companies and may more easily define the focus of their open innovation strategy.

Our third contribution is in providing a comprehensive overview of how different open innovation activities are implemented in companies. By having firms cluster analysed, we select a representative company for each cluster and provide rich information based on a structured interview performed in the company describing how and why the company has strategically orientated towards a particular open innovation dimension. In so doing we are able to emphasise how such open innovation orientation in particular enhances innovation performance. In addition we classify companies according to their score on innovation performance and compare the best-scoring 25% of companies to the worst-scoring 25% with an aim to understand if implementation of more open innovation dimensions leads to superior innovation performance. Finally, based on the results of the analyses and additional interviews with CEOs, we are able to provide guidelines for successful implementation of open innovation that acknowledges the human centredness of open innovation processes.

This study provides theoretical and empirical grounds for addressing fundamental questions in open innovation literature, such as: How do different dimensions of open innovation influence innovation performance? Do different modes of open innovation exist? How can different open innovation dimensions be implemented? Are companies that are highly intense on all open innovation dimensions superior innovators? In providing such answers, we are able to address pressing questions in business practice, such as, "Which open innovation dimensions should be stimulated the most" and "how do leaders effectively implement open innovation process within their organisations".

3.2 Open innovation and a firm's innovation performance

Although existing research of open innovation is prevalently limited to qualitative studies, more empirical studies have recently emerged. The focus of prior empirical research is twofold. One group of open innovation studies aims to analyse relationships between individual dimensions of open innovation and a firm's innovation performance, while several other studies cluster analysed firms regarding their open innovation intensity. Unfortunately, emerging findings from these two streams of open innovation research have not been integrated in order to understand how separate open innovation dimensions and clusters of open innovation companies are associated with a firm's innovation performance. For example, Laursen and Salter (2006) findings based on the U.K. innovation survey suggested a curvilinear relationship between external search breadth and external search depth and innovation performance. In another study on a sample of 141 companies from three countries, Inauen and Schenker-Wicki (2011) showed that openness of the outside-in process positively influences a firm's innovation performance; in particular, collaboration with customers and universities positively influences product innovations, while openness towards suppliers, competitors, and universities impacts process innovations. However, only a few studies have considered the multidimensionality of a firm's open innovation process. In their study van de Vrande and colleagues (2009) cluster analysed 605 companies from Netherlands into three clusters regarding their intensity on several dimensions of open innovation to find three distinct clusters of companies. The first (and the smallest) cluster of companies was high on all open innovation dimensions; the second cluster of companies was intense on open innovation activities associated with employee and customer involvement and external networking; and the third cluster of companies implemented solely customer involvement dimension. These authors have not analysed the relationship between open innovation dimensions and innovation performance, however, nor have they provided evidence on the relationship between the clusters and innovation performance. Similarly, Schroll and Mild (2011) cluster analysed 180 European companies into groups based on their inbound open innovation cooperation, acquisition, and outbound open innovation. Although the authors observed different dimensions of open innovation, the study mainly pointed to the dynamics of adoption of inbound and outbound open innovation activities across European companies without implying how open innovation may impact their innovation performance. To the best of our knowledge, only one study has established a link between open innovation dimensions and a firm's innovation performance. Lazzarotti et al. (2010) examined different models for opening up the innovation process, taking into consideration partner variety (the number and type of partners with whom the company collaborates) and phase variety (the number and type of phases of the innovation process open to external collaborations). They identified four groups of companies: open innovators, who cooperate with a wide set of partners in many phases of the innovation process; specialised collaborators, who open only a small part of the innovation process to a wide variety of partners; integrated collaborators, who cooperate with a limited set of partners along the whole innovation funnel; and closed innovators, who open a very small part of the innovation funnel to a very limited set of partners. Additionally, these

authors analysed the relation between the two open innovation dimensions and a firm's innovation performance to find that open innovators had superior innovation performance as compared to companies in the other three groups. According to the authors, their findings need to be interpreted with caution and are not representative of open innovation phenomenon as a whole because they are based on a small sample of 99 companies analysing one specific dimension of open innovation.

In summary, prior research of open innovation has lacked empirical evidence of how particular open innovation dimensions impact a firm's innovation performance. Moreover, existing literature does not provide suggestions how different open innovation activities can be effectively implemented by taking into account the human centredness of open innovation. Below we build theory to support our arguments about relationships between open innovation dimensions and a firm's innovation performance.

3.2.1 Different dimensions of open innovation

First, to establish particular relationships between open innovation dimensions and a firm's performance, we summarise existing open innovation literature that suggests that open innovation involves two important facets – inbound and outbound and several activities associated with either of the two.

Open innovation consists of two parts: the first one indicates that firms should open up to leverage the discoveries of others, and the second part stresses the importance of sharing internal knowledge and technology with external partners (Chesbrough, 2006b). Inbound open innovation can be acquired with open innovation dimensions, such as external participation, inward IP licensing, external networking, outsourcing R&D, and customer involvement; in contrast, outbound open innovation can be realised through outward IP licensing, employee involvement, and venturing activities (van de Vrande et al., 2009). Table 13 presents different open innovation dimensions; their definitions, benefits, and organisational practices that firms can use in order to integrate them into the overall innovation strategy; and an example from business practice.

Table 13. Description of open innovation activities, their benefits and organisational practices

Open innovation activities and their definitions provided by van de Vrande et al. (2009, p. 428)	**Practices of incorporation**	**Benefits**	**Example**
External participation: Equity investments in new or established enterprises in order to gain access to their knowledge or to obtain other synergies.	• Joint ventures or other similar types of non-equity alliances (Maula et al., 2006).	• Provides specific interdisciplinary knowledge and capabilities (Santamaría et al., 2009) and information about potential new technologies. • Facilitates the development of complementary innovations (Maula et al., 2006). • Can help companies to deal with technological uncertainty (van de Vrande et al., 2006). • Joint ventures positively influence patent results, since the high level of formalisation provides highly detailed contracts difficult to obtain in more informal relationships (Santamaría et al., 2009).	Bio-pharmaceutical firms ally with another company (a biotech firm or, more frequently, a large pharmaceutical company) to gain access to complementary resources (e.g., production capacity or distribution channels) needed to commercially exploit a new drug (Bianchi et al., 2011).
Inward IP licensing: Buying or using intellectual property, such as patents, copyrights or trademarks, of other organisations to benefit from external knowledge.	• Buying or licensing external IP (Chesbrough, 2003b). • Defining formal, systematic ways of searching for external technology (Chesbrough & Crowther, 2006).	• Helps gain already verified technologies that can facilitate the development of more complex products (Tao & Magnotta, 2006). • Often faster and cheaper to look outside for the supplementary technology than to develop it in-house (Chesbrough & Crowther, 2006).	Nokia generally outsourced products outside its core business – for example they bought network elements from SCI, Flextronics Finland, and Elcoteq Networks Oyj because there were no economies of scale for Nokia to produce it by itself, and other firms produced them much more efficiently (Dittrich & Duysters, 2007).

(table continues)

(continued)

Open innovation activities and their definitions provided by van de Vrande et al. (2009, p. 428)	**Practices of incorporation**	**Benefits**	**Example**
External networking: Drawing on or collaborating with external network partners to support innovation processes, for example for external knowledge or human capital.	• Collaboration with individual inventors, high-tech start-ups, academic institutions, spin-offs of large firms (Chesbrough, 2006b), consultancies (Tether & Tajar, 2008), potential competitors (Bergman et al., 2009; Maula et al., 2006).	• Openness to external sources enables firms to reach ideas, knowledge, and technology from the outside and therein exploit new innovative opportunities that positively influences a firm's innovation performance (Laursen & Salter, 2006). • By integrating different partners in innovation processes, organisation gains new creativity and know-how (Schroll & Mild, 2011).	P&G pursues several ways of collaborating with different partners. The company organises events to showcase its most promising technologies and provide a place for its partners, researchers and suppliers to meet; various Internet-based systems facilitate communications and connections, sharing data and information among thousands of innovators, researchers, and users across the globe (Dodgson et al., 2006). Moreover, P&G collaborates with different innovation intermediaries, such as InnoCentive, Yet2.com, and NineSigma (Dodgson, Gann & Salter, 2005).
Outsourcing R&D: Buying R&D services from other organisations, such as universities, public research organisations, commercial engineers or suppliers.	• Collaboration, informal interaction, and discussions between researchers (Fabrizio, 2006) and first-rate individual scientists from other labs worldwide (Chesbrough, 2003b). • Financial support, mentorship, and interaction with PhD students (Chesbrough, 2006b; Rohrbeck et al., 2009).	• Cooperation with research organisations plays an important role in fostering innovation process (Perkmann & Walsh, 2007). It enables organisations to access new technological and scientific capabilities through specialised and expert knowledge of scientists (Bishop et al., 2011).	Deutsche Telekom collaborates with a university through T-Labs, a University–Industry Research Centre where more than 80 post-doctoral researchers and over 100 Deutsche Telekom employees work on technology and customer-driven innovation. Researchers' informal networks enable Deutsche Telekom to access the worldwide R&D community and latest technological trends (Rohrbeck et al., 2009).

(table continues)

(continued)

Open innovation activities and their definitions provided by van de Vrande et al. (2009, p. 428)	**Practices of incorporation**	**Benefits**	**Example**
Customer involvement: Directly involving customers in your innovation processes, for example, by active market research to check their needs, or by developing products based on customers' specifications or modifications of products similar to yours.	• Creation of user innovation community in which users can post, discuss, and review each other's business ideas (Di Gangi & Wasko, 2009). • Developing products based on customers' specifications (van de Vrande et al., 2009). • Providing users toolkits for the development and testing of prototypes (von Hippel & Katz, 2002).	• Customer involvement can be of a great help when searching for innovative ideas about new or improved products and services, since customers seek products or services that better address their needs (Chesbrough, 2003b).	Dell created an online community named Dell IdeaStorm through which users can collaborate with Dell to create or modify new products and services and share their innovative ideas, which are later reviewed, discussed, and voted upon by the user community (Di Gangi & Wasko, 2009). Lego established a platform by which users can co-create, co-design, and, in the end, also buy their unique models and designs (Piller & Ihl, 2009).
Employee involvement: Leveraging the knowledge and initiatives of employees who are not involved in R&D by taking up suggestions, enabling them to implement ideas, or creating autonomous teams to realise innovations.	• Establishing R&D structures that support effective communications among unrelated groups in the company (Dodgson et al., 2006). • Giving rotational assignments to employees (O'Connor, 2005). • Educating the researchers about the business side of innovation and rewarding them for identifying patentable ideas within and outside the firm (Chesbrough, 2003b).	• Employee involvement facilitates creation of innovative ideas about new or improved products/services (van de Vrande et al., 2009) and can bring in useful technology from outside the firm (Chesbrough, 2003b). • Giving rotational assignments require interaction with external partners and collaboration across divisions within the organisation, which enable the sharing and borrowing of ideas (O'Connor, 2005).	According to Whelan, Parise, De Valk and Aalbers (2011), each open innovator should have (as Google has) ideas scouts who have broad external networks and the ability to identify potential ideas outside the company, as well as idea connectors who have a strong internal connection and the ability to understand and translate external information to fit internal needs and capabilities.

(table continues)

(continued)

Open innovation activities and their definitions provided by van de Vrande et al. (2009, p. 428)	**Practices of incorporation**	**Benefits**	**Example**
Outward IP licensing: Selling or offering licenses or royalty agreements to other organisations to better profit from organisational IP, such as patents, copyrights or trademarks.	• Outbound licensing of IP, patent pooling, and even giving away technology that stimulates demand for other firms' products (West & Gallagher, 2006a).	• Companies can gain additional effects by exploiting their internally generated technologies outside the firm (Gassmann, 2006); this approach maximises the returns of internal innovation (West & Gallagher, 2006a).	In the past Qualcomm manufactured cellular phones and software products, but today it focuses on licensing out its code division multiple access (CDMA) technology and associated chipsets to other cell-phone manufacturers, including Motorola and Nokia (Chesbrough, 2003a).
Venturing: Starting up new organisations, drawing on internal knowledge, and possibly also with finance, human capital and other support services from your enterprise.	• Creation of spin-off companies (Gassmann & Enkel, 2004). • Pursuing new businesses in new industries related to a company's current business or entering new businesses by offering new lines and products (Zahra, 1993).	• Venturing helps organisations to enter new markets and industries (Block & MacMillan, 1995), reach information about future technologies and market opportunities (Chesbrough, 2003b), and provide potential opportunity for innovation breakthrough.	Deutsche Telekom created two spin-out firms Qiro and Zimory (financed by external seed capital as well as corporate venture capital from Deutsche Telekom) that are developing technology close to its existing business but do not fit well in its innovation strategy (Rohrbeck et al., 2009).

These open innovation activities are integrated in the proclivity for open innovation measure that we use in our empirical analysis. Below we develop arguments indicating why and how a particular open innovation dimension is related to innovation performance.

3.2.2 The influence of the separate dimension of proclivity for open innovation on firm's innovation performance

Existing research provides overall support for the argument that there is a relationship between inbound and outbound open innovation activities and innovation performance (e.g. Chesbrough, 2003b; Chesbrough & Crowther, 2006). This strong support is evident because inbound open innovation enables firms to reach external sources of knowledge and technology, which facilitate internal innovation processes; on the other hand, outbound open innovation generates additional value in the innovation by reaching external channels to market outside the traditional business of the firm (Chesbrough, 2006b). Therefore, open innovation may be denoted as one part of a firm's dynamic capability, of a "firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (Teece et al., 1997, p. 516).

Given the overall support for the relationship between open innovation and innovation performance, we develop arguments for specific relationships among open innovation dimensions: outsourcing R&D and external networking, customer involvement, inward IP licensing and external participation, employee involvement, and venturing and innovation performance.

3.2.2.1 External networking

Organisations that rely upon a greater number of external search channels have a superior capability to sustain exchanges and collaborations with external partners. This approach facilitates the gain and exploitation of innovative opportunities available to them, which positively influences the firm's innovation performance (Laursen & Salter, 2006). The overall positive effect of external networks on innovation has been also shown by Inauen and Schenker-Wicki (2011). Among resources in the networks, creativity, fresh ideas on product innovation, and know-how to implement such innovations (Schroll & Mild, 2011) significantly contribute to market push innovations (Nijhof et al., 2002).

3.2.2.2 Outsourcing R&D

In collaborating with universities, companies also gain new technological and scientific capabilities that are accessible through specialised and expertise knowledge of scientists (Bishop et al., 2011). Prior literature has suggested a positive relationship between a firm's innovation performance and its technological and scientific capabilities (Fabrizio, 2006). We propose:

H1: There is a direct positive relationship between outsourcing R&D and external networking and innovation performance of a firm.

3.2.2.3 Customer involvement

Customer involvement was in prior research shown to positively affect a firm's innovation performance (Inauen & Schenker-Wicki, 2011). This positive impact emerged from customers' expressing their needs, which can be a great source of innovative ideas for new products and services and for continuously improving existing ones (Chesbrough, 2003b). The involvement of costumers in innovation process can be direct, such as by developing products based on their specifications (van de Vrande et al., 2009), or indirect, such as by equipping costumers with toolkits for the development and testing of prototypes so that they can improve prototypes until the products match their requirements (von Hippel & Katz, 2002). The innovative engagement of customers is longstanding and evolving, and some of their creations may be attractive also to other customers (Prugl & Schreier, 2006). The case of 3M shows that the innovations developed by customers have delivered sales 8 times higher than innovations developed in the traditional manner (Von Hippel, 2005). This evidence leads us to propose:

H2: There is a direct positive relationship between customer involvement and innovation performance of a firm.

3.2.2.4 External participation and inward IP licensing

Formalised relationships among companies, such as joint ventures, positively influence patent results (Santamaría et al., 2009). In case of complex innovation process, specific interdisciplinary knowledge and capabilities are required, which are hard to gain through market-based resources and are therefore attained through more heterogeneous alliances, for example non-equity alliances with more than one type of partner (Santamaría et al., 2009). In addition IP in-licensing enables the focal firm to lower costs of development and time and therein gain already verified technologies that enable the development of more sophisticated products (Tao & Magnotta, 2006). Based on this evidence we hypothesise:

H3: There is a direct positive relationship between external participation and inward IP licensing and innovation performance of a firm.

3.2.2.5 Employee involvement

Innovation process can be stimulated via employee involvement, exploiting the knowledge and ideas of employees who are not involved in the R&D activities (van de Vrande et al., 2009). Employees can facilitate new innovations via internal collaboration among divisions that facilitates sharing and borrowing of ideas (O'Connor, 2005). Another approach to employee involvement is their stimulation of searching for patentable ideas in and outside the organisation (Chesbrough, 2003b). Highly competent employees have greater absorptive capacities and superior abilities to transfer perceptions inside the company, and in this way they facilitate innovation activities (Knudsen, 2007). We hypothesise:

H4: There is a direct positive relationship between employee involvement and innovation performance of a firm.

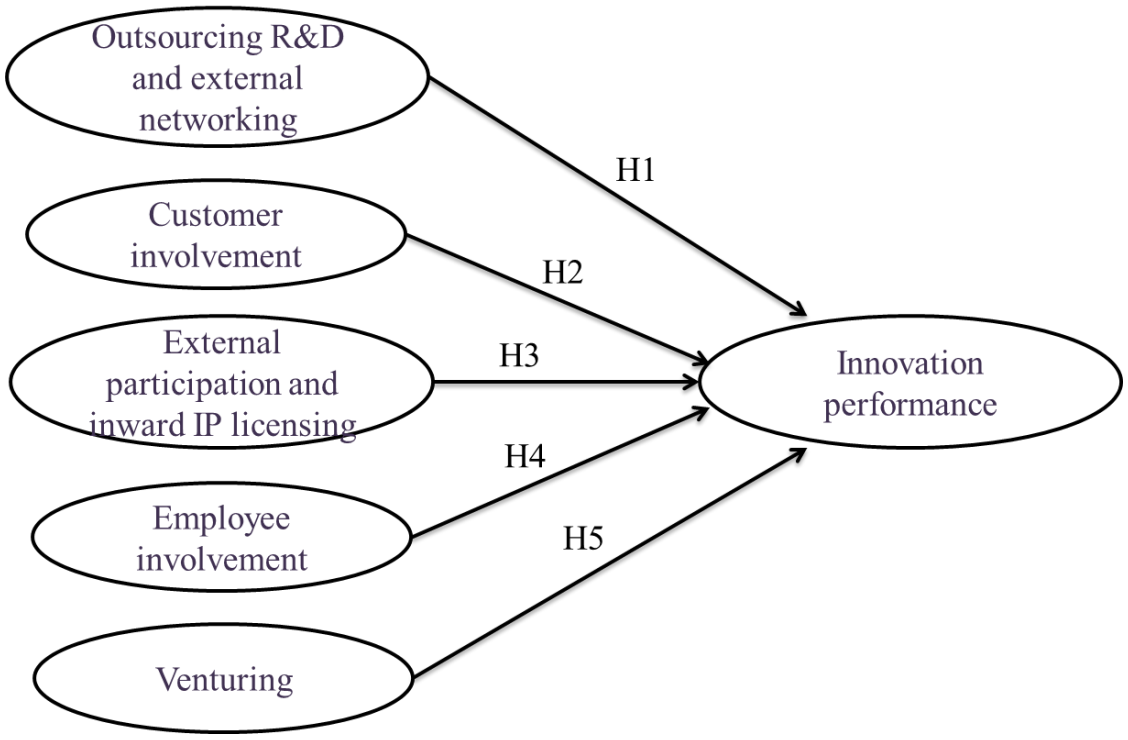
3.2.2.6 Venturing

Internal technological capabilities can be commercialised with venturing (van de Vrande et al., 2009) that helps organisations to enter new markets and industries (Block & MacMillan, 1995) and reach information about imminent technologies and market prospects (Chesbrough, 2003b). In these ways, organisations provide potential opportunities for innovation breakthrough. We anticipate:

H5: There is a direct positive relationship between venturing and innovation performance of a firm.

The hypothesised relations come together in the model presented in Figure 6.

Figure 6. The hypothesised relations between open innovation dimensions and firms's innovation performance



3.3 Methodology and data analysis

3.3.1 Sampling and data collection

The data for the empirical study were gathered via online surveys administered to CEOs of Italian, Slovenian, and Belgian companies. A random sample of 1250 Italian companies was compiled from the Amadeus database in October 2012, the random sample of 2000 Slovenian manufacturing and service firms was compiled in May 2013 from the PIRS database, and 1500 Belgian companies were randomly selected from the BELFirst database in June 2013. We received 99 valid responses in Italy (7.9% response rate), 421 valid responses in Slovenia (21.1% response rate), and 173 valid responses in Belgium (11.5% response rate). The total sample was thus comprised of 693 companies from three countries. The sample included different firm's sizes and a wide range of industries (the majority belonging to manufacturing, information and communication, and service activities). Regarding the industries, the companies in the sample were equally distributed across the countries, but there was a significant difference regarding firm size across the countries. The percentage of Slovenian micro and small companies was higher that the percentage of these companies from Belgium and Italy (comparing to the total sample from each country). On the other side Italian and Belgian samples had higher percentages of medium and large companies compared to Slovenian sample. The samples regarding firm sizes are not equal to the distribution of total population in the separate country; the representation of micro companies in the selected

countries is much higher. When selecting our sample we set the minimum limit of the number of employees to five, with an aim to minimise the chance of inclusion of dormant firms. On the other hand, our sample provides more equal representation of companies, which enables comparison among the groups (regarding firm size).

3.3.2 Measures

3.3.2.1 Independent variables

We measured proclivity for open innovation dimensions: inward IP licensing and external participation, outsourcing R&D and external networking, customer involvement, employee involvement, and venturing with a Proclivity for open innovation measure developed by Rangus et al. (2013). All responses were evaluated on a 7-point Likert scale (e.g. 1 = *strongly disagree*; 7 = *strongly agree*). To validate the dimensionality of the measure, we conducted CFA using Lisrel 8.80 and checked for their internal consistency using Cronbach's alphas (calculated using IBM SPSS Statistics 20). Due to low standardised loadings, we excluded four items from further analysis. The excluded items were: (a) "To ensure successful development of new products/services, we usually buy the IP of other companies", which belongs to factor Inward IP licensing and external participation; (b and c) "In order to acquire new knowhow/technology, we cooperate with consultancy companies" and "In order to acquire new knowhow/technology, we cooperate with competitors", both of which belong to factor Outsourcing R&D and external networking; and (d) "Members of our staff include idea seekers who look for potentially useful knowhow/technologies outside the company", which belongs to factor Employee involvement. Cronbach's alphas of the five dimensions ranged between 0.77 and 0.86 and were consistent with the previous research of Rangus et al. (2013) that reported the range of Cronbach's alphas from 0.78 to 0.88 for Slovenian sample and from 0.76 to 0.88 for Italian sample.

3.3.2.2 Dependent variable

Innovation performance was measured with Jiménez-Jiménez and Sanz-Valle (2011) measure. The measure asks respondents to evaluate various aspects of a firm's innovation performance against the major competitors in the industry in the last 3 years on a 7-point Likert scale ranging from *much worse than competitors* to *much better than competitors*. The construct exhibited high internal consistency with the Cronbach's alpha of 0.91.

We reduced the data and built the final dimensions constituting the components for regression and cluster analyses using summated scales. We also checked for the potential high correlation between the dimensions using correlation analysis, whereas no correlation exceeded the value of 0.5.

3.3.3 Data analyses

The regression analysis and cluster analysis were performed using IBM SPSS Statistics 20. We evaluated the relationship between a specific dimension of proclivity for open innovation and a firm's innovation performance using linear regression analysis. Hierarchical technique (using Ward's method and squared Euclidian distances) was initially used in cluster analysis to help us determine initial solutions on the number of clusters and starting points (i.e., cluster seeds for the non-hierarchical cluster analysis). We performed k-means for a range of initial suggestions by the hierarchical technique, taking into account four, five, and six cluster solution. The final decision for the four cluster solution was made following the suggestions provided by Hair et al. (2010). We performed ANOVA test, which supported the significant differences across the clusters between the variables that presented bases for the cluster analysis (Table 14). In addition, significant differences across the clusters were found on firm size (Kruskal–Wallis test = 31.59; $p < 0.001$); on the other hand, the differences related to firm industry were non-significant (Chi-Square = 18.63; $p = 0.116$). Figure 7 and Figure 8 present graphical demonstration of the clusters and their performance of the individual dimension.

Table 14. Final cluster centres (Mean values) and ANOVA test

	Open innovators (n = 242)	Solution implementers (n = 212)	R&D outsourcers (n = 139)	Customer orientated (n = 100)	*F*
Inward IP licensing and external participation	5.79	4.99	4.32	3.01	225.43
Outsourcing R&D and external networking	4.10	2.04	3.58	1.96	313.56
Customer involvement	6.15	5.77	4.32	4.73	136.54
Employee involvement	5.79	5.60	4.66	4.12	94.63
Venturing	6.08	5.55	5.35	3.39	220.40

Note. Significant at $p < 0.001$

Figure 7. Graphical demonstration of the clusters and their performance of the individual dimension

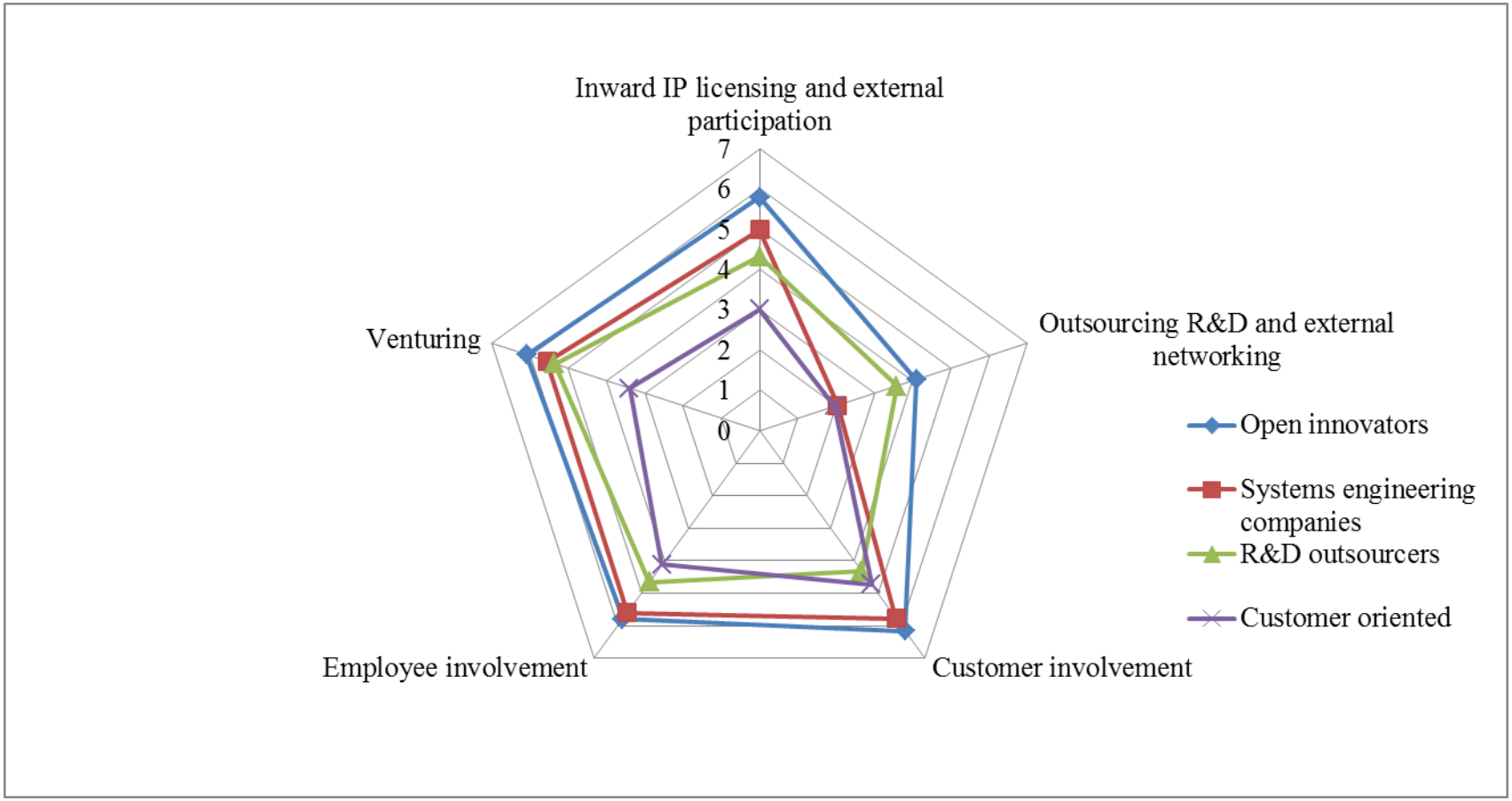
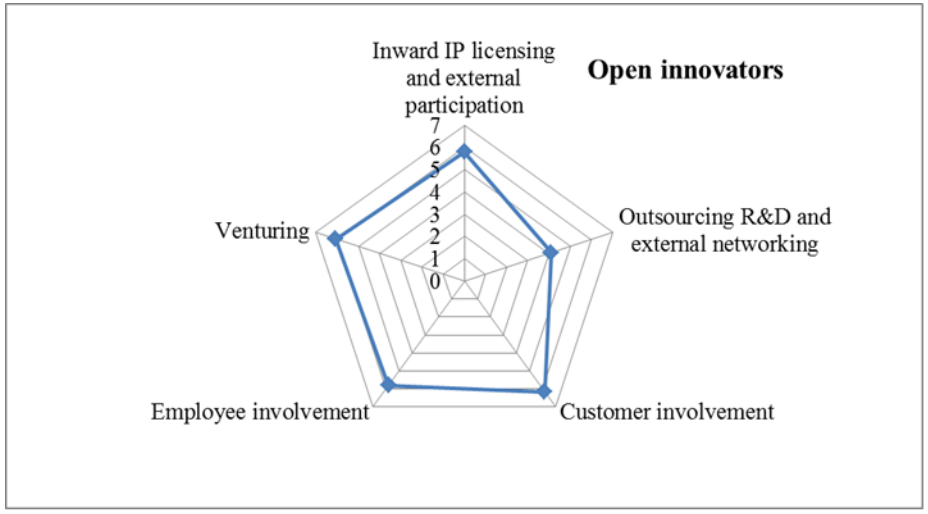
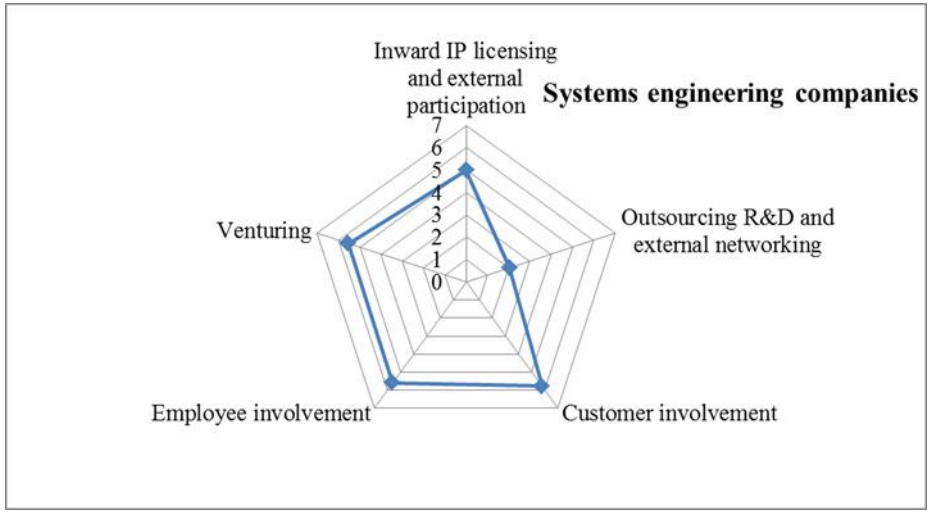
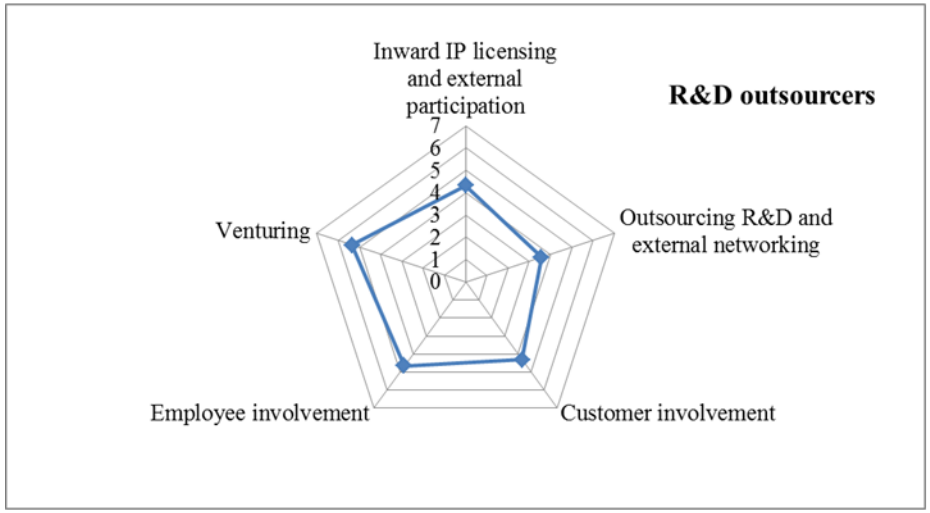
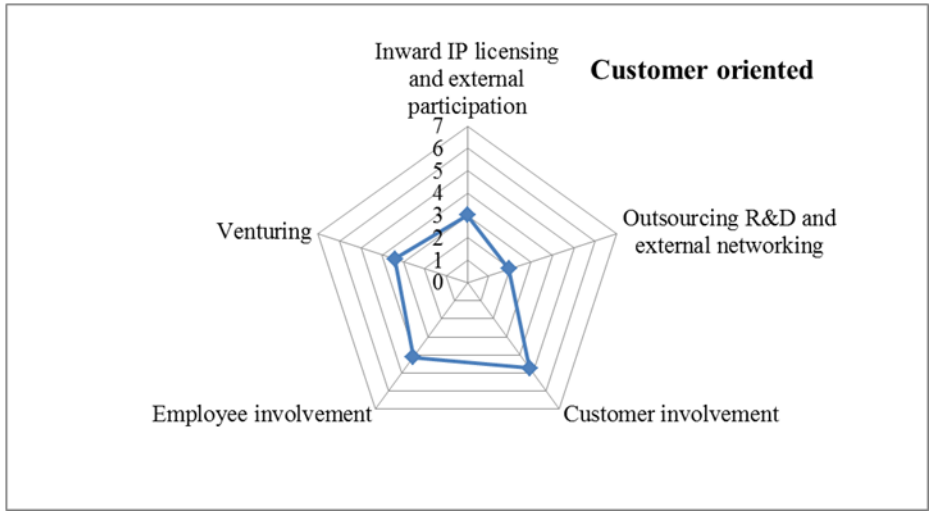


Figure 8. Graphical demonstration of the clusters and their performance of the individual dimension (separate presentation)







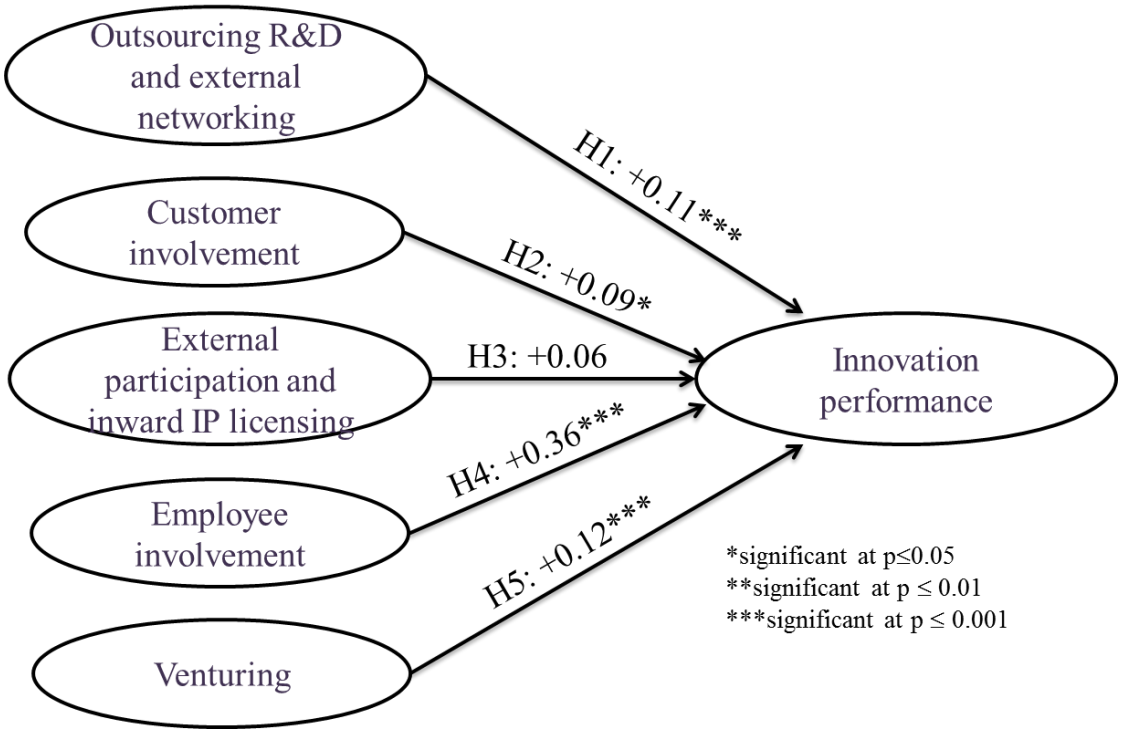


3.4 Results

3.4.1 Results of the regression analysis

The results of the regression analysis (presented in Figure 9) supported the hypotheses with the following impacts: outsourcing R&D and external networking (β = +0.11, $p < 0.001$), customer involvement (β = +0.09, $p < 0.05$), employee involvement (β = +0.36, $p < 0.001$), and venturing (β = +0.12, $p < 0.001$), with exception of Hypothesis 3 that proposed a positive relationship between inward IP licensing and external participation and a firm's innovation performance (the relationship was positive but not significant). The results of the regression analysis exhibited the strongest relationship between employee involvement and a firm's innovation performance (β = +0.364, $p < 0.001$).

Figure 9. Results of the hypothesised relations



3.4.2 Results of the cluster analysis

Results of the cluster analysis suggest that most companies are involved with at least one dimension of proclivity for open innovation, which denotes a more general strategic orientation among practitioners to open their innovation processes. Our first cluster includes the largest group (comprised of 242 companies) with the highest percentage of large companies (compared to other three clusters) that are highly intense in all aspects of open innovation; we labelled this first cluster as "open innovators". A representative company from

this cluster is a large company that develops measures and test solutions to improve the quality of products and processes for the manufacturing and service industry.

The second cluster comprises a group of 212 companies involved in most open innovation activities with exception of the outsourcing R&D and external networking dimension. Many companies in this cluster implement solutions on B2B markets that are developed for large customers; we labelled this second cluster as "systems engineering companies". The companies in the cluster tend to be smaller as compared to companies in first and third clusters. An example of a company from this cluster is a small firm developing off-the-shelf and custom-designed digital television solutions.

The dominant characteristic of the third cluster is inclination of companies in the cluster to intensely involve in outsourcing R&D and external networking dimension; we labelled this third cluster as "R&D outsourcers". This group is more intense on other dimensions as compared to Cluster 4 but less intense as compared to Cluster 2. This third cluster includes 139 companies with a higher percentage of medium-sized companies than in other clusters. A representative company in the cluster has very well developed R&D activities, but also others such as design, quality control, testing and analysis and consulting.

The smallest cluster consists of companies that are the least inclined to most open innovation activities. These companies only involve in co-operation with their customers as far as open innovation activities are concerned. This fourth cluster includes 100 companies (mostly micro to small sized), and we labelled it as "customer oriented". An example is a micro company that is specified on the development and production of consumer goods.

With the aim of finding out why companies choose different combinations of open innovation activities and how effective they are in implementing selected open innovation dimensions, we collected additional qualitative data from the companies. Several semi-structured interviews were conducted with CEOs of companies in each cluster. The goal of the interviews was to obtain deeper understanding of why companies opt to use a specific open innovation dimension, how they perform it, and what the benefits and potential barriers are related to these activities.

The insights from the interviews are presented in Table 15 and discussed in the discussion part.

Table 15. Description of representative companies for each cluster and their open innovation practice

CLUSTER NAME and CASE DESCRIPTION	DEFINITION OF OPEN INNOVATION and ITS BENEFITS	DESCRIPTION OF OPEN INNOVATION PRACTICE
OPEN INNOVATORS Large company that develops measures and test solutions to improve the quality of products and processes for the manufacturing and service industry. It is a family company established in 1968 with the aim of creating in home territory – and delivering to the world – an entrepreneurial model for work and knowledge development. The mission of the company is "to integrate ideas, people, technologies to transform data into values. Transforming data into values is our commitment towards our interlocutors – clients, collaborators, suppliers, partners – with the aim of improving ourselves, of going beyond the limits and facing new challenges."	To share and discuss your ideas with several external partners. Gain additional knowledge and information on the topic, develop your idea, and in this way assess the potential of the idea. During the development process, you can produce some spillovers that are not in the focus of the company and are offered to other firms for further development, which is again a part of open innovation. Openness nourishes the ongoing search for depth, new knowledge, will to change, innovation. Openness enhances the creation of new businesses and the development of new technologies, facilitating relations and the creation of international excellence networks with which to design future markets and technology applications.	They state: "We are an open company, open to young people and to long experienced ones, to customers, suppliers, competitors, to the scientific and public community." Most projects in the company are performed in collaboration with different partners. In their view: "the network is the main source of opportunity and development. As an old saying reads 'alone you can go faster but together you can go further'." Their first network is comprised of internal employees called 'intra-preneurs' that are every day sharing their knowledge and projects inside the company. The second one is comprised of spin-off companies, ex-collaborators leaving the companies and becoming entrepreneurs (82 companies in 43 years employing about 300 people on the territory). They collaborate with faculties, institutions, clients, partners, suppliers and with the territory. For example they have a special project in which they host and train students; in another project, they created a multidisciplinary network of several universities and research centres with an aim to develop scientific competences and applied research. They are part of multidisciplinary network of several organisations with an aim to stimulate the technological transfer among different sectors. They also created network of retired people (such as ex-collaborators, clients, suppliers, and partners) who transfer their experience to young people. Their projects are customer orientated and customised to meet the customers' requirements. They integrate the best internal and external competences and technologies and build with customers and partners long term relations for mutual development.

(table continues)

(continued)

CLUSTER NAME and CASE DESCRIPTION	DEFINITION OF OPEN INNOVATION and ITS BENEFITS	DESCRIPTION OF OPEN INNOVATION PRACTICE
SYSTEMS ENGINEERING COMPANIES Small company developing off-the-shelf and custom-designed digital television solutions. Their new solution enables system providers to integrate their services according to customer needs and create unique business models for the operators. "The new integration project proves our ability to make our applications accessible to a wide range of devices", said the CEO of the company about their newly established collaboration, who added: "The new strategic alliance is allowing us to move into new markets based on a strong technology partnership."	Open innovation is a kind of initiative that gathers companies around some innovation topics to communicate openly about what they are doing from an innovation standpoint and potentially develop some joint projects. The main benefits are related to boosting creativity and innovation in the company, gaining new and fresh ideas, achieving faster time to market, and sharing the development costs.	The company mainly collaborates with other companies from start-ups to multinationals, depending on the solution they are developing. Since their main product is software, it cannot stand and be sold alone; therefore, they search for potential partners, team up with them, and jointly develop the complete system. In this way they share their knowledge and technology with other partners to provide the most convenient final solution, which is jointly brought on the market. They have been also participating in and initiating the creation of an independent research institute for new start-up firms that enables joint creation and development of new technologies. Additionally, the community stimulates students to develop their business ideas. One of the aims of the institute is to boost local economy. The main reason for rare collaboration with knowledge institutions lies in the nature of their business and market pressure. The technological turbulence in their sector is enormous, so they strive to be as quick as possible on the market and mostly focus on development. On the other hand, knowledge institutions mostly provide the research part of the "R&D", and this part takes time before the results are seen (in form of income). But they are aware of the importance of the research, which brings new perspectives of preliminary and emerging technologies. Unfortunately, the market pressure is so strong that they often forget about it. However, they often collaborate with students in internships, by providing mentorships, and by facilitating equipment for students' research. After the internship/research programme, they often employ these students.

(table continues)

(continued)

CLUSTER NAME and CASE DESCRIPTION	DEFINITION OF OPEN INNOVATION and ITS BENEFITS	DESCRIPTION OF OPEN INNOVATION PRACTICE
R&D OUTSOURCERS Company that primarily deals with research and development but has additional activities such as design, quality control, testing and analysis, and consulting. The mission of this company has always been to create a link between academic circles and the industry. The basic activity of the company has always been directed towards integral treatment of the problems, continuously adapting to the needs of the practice.	To open up in the process of product and service development. It means that the company collaborates with various partners with an aim to access the knowledge and expertise missing internally.	The company collaborates with different partners, from researchers to companies and consultancies, with an aim to access the knowledge that they miss internally but is essential to the process of solution development. This process often demands involvement of multidisciplinary teams that consequently lead to collaboration with various (internal and external) partners in one project. The company does not have a predefined partner list; instead, the selection of the partners depends on the knowledge they are looking for. They look for partners that are competent, educated, and experienced in the specified domain. This company collaborates with knowledge institutions in two ways: • collaboration with institutes to test their products (to match the regulative requirements); • collaboration with institutes, faculties, universities and companies, when developing technological innovations or improvements in the production process. External partners provide research on the technological features and solutions for new products or improved processes. Additionally, the company collaborates with various faculties in two ways: • co-mentorships in bachelor or Master's degree programs; • provision of a 1 month student practice. The aim of the practice is to present to the students the main activities of the company and acquaint them with the practical sector characteristics. The outstanding and the most interested students can be later also employed in the company. The benefits of student practices are twofold: • knowledge sharing and development of potential employees; • increased training for current employees in their presentation skills, which are crucial in their relationship with clients.

(table continues)

(continued)

CLUSTER NAME and CASE DESCRIPTION	DEFINITION OF OPEN INNOVATION and ITS BENEFITS	DESCRIPTION OF OPEN INNOVATION PRACTICE
CUSTOMER ORIENTED Micro company focused on the development and production of consumer goods. The idea for the product came out of totally different firm activity: from the strawberry cultivation in 1993 to the bottle that improves the structure of water in 2009. The director said, "I really enjoy doing something that makes other people's lives better. This feeling gets even better since we help people to take care of the environment as well."	Are not familiar with the concept of open innovation. The main benefit of collaboration with customers are: • direct feedback on the product, • customer loyalty, and • brand building. Customers who like one brand are willing to help this brand (even for free); to reveal their ideas of improved or new products/services; to spread good words and (unconsciously) promote the brand.	The beginnings of the development of their main product base on customer involvement. The director produced one sample of the potential product and tested it on the potential customers. Based on their feedback, the final product was created. Moreover, in the design process one of the designers created a special design for the product for its own use. The director liked the idea so much that he asked the designer to create some additional designs, which turned out to be a good idea because the sales subsequently increased threefold. This experienced showed that it is not all about the functionality of the product; the design matters, too. Therefore, they decided to include a broader audience in the product design. They issued a public call for the product design; promoted the call among students of design schools, individuals, suppliers, customers and users; and received several new ideas. Moreover, they included broader public when searching for ideas on how to use leftovers of material used for the product. The response was again excellent, and they received and implemented some of the ideas of how to "recycle" the material. In addition, they provide an option for personalised products for customers who strive for uniqueness and speciality. They used the Christmas season as an opportune time to test their new potential product (out of their assortment of products). They were giving away this product as a Christmas gift and in this way collected responses and feedbacks on the product.

Note. All the data in the table were collected through interviews and from the web pages of the companies.

3.4.3 The relationship between open innovation mode and innovation performance

To evaluate whether meaningful differences exist among a firm's innovation performance in different clusters, we further analysed innovation performance of the companies. We ranked companies in the total sample according to their scores on innovation performance and compared the best-scoring 25% companies with the worst-scoring 25%, taking into consideration their performance on the open innovation dimensions, cluster membership, and firm's size and activity. We performed a *t* test for the evaluation of the differences between the performance of dimensions, a Mann-Whitney U test for comparison of firms' sizes, and crosstabs for cluster memberships and firms' activities. The results (in Table 16 and Table 17) exhibit significant differences between the two performance groups on intensity of involvement with specific dimension (at $p < 0.001$), firm size (at $p < 0.05$), and cluster membership and firm industry (at $p \leq 0.001$). The top 25% companies are more likely to be in service sector, are highly intense on all dimensions of open innovation, are in general larger in size, and are very likely to be grouped in either the first or the second cluster. These results provide support for the argument that companies that thrive in innovation performance tend to be open in all dimensions of open innovation.

Table 16. Mean, standard deviation and *t* test

	Mean (first 25%)	SD (first 25%)	Mean (last 25%)	SD (last 25%)	*t*-value	*p*-value
Outsourcing R&D and external networking	3.34	1.37	2.70	1.22	4.61	0.000
Customer involvement	5.80	1.08	5.04	1.36	5.76	0.000
External participation and inward IP licensing	5.31	1.36	4.27	1.42	6.95	0.000
Employee involvement	5.93	0.82	4.64	1.29	11.13	0.000
Venturing	5.89	1.13	5.00	1.41	6.50	0.000

Table 17. Results of the Mann-Whitney U and Chi-Square tests

	Mann-Whitney U	Chi-Square	*p*-value
Firm size	13273.50		0.028
Cluster membership		72.49	0.000
Firm industry		17.01	0.001

3.5 Discussion

The aim of our research was to contribute to a deeper understanding of how aspects of open innovation are implemented in companies and how they correlate with a firm's innovation performance. We began with a systematic overview of possible dimensions of open innovation, specific benefits of those dimensions, and through what mechanisms they may impact a firm's innovation performance. In so doing we have aimed to help managers to recognise the rich and abundant opportunities of open innovation, which is comprised of several activities. We continue with regression analysis, underscoring the influence of the individual dimension of open innovation on a firm's innovation performance. Our empirical findings suggest that all open innovation dimensions are positively associated with a firm's innovation performance, with the strongest impact of employee involvement. Since the importance of this dimension was emphasised through interviews as well, we have discussed it in more detail in a separate subsection. In general the findings suggest that stimulating any open innovation dimensions may strengthen a firm's innovation performance. The exception to this finding was the dimension of the inward IP licensing and external participation, which did not turn out to be significant. This result may denote that buying or licensing external technology does not create benefits; firms must have the capabilities to incorporate and turn this technology into innovation opportunities.

Moreover, we cluster analysed a large cross-cultural and cross-industry sample of companies based on their involvement with specific dimensions of open innovation. In so doing we presented different modes of open innovation that may be implemented by firms related to their industry focus and size. Larger companies may opt for the first mode (i.e. opening on all dimensions and performing all open innovation activities), keeping in mind the mission of the company we interviewed: "to integrate ideas, people, technologies to transform data into values. Transforming data into values is our commitment towards our interlocutors – clients, collaborators, suppliers, partners – with the aim of improving ourselves, of going beyond the limits and facing new challenges." Companies that are mostly present on the B2B markets turned out to have the strongest inclination to the second mode (i.e. performing most open innovation activities but excluding outsourcing of R&D). They are aware of the importance of the collaboration with knowledge institutions, but the dynamic business environment and market pressures force them to provide fast solutions, which consequently lead to their focus on the development (at the expense of research). Companies that have a strong focus on R&D and frequently collaborate with knowledge institutions may decide for Mode 3 (R&D outsourcers); and companies that are smaller, focused on consumer goods, and lacking the capabilities to open up on all dimensions may adopt Mode 4 (i.e., strong orientation towards customers and their active involvement in the innovation process).

Overall the results emphasise a general trend among companies to open up their innovation processes and provide further evidence to existing findings in the literature (e.g. Schroll & Mild, 2011; van de Vrande et al., 2009). In particular, our results suggest that the larger the

size of the company, the higher the probability that such company is involved in several aspects of open innovation. Our results support and refine findings of van de Vrande et al. (2009) who suggested that companies more inclined towards closed innovation are likely to be small and to some extent involve customers in their innovation process. Perhaps one of the most relevant observations from our findings is that the more aspects of open innovation in which a firm is involved, the higher probability of that firm's superior innovation performance. Therefore, managers should strive to stimulate as many open innovation activities as possible. As one interviewee in this study said: "It doesn't make any sense to develop technology internally, if external partners do this better and cheaper."

Finally, based on the interviews with CEOs, we are able to provide guidelines for successful implementation of open innovation. An important aspect emphasised by the interviewees is the establishment of the right proportion of external ideas' realisation. One CEO noted that "Each customer has its own wish (and idea of improved product/service) and when striving to satisfy all of them you can find yourself in a circle of constant improvements, which can be costly and time consuming. Instead focusing on promotion, marketing and development you spend precious time for improvements which may in turn often satisfy only a minority of potential customers." Therefore, managers should find a balance between accepted and rejected ideas. We suggest companies develop a system for idea assessment that will show which ideas may bring the anticipated outcome and which do not achieve sufficient benefit (e.g. because of high developmental costs, low demand, etc.). A potential method for evaluation of the ideas is articulated below.

3.5.1 Implications for practitioners: Strategies to effective implementation of open innovation

To better understand pathways towards successful implementation of open innovation and the barriers the company may encounter during the implementation processes, we rely on observations that we gain in an in-depth interview with Ms. Lucia Chierchia, Open Innovation Manager at Electrolux Group. She indicated that the first step in open innovation implementation is the definition of strategic areas for the company, intended not as boundaries for the scouting of solutions but as inspirational material to stimulate the external network of innovators (for the satisfaction of the customers' needs). However, there is a specific concern: "the problem is not to get new ideas, the problem is how to select the best one and decide which to implement and how to implement it." Electrolux navigates this situation by devoting a specialised team of people to constantly evaluate and filter incoming ideas. The process of idea evaluation involves three main criteria for evaluating the feasibility of a specific idea. These criteria include (a) an overall assessment of consumer related opportunity (which describes the additional value of consumers' detailing how Electrolux could deliver this value); (b) business opportunity (which describes the additional value of Electrolux business and the competitiveness of the idea in the existing market, the possibility to patent the idea, and the compliance of the idea with Electrolux's strategy); and (c) alliance

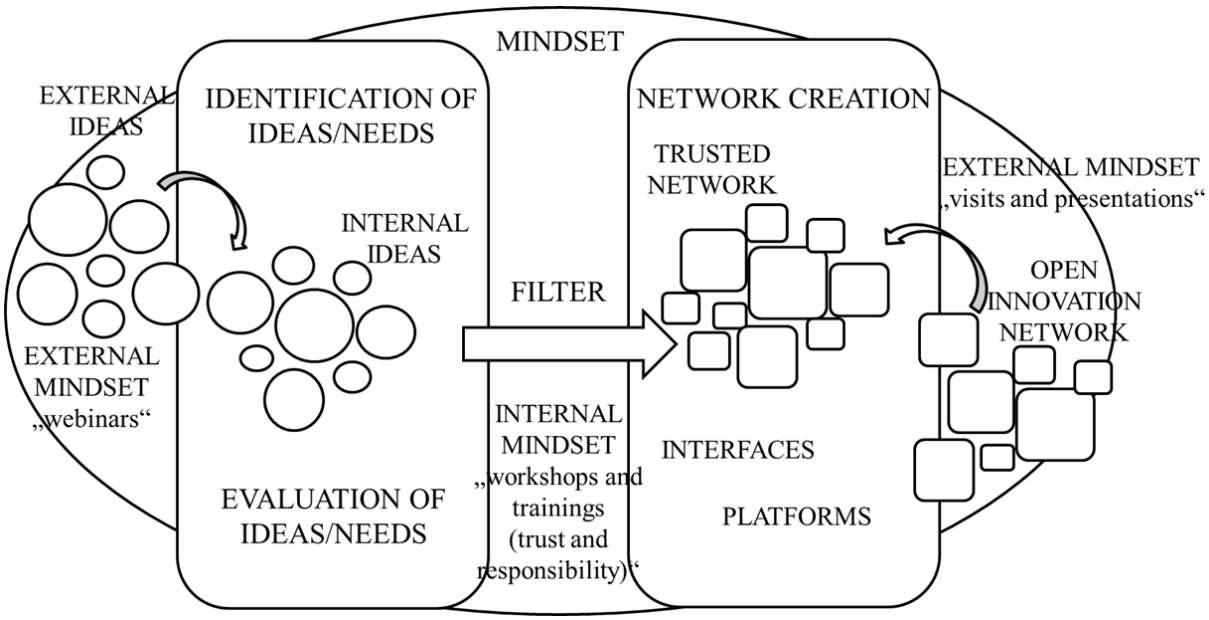
viability (which describes capabilities and resources to build a partnership with external innovators, detailing IP model, alliance model, and capabilities). The open innovation team prepares the document to present summaries of the ideas along with results of the three evaluation criteria. Based on the facts presented in this document, the top management at Electrolux makes the final decision on launching the development of the idea or not.

Lucia Chierchia from Electrolux argues that "the key challenge of open innovation is the creation of synergies between people inside and outside the company". Based on her experiences, the implementation of open innovation should start with the identification of an open innovation network – that is, the network of partners outside the trusted network of the company (i.e., the network of long-standing partnerships with associates they know and trust). Collaboration with the trusted network "is not open innovation, but a normal way of business". So "the challenge is to reach and interact with people/organisations that we don't know; and because we don't know them we cannot trust them. This is open innovation." The network should consist of different partners, including suppliers, customers, companies from different industries, start-ups, universities, research institutes, laboratories, individual researchers and inventors, venture capitals, etc. These partnerships can be established informally by way of a "facial or virtual word of mouth approach" (in Electrolux called interfaces), connecting with new partners through acquaintances or more formally by way of platforms/online communities (such as Nine Sigma, Innocentive, etc.) that can help at identification of the right partner for new product/service development. "The challenge is to put the ideas on innovation every day; to transfer ideas into running projects of a company…but in parallel we need to constantly enlarge and reinforce the open innovation network." However, the grounds for the successful implementation of open innovation are establishment of the open mind-sets of internal and external participants. Hence, the human centredness of open innovation is crucial, and companies need to invest into activities that nurture open mind-sets. The way they grow open innovation mind-sets in Electrolux is through workshops and trainings, motivating employees to overcome the NIH syndrome. Moreover, the NIH syndrome can be softened with the establishment of trust and reliability among employees, giving them space to feel the open innovation and make decisions on their own, refraining from pushing employees into bounded and constrained thinking processes. "Open innovation is a model of interaction among people – is about people. So it is crucial to consider also the psychological part." Another internal constraint is connected to the IP paradigm: "most of the people specifically in R&D are convinced that innovation should be related to patenting…patents are pictures of success." In Electrolux they overcome this barrier with practical examples and successful stories, showing that innovation is not invention, innovation does not require control of IP; instead, innovation is creation of new value for consumers and consequently new value for the company, where the patent can play the role of legal protection or as property that can represent a value to exchange, buy, or license. In addition, they externally promote open innovation mindsets through free webinars for external partners; they are also often invited to other organisations to share their knowledge and experiences on open innovation and explain their ways of implementation. Lucia Chierchia

stressed, “open innovation is today the only way to accelerate innovation. It provides vast number of ideas that can create new businesses, high level of readiness of the solutions from external partners and precious information on (market, technological, etc.) trends.”

To summarise the main steps of successful implementation of open innovation (presented in Figure 10 are (a) to identify potential internal and external ideas for new or improved products/services; (b) to evaluate these ideas based on three criteria (consumer opportunity, business opportunity, alliance viability); (c) to create a network of partners (not only a trusted network but also an open innovation network of new, unknown partners that has to be enlarged all the time); and most important (d) to stimulate open mind-sets internally and externally.

Figure 10. Steps for successful implementation of open innovation



Source: Adapted from Lucia Chierchia, Open Innovation Manager at Electrolux Group, 2014

3.5.2 The importance of the employee involvement

Finally, an important aspect raised in this study is the importance of the employee involvement dimension. This dimension turned to have the most significant relationship with a firm’s innovation performance among the selected open innovation dimensions. Previous studies showed that high performance work practices, which include employee recruitment, incentive compensation, employee involvement, and training, are associated with lower employee turnover, greater productivity, and corporate financial performance (Huselid, 1995). Our study adds to the existing evidence on the importance of employee involvement by displaying their significant influence on innovation performance. Therefore, managers have to dedicate special attention to the development and personal growth of employees. As we have emphasised earlier in the paper, the absorptive capacity of the employees to identify,

integrate, and combine externally acquired knowledge and technology facilitates innovation outcomes. Moreover, the greater the employees' competences, the greater their absorptive capacities (Knudsen, 2007). As denoted in Table 13, competences of employees may be raised by forming rotational assignments through which different interactions internally and externally enhance the sharing and borrowing of ideas (O'Connor, 2005). Employee involvement may be enhanced by establishing and stimulating R&D structures that support effective communications among unrelated groups in the company (Dodgson et al., 2006). Another important aspect is raising awareness, especially among researchers, about the business side of innovation and rewarding them for identifying patentable ideas within as well as outside the firm's boundaries (Chesbrough, 2003b). A company has to stimulate all of its employees, not only those involved in R&D, to elicit their ideas for new or improved products/services and enable them to implement these ideas (van de Vrande et al., 2009). By affording its employees a certain amount of responsibility, decision-making, and freedom, a company may create a more relaxed atmosphere that may in turn lead to fresh, creative ideas and innovations. Organisational cultures that stimulate structural linkages between internal and external participants, open communication, greater degrees of liberty, collaboration, and teamwork will most likely lead to more innovations (Kanter, 1996).

3.5.3 Limitations and future research opportunities

Although the study provided an extensive overview of open innovation and broad evidence of the separate aspects of this phenomenon, it has several limitations. The research was based on the use of cross-sectional data, which limits the understanding of the development and implementation of open innovation over longer periods. Longitudinal data may provide evidence on how this phenomenon may evolve over time. The study included three European countries; however, due to smaller sample sizes in Italy and Belgium, the study joined the three samples into one, not taking into account the specific nation. Encompassing greater international context and distinguishing among countries may provide some additional insights on the evolution of open innovation. The empirical part of this study relates to the use of the measure for a firm's inclination towards open innovation, which enabled the inclusion of smaller companies. On the other hand, the measure does not directly show a firm's open innovation output. The research indicated the importance of the human centredness of open innovation processes; nevertheless, more evidence is needed on this aspect. Therefore, an interesting avenue for future research would be an examination of the competences needed for managers to successful implement and lead the open innovation processes and the abilities of employees to understand the process and its complexities. More evidence is needed on the training of employees (i.e. how to train, motivate employees to overcome the NIH syndrome, to establish the trust) and understanding of the importance of open innovation.

3.6 Conclusion

Our study showed that there are different ways to open up the innovation process. The best way to do so, however, is to stimulate as many open innovation activities as possible. In the words of Lucia Chierchia, “people outside the company are smart, they can provide us with precious clues about consumer, market and technology trends; they can answer better to our needs and can highlight some essentials that we probably haven’t put on the top of the priority list.” The study provided some guidelines on how to implement specific open innovation dimensions and benefits of that implementation. In addition, the results indicated the importance of open mind-sets among leaders, employees, and external partners that have to be stimulated internally and externally. Finally, the study emphasised the significance of employee involvement. Besides the stimulation of the internal development of technology and the search for external resources and collaboration, managers thus have to pay greater attention to the personal development of employees.

GENERAL DISCUSSION AND CONCLUSION

In this chapter the summary of main findings of the doctoral dissertation are presented in relation to the main goals that were outlined in the Introduction. In addition the summaries of implications, limitations, and future research opportunities are discussed.

Summary of main findings

The aim of the dissertation was to contribute to the better understanding of the concept of open innovation by (1) providing a reliable and validated measure of proclivity for open innovation; (2) showing how proclivity for open innovation influences other correlates in the nomological network; and (3) providing broad overview of open innovation activities, the benefits of each of them, their influence on firm's innovation performance, and guidelines for a successful implementation of open innovation that acknowledges human centredness in the process.

In the forthcoming paragraphs, the main findings related to specific research goal are discussed in detail.

Research goal 1: To define the dimensions and their items that compose the construct of proclivity for open innovation.

Based on the in-depth literature review of open innovation, we generated the initial pool of potential proclivity for open innovation items. We identified eight potential open innovation proclivity dimensions (external participation, inward IP licensing, outsourcing R&D, external networking, customer involvement, employee involvement, venturing, and outward IP licensing) with 121 potential corresponding items.

Research goal 2: To conceptualise and operationalise the construct of proclivity for open innovation.

In proposing the conceptualisation of proclivity for open innovation, we took into consideration the multidimensional nature of the construct. Based on the existing literature and empirical research, we extended Hung and Chiang's (2010) definition of open innovation proclivity and proposed that proclivity for open innovation denotes a firm's predisposition to perform different open innovation activities, such as external participation, inward IP licensing, external networking, outsourcing R&D, customer involvement, employee involvement, venturing, and outward IP licensing. We further operationalised the measure of proclivity for open innovation by providing the revision of the initial item pool of potential proclivity for open innovation items by experts in the field from different professions. From the academic perspective we interviewed professors and PhD students who were active researchers in the field of open innovation, whereas the business side was captured through

interviews with the directors of consultancy firms consulting in the field of open innovation and representatives of supporting environment. Drawing revisions from this range of expertise enabled us to capture different observations of the proclivity for open innovation. The interviews with entrepreneurs enabled us to corroborate the understanding, variability, and comprehension of the questionnaire. Moreover we discussed the list of potential items with 16 experts from nine countries. Steps of scale development process described above enabled us to maximise the content validity of the measure.

Research goal 3: To ensure the reliability and validity of the measure of proclivity for open innovation.

For the empirical evaluation of the new measure, we prepared a survey instrument following Dillman, Smyth, and Christian's (2009) tailored design method. Since the survey was conducted in two countries, we first translated the questionnaire from English to the Slovene language and then back-translated into English. Before conducting the final analysis, we pilot tested the survey instrument with an aim to evaluate the performance of the individual item as suggested by DeVellis (2003). Based on this step we excluded additional 10 items. We conducted an online survey among Slovenian manufacturing and service firms (which were randomly selected from the PIRS database) in September 2012. We received 340 responses (17% response rate). Since the sample was sufficiently large, we randomly split it into two subsamples. The dimensionality was assessed using EFA on the first half of the sample, which resulted in a six-factor solution with 30 variables. Moreover, we performed CFA on the second half of the sample and excluded 4 variables due to low or insignificant loadings. In the next step we checked for the reliability and convergent and discriminant validity of the measure. The reliability of the scale was supported since Cronbach's alphas of the model were all above the threshold of 0.7 (Hair et al., 2010) and ranged from 0.783 to 0.882. The results in general supported the convergent validity, as AVEs ranged between 0.424 and 0.689 and discriminant validity comparing the AVEs of the factors and the shared variance between the factors. The overall results from the psychometric evaluation supported the construct validity and suggested that proclivity for open innovation is a second-order construct composed of six factors (inward IP licensing and external participation, outsourcing R&D and external networking, customer involvement, employee involvement, venturing and outward IP licensing) with 26 corresponding items.

Research goal 4: To support the generalisability of the new measure of proclivity for open innovation.

To provide the generalisability of the measure, we conducted an online survey among Italian firms in October 2012. The questionnaire was sent to top executives of 1250 firms as randomly selected from the Amadeus database. We received 101 responses (8% response rate). The validation results on the Italian sample generally supported the proposed factorial structure. Wherein, the sixth factor (i.e., "outward IP licensing") and four variables from other

factors were not supported. The results on the Italian sample in general also supported the reliability and convergent and discriminant validity of the construct proclivity for open innovation. The results on the Italian sample suggested that proclivity for open innovation is a five-factor construct with 22 corresponding items. The scale was also used in the second survey (which was the basis for the results presented in Chapter 2 and Chapter 3) conducted on a new sample of Slovenian firms and a sample of companies from Belgium. The results from both samples in general supported the five-factor solution of the measure with the deviations of some items. Therefore, we accomplished the fourth goal by supporting the measure of proclivity for open innovation on four samples from distinct economies.

Research goal 5: To determine the relationship between proclivity for open innovation, absorptive capacity and a firm's innovation performance.

The fifth goal was accomplished with the research presented in Chapter 2. Based on the resource-based view and the dynamic capabilities perspective, we conceptualised and empirically tested a model of a firm's innovation performance and its determinants: proclivity for open innovation and absorptive capacity. Based on the literature review, we hypothesised that proclivity for open innovation directly influences a firm's innovation performance and absorptive capacity, that absorptive capacity directly impacts innovation performance, and consequently that absorptive capacity mediates the relationship between proclivity for open innovation and a firm's innovation performance. To test the proposed model we developed a survey instrument that included validated scales of proclivity for open innovation, absorptive capacity, a firm's innovation performance, and technological turbulence (control variable). We conducted an online survey among Slovenian companies in May 2013 and received 421 responses (21.1% response rate). We collected data from a wide range of industries (the majority from manufacturing, information and communication, and services). Before testing for the hypothesised relationships, we checked for the reliability and convergent and discriminant validity of the constructs. We performed three tests for checking for the mediation effect of absorptive capacity: step-by-step inclusion of the paths to assess the best fitting model; the Sobel, Aronian, and Goodman tests; and the steps recommended by Baron and Kenny (1986). All three tests supported the proposition that absorptive capacity mediates the relationship between proclivity for open innovation and firm's innovation performance.

Research goal 6: To provide the evidence on the connectedness of separate dimension of open innovation with a firm's innovation performance.

The sixth goal was addressed in the third chapter based on a large sample of companies from three countries. We joined the Italian sample from the first research with the Slovenian sample from the second research and added a sample of companies from Belgium. The survey instrument was in June 2013 sent to 1500 Belgian companies randomly selected from the BELFirst database, and we received 173 valid responses (11.5% response rate). The total sample was thus comprised of 693 companies. The sample included different firms' sizes and

a wide range of industries. Using regression analysis, we evaluated the impact of the individual dimension of open innovation on a firm's innovation performance. The results showed the positive influence of all open innovation dimensions on a firm's innovation performance (outsourcing R&D and external networking: $\beta = +0.11$, $p < 0.001$; customer involvement: $\beta = +0.09$, $p < 0.05$; employee involvement: $\beta = +0.36$, $p < 0.001$; venturing: $\beta = +0.12$, $p < 0.001$). The influence of the inward IP licensing and external participation dimensions, however, was not significant. The results suggested that the strongest influence on the innovation performance among selected dimensions retains the employee involvement open innovation dimension.

Research goal 7: To indicate different modes of open innovation.

The next step of our research in the third chapter was a cluster analysis of the large sample of companies from the three countries based on their performance of specific dimension of open innovation. In this way we presented different modes of open innovation (i.e. different combinations of open innovation activities). The first mode labelled open innovators denoted that firms in this group are inclined to perform all open innovation activities. Companies in this group were in general larger. The second group of companies mostly involved in B2B market presented the second mode, named systems engineering companies. These companies are strongly involved in all open innovation activities except outsourcing of R&D. We labelled the third open innovation mode outsourcers of R&D. Companies in this group frequently collaborate with knowledge institutions. The fourth group, mostly composed of smaller companies, focused on consumer goods present the fourth mode (i.e. customer oriented). These companies actively involve their customers in the open innovation process but are rarely involved in other open innovation activities.

Research goal 8: To describe how different open innovation dimensions be implemented.

The third chapter begins with a systematic overview of open innovation dimensions and their definitions, benefits, and the organisational practices that firms can use in order to integrate them into the overall innovation strategy and an example from business practice. Additional description of how distinct open innovation dimension may be implemented is provided in the second part of the research in Chapter 3, where we provided the representation of a company from each cluster. The overall guidelines on how to successfully implement open innovation processes are provided at the end of this research, where we discuss the lessons learned through the interviews with CEOs. We identified four fundamental steps required for successful implementation of open innovation. The first step relates to the identification of potential ideas for new or improved products/services inside and outside organisation; the second step is connected to the evaluation of these ideas based on the three criteria (consumer opportunity, business opportunity, alliance viability); the third step is a creation of networks with different partners, which may help to develop the idea into innovation; and the fourth step is the stimulation of the open mind-sets internally and externally.

Research goal 9: To denote the human centredness of open innovation process.

Although the general goal of open innovation is increased innovation outcome, the successful implementation of open innovation processes is strongly related to the human aspects. This was emphasised in our third research among the suggestions for successful implementation of open innovation. Based on the interviews with CEOs, we learned that the fundamental step in open innovation implementation is the open mind-set of internal and external participants. Therefore, companies need to invest into activities that nurture open mind-sets (e.g. through different workshops and trainings, motivating employees to overcome the NIH syndrome and constraints related to the IP paradigm). Moreover, the results of the regression analysis indicated the strong influence of employee involvement on a firm's innovation performance. Thus managers have to stimulate and enable all employees to raise their ideas and dedicate special attention to the development and personal growth of employees. The existing research indicated that high performance work practices, which include employee recruitment, incentive compensation, employee involvement and training positively influence productivity and corporate financial performance (Huselid, 1995). Our study adds to the existing evidence on the importance of the employee involvement by displaying their significant influence on innovation performance. Based on the literature review and structured interviews we provide some practical ways of how to stimulate employee involvement in firm's innovation processes.

Summary of main implications

The doctoral dissertation contributes to the theoretical and empirical work on open innovation as well as to business practice as follows.

Theoretical implications

The first theoretical implication relates to the conceptualisation and empirical validation of the proclivity for open innovation measure. Although research related to the concept of open innovation has been growing rapidly, the construct that would incorporate the multidimensional nature of open innovation had not yet been conceptualised nor empirically validated. Therefore, by identifying and integrating the dimensions of open innovation from the existing literature into a coherent construct of proclivity for open innovation and by empirically validating the construct on four cross-cultural samples, we have provided the basis for future programmatic research on open innovation. Moreover, we contribute to the body of theoretical and empirical work by showing how different dimensions of open innovation are interrelated. Based on the results we revealed that external participation dimension and inward IP licensing dimension build one facet of open innovation. Similarly the activities of outsourcing R&D and external networking joined into one dimension. In addition, in line with the existing empirical work, we found that technology exploration and technology exploitation are different facets of one open innovation activity with the shared

goal of improved organisational performance. In so doing we expand the existing literature on open innovation, first by showing which organisational activities are at the heart of open innovation, second by developing and empirically validating the measure of proclivity for open innovation, and third by revealing how different dimensions of open innovation are interrelated. These findings significantly contribute to the work on open innovation because they provide understanding of mechanisms and their interconnectedness that inform the concept of open innovation. Moreover, by providing the empirically validated measure of proclivity for open innovation that can be used in different geographical settings, organisational environments, and industries, we facilitate better foundations for future quantitative research on open innovation.

The second theoretical implication relates to the theoretically derived contingency model of proclivity for open innovation, absorptive capacity, and the firm's innovation performance. By setting the concept of proclivity for open innovation into a nomological network with other organisational correlates, we show their interplay in influencing a firm's innovation performance. Our study differentiates from others by taking into consideration the multidimensionality of the constructs of proclivity for open innovation and absorptive capacity. Ours is one of the few studies related to open innovation that is based on a large empirical dataset and uses multivariate data analysis techniques. Existing studies have not yet well defined or researched the mechanisms that explain the relationship between open innovation and other important organisational correlates (Huizingh, 2011). Thus, we contribute to the work on open innovation by showing how proclivity for open innovation operates with other organisational correlates in impacting a firm's innovation performance. We contribute to the theory of absorptive capacity by providing evidence on the antecedents of this capability, which in existing research is poorly represented (Jansen et al., 2005). Moreover, we contribute to a resource-based view by supporting the importance attached to internal resources in achieving superior innovation performance, especially in the form of employee involvement. Our research revealed that involving the employees in the innovation process (e.g. leveraging the knowledge of employees who are not involved in R&D activities and their collaboration across divisions) positively influences innovation performance. Moreover, in line with the proposition of the extended resource-based view, our results supported the importance of network resources in achieving and maintaining a firm's competitive position. We showed that proclivity for open innovation – which assumes firms to be embedded in different networks, collaborate with different partners and, in this way, leverage their knowledge and technology – positively influences a firm's innovation performance. Finally, by setting different dynamic capabilities in a nomological network and showing how they jointly influence a firm's innovation performance, we contribute to the dynamic capabilities framework. Most prior studies on dynamic capabilities used longitudinal and qualitative research with an aim of theory building (C. L. Wang & Ahmed, 2007), an approach that did not reveal how distinct dynamic capabilities function in combination with each other (Ambrosini & Bowman, 2009). Thus, by showing how firms should direct their capabilities to benefit from them, we complement existing literature on dynamic capabilities.

Our study emphasises the significance of the interactions of organisational capabilities in achieving superior innovation performance.

The third theoretical implication relates to our integrative perspective of open innovation and provision of a comprehensive overview of open innovation activities. We provide a systematic description of the multidimensional construct of open innovation and its activities, which were fragmented and dispersed across several studies. We show how different dimensions of open innovation influence a firm's innovation performance, how different modes of open innovation are related to firm's innovation performance and provide suggestions for steps to be followed when implementing open innovation processes by taking into account the human centredness of open innovation. These empirical evidences contribute to the existing literature on open innovation, which lacks the examination of the multidimensional construct of open innovation in its whole and misses the explanation how separate open innovation dimensions and modes of open innovation are associated with a firm's innovation performance. Moreover, the majority of existing studies of open innovation disregard the human side of the open innovation processes, which was explicitly discussed in our third research.

Methodological implications

The dissertation provides several methodological implications. The first one relates to the development and the use of reliable and validated measure of proclivity for open innovation. Evolving theories require development and operationalisations of the constructs of interest which enable theory testing (Netemeyer et al., 2003). Only valid and reliable measures contribute to a field's continued development (Crook, Shook, Madden & Morris, 2010). To our knowledge this is the first study that conceptualised, operationalised and empirically tested open innovation related construct taking into consideration the multidimensional nature of the concept.

Second, by providing a quantitative analysis based on the large empirical dataset we provide methodological implications for work on open innovation and dynamic capabilities, which was previously mostly related to conceptual papers and case study representations with an aim of theory building. By performing structural equation modelling we addressed the call from Huizingh (2011) for research on open innovation based on more complex models (including mediators and/or moderators) which would help to understand larger chain of effects.

Third, we performed the research in three different national settings. The development and empirical validation of the proclivity for open innovation measure was carried out in Slovenia and validated in Italy, the structural equation modelling based on the results from another sample of companies from Slovenia and the third analysis incorporated the results from a sample of companies from Slovenia, Italy and Belgium. Testing the measure on several

samples in different geographical and time contexts contributes to the generalisability of the newly developed scale (Netemeyer et al., 2003). Despite the fact that we were very careful in the conceptualisation and scale development process and the measure of proclivity for open innovation was tested on four samples, additional testing of the scale on distinct samples and geographical settings should be carried out in order to support, reject or complement the dimensions and elements of proclivity for open innovation identified in our study.

Fourth, in the three studies we incorporated and joined qualitative and quantitative research methods. Qualitative methods were used in the first steps of scale development, researching the basis of open innovation in form of in-depth literature review. We searched online bibliographic databases, such as Science Direct, Proquest, EBSCOhost, Emerald Fulltext, and others. Furthermore, all the latest issues of the most important journals in the field of innovation, management and entrepreneurship, such as Technovation, Research Policy, R&D Management, Academy of Management Journal, and others were reviewed. We continued with interviews with several experts in the field of open innovation with an aim of purification of the scale. We carried out interview with several executives of Slovenian companies with the goal of testing the measurement instrument. We incorporated interviews also in the third study with the purpose to clarify and better understand the activities behind the individual open innovation dimension and their benefits. We used quantitative research techniques for testing and validating the measure of proclivity for open innovation, investigating its influence in the nomological network, for identifying the influence of specific open innovation dimension on firm's innovation performance and for clustering the companies according to their performance of different open innovation activities. We employed descriptive statistics, correlations analyses, ANOVA, reliability tests, exploratory factor analysis, confirmatory factor analysis, structural equation modelling, regression analysis and cluster analysis.

Practical implications

Besides theoretical and methodological implications, the dissertation provides also several implications for business practice.

First, by identifying and defining main dimensions and elements of proclivity for open innovation we help managers to identify the possibilities they have for exploitation of internal resources and exploration of the knowledge and technology from the outside. We also describe different ways of implementing distinct open innovation activities; therefore, managers can assess and decide which activities are best for their business. Our study stresses the importance of developing several open innovation dimensions and not focusing just on one. We demonstrate that mixture of all open innovation dimensions positively influences firm's innovation performance. The notion that combining several open innovation dimensions brings success is evident also from the business practice. For example, the multinational company Deutsche Telekom successfully boosted its innovation capability by

incorporating several open innovation activities, such as networking, customer involvement and external participation (Rohrbeck et al., 2009). Similarly, Nokia in the late 20th century dealt with a changing technological environment by integrating distinct open innovation activities (such as networking, outsourcing R&D and inward IP licensing) in the process of product development and pursuing strategic alliances with an aim to enter new markets (Dittrich & Duysters, 2007). Hence, managers should strive to develop all open innovation activities, since greater openness provides more opportunities for new product/service development and entrance to new markets.

Second, our study shows the importance of networks, which facilitates access to the resources of others. We demonstrate that relationships with different partners (in association with other open innovation dimensions) positively influence firm's innovation performance. The importance of collaboration with different partners is for example evident in the bio-pharmaceutical industry where firms establish relationships with different types of partners, from large pharmaceutical companies, to product biotech firms and universities depending on the goal they are pursuing; to acquire or to commercially exploit knowledge and technology (Bianchi et al., 2011). Third, the dissertation emphasises the role of interconnectedness of firm's capabilities. The study shows that the proclivity for open innovation has superior influence on firm's innovation performance when also other organisational capabilities are triggered. In specifics, the positive effects of the opening up of innovation process is enhanced when firm possess the absorptive capacity, i.e. the capability to modify and connect newly acquired knowledge with existing one. Therefore, managers should take into consideration which capability to stimulate, since it can consequently positively or negatively influences the others.

Fourth, the comprehensive overview of the open innovation and its dimensions may help managers to realise the fertility and abundant opportunities that this phenomenon offers. By indicating the influence of a particular open innovation dimension on a firm's innovation performance and by showing different modes of open innovation we may help managers at the decision which open innovation dimension should be stimulated the most. However, the results suggested that the more open innovation activities firm performs, the higher the chance of superior innovation performance. Therefore, managers should try to encourage as much open innovation activities as possible. Moreover, by providing steps for successful implementation of open innovation we help managers to understand how to effectively implement open innovation processes within their organisations. Finally, our research emphasised the importance of the human centredness and employee involvement; managers should pay greater attention to the development of open mind-sets inside and outside organisation and to the personal development and active involvement of employees. Employee involvement may be stimulated by forming rotational assignments through which different interactions internally and externally enhance the sharing and borrowing of ideas (O'Connor, 2005) or by establishing and stimulating R&D structures that support effective communications among unrelated groups in the company (Dodgson et al., 2006). Moreover,

companies should educate researchers about the business side of innovation as well as reward them for identifying patentable ideas within and outside the firm (Chesbrough, 2003b). Companies should strive to foster a relaxed atmosphere (e.g. giving employees a certain amount of responsibility, decision-making, and liberty), which may facilitate new and fresh ideas. Stimulating structural relationships between internal and external environments, open communication, greater freedom, cooperation, and teamwork will most likely contribute to more innovations (Kanter, 1996).

Summary of limitations and future research opportunities

As with any study, also this dissertation has several limitations, which can in turn open avenues for future research.

The first set of limitations and future research avenues relates to the development of the proclivity for open innovation construct. The scale was conceptualised and developed with precision, and the research included all the steps recommended for the scale development process. However, future analysis should further test the proposed list of proclivity for open innovation items and refine the measure. The next limitation concerns the data collection process, since the data were collected based on the questionnaire filled in by single respondent per company which can present the problem of common method variance. Though, we minimised this problem already in the process of research design with the interviews and pre-tests of the measure. Moreover, the measure was tested on four samples from different countries. Since there were some differences in the validation of the measure among the samples, future research should test the measure in other organisational and ecological settings. The analysis provided the cross-sectional data on firms' proclivity for open innovation. However, some organisational features may change on the long run; therefore, forthcoming research should deliver the data incorporating greater time period. The study also misses the nomological validity that would show how the construct behaves in a network of relationships exposed by theory. This in turn presented opportunity for our second research that investigated the relations between proclivity for open innovation, absorptive capacity and firm's innovation performance.

The second research supported the nomological validity of the proclivity for open innovation and showed that absorptive capacity mediates the relationship between proclivity for open innovation and firm's innovation performance. However, the research based on a single sample from Slovenia, therefore the model should also be tested in other national contexts. Again the data were cross-sectional, so future research grounded on longitudinal data can provide additional insights about the causalities in hypothesised relationships. Forthcoming research should test other mediating and moderating effects on the relation between proclivity for open innovation and firm's innovation performance, such as organisational culture and structure which according to the theory strongly relates to all of the constructs set in our nomological network. On the other hand, firm's pro-activeness may have a potential

moderating role. Finally, the successful implementation of open innovation strongly depends also on the individuals (top management as well as employees) of the firm. Consequently, an interesting avenue for future research would be examination of the influence of employees' readiness for change on firm's proclivity for open innovation. In addition, empirical evidence (e.g. Di Minin et al., 2010; Huston & Sakkab, 2006) showed how important the visionary leaders are for the implementation of open innovation. Therefore, the multilevel approach with cross-level interactions, such as relation between management style and open innovation could show which managerial characteristics play a vital role at implementing and integrating distinct open innovation activities.

The limitations of the third research are again related to the use of the cross-sectional data. Longitudinal data may provide additional evidences on the development and implementation of open innovation over time. The second limitation of the third study relates to the uniting the samples from three countries into one. Incorporating broader set of countries and distinguishing among nations may provide some additional insights of the international evolution of open innovation. This may also enable the comparison and examination of the differences among the countries. The research indicated the importance of the human centredness of open innovation process; nevertheless more evidence is needed on this aspect. Therefore, an interesting opportunity for future studies is to provide evidence on the competences needed for managers to successful implement and lead the open innovation processes on one side, and the abilities that are needed on the employees' side to understand the comprehension and complexities behind these processes. The results showed that an important part of the open innovation implementation is the stimulation of the open mind-sets of employees and external partners. Therefore, future studies may examine the ways how to train and motivate employees and partners to feel safe and trusted in an open innovation environment.

Concluding remarks

The importance of open innovation is seen by the growing body of literature and empirical evidence on this subject that has escalated in the last decade. The topic started to evolve from the case studies of famous high-tech multinationals but was soon applied in the SMEs, traditional industries, and the service sector. Therefore, it is essential for managers to understand the mechanisms that lay behind the open innovation and enable a firm's success and consequently social prosperity.

The dissertation exhibits important contributions to the existing literature on open innovation. It provides detailed description of the main open innovation dimensions and their elements and in this way contributes to the better understanding of the complexity of this multidimensional construct. It develops and empirically tests the multidimensional measure of proclivity for open innovation and thus provides the foundations for future programmatic research on open innovation. Moreover, it shows how organisational capabilities influence a

firm's innovation performance and indicates some guidelines for successful implementation of open innovation. However, future studies are needed to provide additional thorough evidence on the mechanisms behind this concept and its connectedness with other correlates in the social sciences and in this way turn the research on open innovation into theory.

REFERENCES

1. Acha, V. (2008). *Open by design: the role of design in open innovation.* Paper presented at the Academy of Management Proceedings, Anaheim.
2. Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes, 50*(2), 179-211.
3. Almirall, E., & Casadesus-Masanell, R. (2010). Open versus closed innovation: A model of discovery and divergence. *Academy of Management Review, 35*(1), 27–47.
4. Ambrosini, V., & Bowman, C. (2009). What are dynamic capabilities and are they a useful construct in strategic management? *International Journal of Management Reviews, 11*(1), 29–49.
5. Antikainen, M., Mäkipää, M., & Ahonen, M. (2010). Motivating and supporting collaboration in open innovation. *European Journal of Innovation Management, 13*(1), 100–119.
6. Antoncic, B., & Hisrich, R. D. (2001). Intrapreneurship: Construct refinement and cross-cultural validation. *Journal of Business Venturing, 16*(5), 495–527.
7. Arndt, M. (2009). Open innovation's secret: It takes a crisis. Retrieved 10.1.2011, from http://www.businessweek.com/innovate/next/archives/2009/12/open_innovation.html
8. Asakawa, K., Nakamura, H., & Sawada, N. (2010). Firms' open innovation policies, laboratories' external collaborations, and laboratories' R&D performance. *R&D Management, 40*(2), 109–123.
9. Aylen, J. (2009). Open versus closed innovation: Development of the wide strip mill for steel in the United States during the 1920s. *R&D Management, 40*(1), 67–80.
10. Bahemia, H., & Squire, B. (2010). A contingent perspective of open innovation in new product development projects. *International Journal of Innovation Management 14*(4), 603–627.
11. Barge-Gil, A. (2010). Open, semi-open and closed innovators: Towards an explanation of degree of openness. *Industry & Innovation, 17*(6), 577–607.
12. Barney, J. B. (1986). Organizational culture: Can it be a source of sustained competitive advantage? *Academy of Management Review, 11*(3), 656–665.
13. Barney, J. B. (1991). Firm resources and sustained competitive advantage. *Journal of Management, 17*(1), 99–120.
14. Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51*(6), 1173–1182.
15. Bergman, J., Jantunen, A. R. I., & Saksa, J.-M. (2009). Enabling open innovation process through interactive methods: Scenarios and group decision support systems. *International Journal of Innovation Management, 13*(1), 139–156.
16. Bianchi, M., Cavaliere, A., Chiaroni, D., Frattini, F., & Chiesa, V. (2011). Organisational modes for open innovation in the bio-pharmaceutical industry: An exploratory analysis. *Technovation, 31*(1), 22–33.
17. Bishop, K., D`Este, P., & Neely, A. (2011). Gaining from interactions with universities: Multiple methods for nurturing absorptive capacity. *Research Policy, 40*(1), 30–40.

18. Block, Z., & MacMillan, I. (1995). *Corporate Venturing: Creating New Businesses Within the Firm*. Boston: Harvard Business Press.
19. Brislin, R. W. (1970). Back-translation for cross-cultural research. *Journal of cross-cultural psychology, 1*(3), 185–216.
20. Buganza, T., & Verganti, R. (2009). Open innovation process to inbound knowledge: Collaboration with universities in four leading firms. *European Journal of Innovation Management, 12*(3), 306–325.
21. Cassiman, B., & Veugelers, R. (2006). In search of complementarity in innovation strategy: Internal R&D and external knowledge acquisition. *Management Science, 52*(1), 68–82. doi: 10.2307/20110484
22. Chen, Y.-S., Lin, M.-J. J., & Chang, C.-H. (2009). The positive effects of relationship learning and absorptive capacity on innovation performance and competitive advantage in industrial markets. *Industrial Marketing Management, 38*(2), 152–158.
23. Chesbrough, H. W. (2003a). The era of open innovation. *MIT Sloan Management Review, 44*(3), 1–9.
24. Chesbrough, H. W. (2003b). *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Boston: Harvard Business Press.
25. Chesbrough, H. W. (2004). Managing open innovation. *Research-Technology Management, 47*(1), 23–26.
26. Chesbrough, H. W. (2006a). New puzzles and new findings. In H. W. Chesbrough, W. Vanhaverbeke & J. West (Eds.), *Open innovation: researching a new paradigm* (pp. 15–34). Oxford: Oxford University Press.
27. Chesbrough, H. W. (2006b). Open innovation: A new paradigm for understanding industrial innovation. In H. W. Chesbrough, W. Vanhaverbeke & J. West (Eds.), *Open innovation: researching a new paradigm* (pp. 1–12). Oxford: Oxford University Press.
28. Chesbrough, H. W. (2007). Why companies should have open business models. *MIT Sloan Management Review, 48*(2), 22–28.
29. Chesbrough, H. W. (2011). The case for open services innovation: The commodity trap. *California Management Review, 53*(3), 5–20.
30. Chesbrough, H. W., & Crowther, A. K. (2006). Beyond high tech: Early adopters of open innovation in other industries. *R&D Management, 36*(3), 229–236.
31. Chesbrough, H. W., & Garman, A. R. (2009). How open innovation can help you cope in lean times. *Harvard business review, 87*(12), 68–76.
32. Chiaroni, D., Chiesa, V., & Frattini, F. (2010). Unravelling the process from closed to open innovation: Evidence from mature, asset-intensive industries. *R&D Management, 40*(3), 222–245.
33. Christensen, J. F. (2006). Whither core competency for the large corporation in an open innovation world? In H. W. Chesbrough, W. Vanhaverbeke & J. West (Eds.), *Open Innovation: Researching a New Paradigm* (pp. 35–61). Oxford: Oxford University Press.
34. Churchill, G. A. (1979). A paradigm for developing better measures of marketing constructs. *Journal of Marketing Research (JMR), 16*(1), 64–73.
35. Cohen, W. M., & Levinthal, D. A. (1989). Innovation and learning: The two faces of R&D. *The Economic Journal, 99*(397), 569–596.
36. Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly, 35*(1), 128–152.
37. Collis, D. J. (1994). Research note: How valuable are organizational capabilities? *Strategic Management Journal, 15*(S1), 143–152.

38. Costello, A. B., & Osborne, J. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Practical Assessment Research & Evaluation, 10*(7), 173–178.
39. Crook, T. R., Shook, C. L., Madden, T. M., & Morris, M. L. (2010). A review of current construct measurement in entrepreneurship. *International Entrepreneurship and Management Journal, 6*(4), 387–398.
40. Cuccureddu, G. (2011). Open innovation is a key enabler of businesses' overall strategies. Retrieved 22nd November, 2013, from http://www.businessinsider.com/open-innovation-is-a-key-enabler-of-businesses-overall-strategies-2011-6
41. Dahlander, L., & Gann, D. M. (2010). How open is innovation? *Research Policy, 39*(6), 699–709.
42. DeVellis, R. F. (2003). *Scale development: Theory and applications*. London: Sage Publications, Inc.
43. Di Gangi, P. M., & Wasko, M. (2009). Steal my idea! Organizational adoption of user innovations from a user innovation community: A case study of Dell IdeaStorm. *Decision Support Systems, 48*(1), 303–312.
44. Di Minin, A., Frattini, F., & Piccaluga, A. (2010). Fiat: Open innovation in a downturn (1993-2003). *California Management Review, 52*(3), 132–159.
45. Dillman, D. A., Smyth, J. D., & Christian, L. M. (2009). *Internet, Mail, and Mixed-Mode Surveys: The Tailored Design Method*. Hoboken: Wiley.
46. Dittrich, K., & Duysters, G. (2007). Networking as a means to strategy change: The case of open innovation in mobile telephony. *Journal of Product Innovation Management, 24*(6), 510–521.
47. Dodgson, M., Gann, D., & Salter, A. (2005). *Think, play, do: Technology and the new innovation process*. Oxford: Oxford University Press.
48. Dodgson, M., Gann, D., & Salter, A. (2006). The role of technology in the shift towards open innovation: The case of Procter & Gamble. *R&D Management, 36*(1), 333–346.
49. European Commission. (2003). Commission Recommendation of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises. *Official Journal of the European Union, L, 124*(36), 2003.
50. European Commission. (2013). The Innovation Union Scoreboard 2013. Retrieved October 1, 2013, from http://ec.europa.eu/enterprise/policies/innovation/files/ius-2013_en.pdf
51. Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: What are they? *Strategic Management Journal, 21*(10-11), 1105–1121.
52. Escribano, A., Fosfuri, A., & Tribó, J. A. (2009). Managing external knowledge flows: The moderating role of absorptive capacity. *Research Policy, 38*(1), 96–105.
53. Fabrizio, K. R. (2006). The use of university research in firm innovation. In H. W. Chesbrough, W. Vanhaverbeke & J. West (Eds.), *Open Innovation: Researching a New Paradigm* (pp. 134–160). Oxford: Oxford University Press.
54. Flatten, T. C., Engelen, A., Zahra, S. A., & Brettel, M. (2011). A measure of absorptive capacity: Scale development and validation. *European Management Journal, 29*(2), 98–116.
55. Fosfuri, A., & Tribó, J. A. (2008). Exploring the antecedents of potential absorptive capacity and its impact on innovation performance. *Omega, 36*(2), 173–187.
56. García-Morales, V. J., Jiménez-Barrionuevo, M. M., & Gutiérrez-Gutiérrez, L. (2012). Transformational leadership influence on organizational performance through

organizational learning and innovation. *Journal of Business Research, 65*(7), 1040–1050.
57. Gassmann, O. (2006). Opening up the innovation process: Towards an agenda. *R&D Management, 36*(3), 223–228.
58. Gassmann, O., & Enkel, E. (2004). *Towards a theory of open innovation: three core process archetypes.* Paper presented at the R&D management conference.
59. George, G., Zahra, S. A., Wheatley, K. K., & Khan, R. (2001). The effects of alliance portfolio characteristics and absorptive capacity on performance: A study of biotechnology firms. *Journal of High Technology Management Research, 12*(2), 205–226.
60. Gerbing, D. W., & Anderson, J. C. (1984). On the meaning of within-factor correlated measurement errors. *Journal of Consumer Research*, 572–580.
61. Graham, S. J. H., & Mowery, D. C. (2006). The use of intellectual property in software: implications for open innovation. In H. W. Chesbrough, W. Vanhaverbeke & J. West (Eds.), *Open Innovation: researching a new paradigm*. Oxford: Oxford University Press.
62. Gronlund, J., Sjodin, D. R., & Frishammar, J. (2010). Open Innovation and the Stage-Gate Process: A revised model for new product development. *California Management Review, 52*(3), 106–131.
63. Gruber, M., & Henkel, J. (2006). New ventures based on open innovation-an empirical analysis of start-up firms in embedded Linux. *International Journal of Technology Management, 33*(4), 356–372.
64. Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2010). *Multivariate Data Analysis: A Global Perspective* (seventh ed.). Upper Saddle River, New Jersey: Pearson Education.
65. Haynes, S. N., Richard, D., & Kubany, E. S. (1995). Content validity in psychological assessment: A functional approach to concepts and methods. *Psychological assessment, 7*(3), 238–247.
66. Herstad, S. J., Bloch, C., Ebersberger, B., & van de Velde, E. (2010). National innovation policy and global open innovation: exploring balances, tradeoffs and complementarities. *Science & Public Policy 37*(2), 113–124.
67. Hofstede, G. H. (2001). *Culture's consequences: Comparing values, behaviors, institutions and organizations across nations*. New Delhi: Sage Publications.
68. Hughes, B., & Wareham, J. (2010). Knowledge arbitrage in global pharma: A synthetic view of absorptive capacity and open innovation. *R&D Management, 40*(3), 324–343.
69. Huizingh, E. K. R. E. (2011). Open innovation: State of the art and future perspectives. *Technovation, 31*(1), 2–9.
70. Hung, K. P., & Chiang, Y. H. (2010). Open innovation proclivity, entrepreneurial orientation, and perceived firm performance. *International Journal of Technology Management, 52*(3), 257–274.
71. Huselid, M. A. (1995). The impact of human resource management practices on turnover, productivity, and corporate financial performance. *Academy of Management Journal, 38*(3), 635–672.
72. Hüsig, S., & Kohn, S. (2011). Open CAI 2.0 - Computer aided innovation in the era of open innovation and Web 2.0. *Computers in Industry, 62*(4), 407–413.
73. Huston, L., & Sakkab, N. (2006). Connect and Develop: Inside Procter & Gamble's new model for innovation. *Harvard Business Review, 84*(3), 58–66.

74. Inauen, M., & Schenker-Wicki, A. (2011). The impact of outside-in open innovation on innovation performance. *European Journal of Innovation Management, 14*(4), 496–520.
75. Inauen, M., & Schenker-Wicki, A. (2012). Fostering radical innovations with open innovation. *European Journal of Innovation Management, 15*(2), 212–231.
76. Jansen, J. J. P., Van Den Bosch, F. A. J., & Volberda, H. W. (2005). Managing potential and realized absorptive capacity: How do organizational antecedents matter? *Academy of Management Journal, 48*(6), 999–1015.
77. Jaworski, B. J., & Kohli, A. K. (1993). Market orientation: Antecedents and consequences. *Journal of marketing*, 53–70.
78. Jiménez-Barrionuevo, M. M., García-Morales, V. J., & Molina, L. M. (2011). Validation of an instrument to measure absorptive capacity. *Technovation, 31*(5–6), 190–202.
79. Jiménez-Jiménez, D., & Sanz-Valle, R. (2011). Innovation, organizational learning, and performance. *Journal of Business Research, 64*(4), 408–417.
80. Kanter, R. M. (1996). When a thousand flowers bloom: Structural, collective, and social conditions for innovation in organizations. In P. S. Myers (Ed.), *Knowledge Management and Organizational Design* (pp. 93–131). Boston: Butterworth-Heinemann.
81. Keizer, J. A., Dijkstra, L., & Halman, J. I. M. (2002). Explaining innovative efforts of SMEs: An exploratory survey among SMEs in the mechanical and electrical engineering sector in The Netherlands. *Technovation, 22*(1), 1-13.
82. Knudsen, L. G. (2007). *Opening the black box of 'open innovation': Organizational practice, employee competences, and knowledgde processes*. Paper presented at the DRUID-DIME Academy Winter PhD Conference on Geography, Innovation and Industrial Dynamics, Aalborg, Denmark.
83. Korsgaard, M. A., & Roberson, L. (1995). Procedural justice in performance evaluation: the role of instrumental and non-instrumental voice in performance appraisal discussions. *Journal of Management, 21*(4), 657–669.
84. Kotabe, M., Jiang, C. X., & Murray, J. Y. (2011). Managerial ties, knowledge acquisition, realized absorptive capacity and new product market performance of emerging multinational companies: A case of China. *Journal of World Business, 46*(2), 166–176.
85. Koufteros, X., Babbar, S., & Kaighobadi, M. (2009). A paradigm for examining second-order factor models employing structural equation modeling. *International Journal of Production Economics, 120*(2), 633–652.
86. Kraft, K. (1990). Are product and process innovations independent of each other? *Applied Economics, 22*(8), 1029–1038.
87. Kutvonen, A. (2011). Strategic application of outbound open innovation. *European Journal of Innovation Management, 14*(4), 460–474.
88. Kyriakopoulos, K., & De Ruyter, K. (2004). Knowledge stocks and information flows in new product development. *Journal of Management Studies, 41*(8), 1469–1498.
89. Lane, P. J., Koka, B. R., & Pathak, S. (2006). The reification of absorptive capacity: A critical review and rejuvenation of the construct. *Academy of Management Review, 31*(4), 833–863.
90. Langvardt, A. W. (2010). Building the pipeline through an "open innovation" strategy and a focus on ethics: An interview with Young-Jin Kim, CEO and Chairman of Handok Pharmaceuticals Co. *Business Horizons, 53*(2), 101–104.

91. Laursen, K., & Salter, A. (2006). Open for innovation: The role of openness in explaining innovation performance among UK manufacturing firms. *Strategic Management Journal, 27*(2), 131–150.
92. Lavie, D. (2006). The competitive advantage of interconnected firms: An extension of the resource-based view. *Academy of Management Review, 31*(3), 638–658.
93. Lazzarotti, V., Manzini, R., & Pellegrini, L. (2010). Open innovation models adopted in practice: An extensive study in Italy. *Measuring Business Excellence, 14*(4), 11–23.
94. Liao, S.-h., Fei, W.-C., & Chen, C.-C. (2007). Knowledge sharing, absorptive capacity, and innovation capability: An empirical study of Taiwan's knowledge-intensive industries. *Journal of Information Science, 33*(3), 340–359.
95. Lichtenthaler, U. (2008). Open innovation in practice: An analysis of strategic approaches to technology transactions. *IEEE Transactions on Engineering Management, 55*(1), 148–157.
96. Lichtenthaler, U. (2009). Outbound open innovation and its effect on firm performance: Examining environmental influences. *R&D Management, 39*(4), 317–330.
97. Lichtenthaler, U. (2011). Open innovation: Past research, current debates, and future directions. *Academy of Management Perspectives, 25*(1), 75–93.
98. Lichtenthaler, U., & Ernst, H. (2009). Opening up the innovation process: The role of technology aggressiveness. *R&D Management, 39*(1), 38–54.
99. Mäkipää, M., Ahonen, M., & Mäntymäki, M. (2006). Developmental steps from closed innovation to open innovation. *Increasing Customer Involvement Through Mass Customization and Customer Co-design. University of Tampere, Tampere*.
100. Maula, M. V. J., Keil, T., & Salmenkaita, J. P. (2006). Open innovation in systemic innovation contexts. In H. W. Chesbrough, W. Vanhaverbeke & J. West (Eds.), *Open Innovation: Researching a New Paradigm* (pp. 241–257). Oxford: Oxford University Press.
101. Murovec, N., & Prodan, I. (2009). Absorptive capacity, its determinants, and influence on innovation output: Cross-cultural validation of the structural model. *Technovation, 29*(12), 859–872.
102. Netemeyer, R. G., Bearden, W. O., & Sharma, S. (2003). *Scaling procedures: Issues and applications*. Thousand Oaks, CA: Sage Publications.
103. Nijhof, A., Krabbendam, K., & Looise, J. (2002). Innovation through exemptions: building upon the existing creativity of employees. *Technovation, 22*(11), 675–683.
104. Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory* (3 ed.). New York: McGraw-Hill.
105. O'Connor, G. C. (2005). Open, radical innovation: Toward an integrated model in large established firms. In H. W. Chesbrough, W. Vanhaverbeke & J. West (Eds.), *Open Innovation: Researching a New Paradigm* (pp. 62–81). Oxford: Oxford University Press.
106. Parida, V., Westerberg, M., & Frishammar, J. (2012). Inbound open innovation activities in high-tech SMEs: The impact on innovation performance. *Journal of Small Business Management, 50*(2), 283–309. doi: 10.1111/j.1540-627X.2012.00354.x
107. Perkmann, M., & Walsh, K. (2007). University-industry relationships and open innovation: Towards a research agenda. *International Journal of Management Reviews, 9*(4), 259–280.
108. Piller, F. T., & Ihl, C. (2009). Open innovation with customers: Foundations, competences and international trends *Trend Study within the BMBF Project—International Monitoring*‖. Aachen: RWTH Aachen University.

109. Piller, F. T., & Walcher, D. (2006). Toolkits for idea competitions: A novel method to integrate users in new product development. *R&D Management, 36*(1), 307–318.
110. Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: a critical review of the literature and recommended remedies. *Journal of Applied Psychology, 88*(5), 879–903.
111. Pontiskoski, E., & Asakawa, K. (2009). Overcoming barriers to open innovation at Apple, Nintendo and Nokia. *International Journal of Social Sciences, 53*(1), 26–31.
112. Prugl, R., & Schreier, M. (2006). Learning from leading-edge customers at The Sims: Opening up the innovation process using toolkits. *R&D Management, 36*(3), 237–250.
113. Rangus, K., Drnovšek, M., & Di Minin, A. (2013). *Proclivity for open innovation: Construct conceptualization and empirical validation.* Paper presented at the Academy of Management, Orlando.
114. Remneland-Wikhamn, B., & Wikhamn, W. (2011). Open innovation climate measure: The introduction of a validated scale. *Creativity and Innovation Management, 20*(4), 284–295.
115. Rohrbeck, R., Holzle, K., & Gemunden, H. G. (2009). Opening up for competitive advantage - How Deutsche Telekom creates an open innovation ecosystem. *R&D Management, 39*(4), 420–430.
116. Rufat-Latre, J., Muller, A., & Jones, D. (2011). What do Apple, IBM and P&G know? How open innovation can help business - and yourself. *Strategic Direction, 27*(3), 29–31.
117. Santamaría, L., Nieto, M. J., & Barge-Gil, A. (2009). Beyond formal R&D: Taking advantage of other sources of innovation in low-and medium-technology industries. *Research Policy, 38*(3), 507–517.
118. Santamaría, L., Nieto, M. J., & Barge-Gil, A. (2010). The relevance of different open innovation strategies for R&D performers. *Asociacion Cientifica de Economia y Direccion de la Empresa (ACEDE), 45*, 93–114.
119. Sarkar, S., & Costa, A. I. A. (2008). Dynamics of open innovation in the food industry. *Trends in Food Science & Technology, 19*(11), 574–580.
120. Schroll, A., & Mild, A. (2011). Open innovation modes and the role of internal R&D: An empirical study on open innovation adoption in Europe. *European Journal of Innovation Management, 14*(4), 475–495.
121. Simard, C., & West, J. (2006). Knowledge networks and the geographic locus of innovation. In H. W. Chesbrough, W. Vanhaverbeke & J. West (Eds.), *Open Innovation: Researching a New Paradigm* (pp. 220–240). Oxford: Oxford University Press.
122. Sorensen, F., Mattsson, J., & Sundbo, J. (2010). Experimental methods in innovation research. *Research Policy, 39*(3), 313–322.
123. Spithoven, A. (2013). Open innovation practices and innovative performances: an international comparative perspective. *International Journal of Technology Management, 62*(1), 1–34.
124. Spithoven, A., Clarysse, B., & Knockaert, M. (2010). Building absorptive capacity to organise inbound open innovation in traditional industries. *Technovation, 30*(2), 130–141.
125. Spithoven, A., Vanhaverbeke, W., & Roijakkers, N. (2013). Open innovation practices in SMEs and large enterprises. *Small Business Economics, 41*(3), 537–562.
126. Tao, J., & Magnotta, V. (2006). How air products and chemicals" identifies and accelerates". *Research-Technology Management, 49*(5), 12–18.

127. Teece, D. J. (2007). Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal, 28*(13), 1319–1350.
128. Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal, 18*(7), 509–533.
129. Teirlinck, P., & Spithoven, A. (2008). The spatial organization of innovation: Open innovation, external knowledge relations and urban structure. *Regional Studies, 42*(5), 689–704.
130. Tether, B. S., & Tajar, A. (2008). Beyond industry-university links: Sourcing knowledge for innovation from consultants, private research organisations and the public science-base. *Research Policy, 37*(6–7), 1079–1095.
131. Tsai, W. (2001). Knowledge transfer in intraorganizational networks: Effects of network position and absorptive capacity on business unit innovation and performance. *Academy of Management Journal, 44*(5), 996–1004.
132. van de Vrande, V. (2006). The importance of internal alignment for open innovation Graham Cross. Retrieved January 5, 2011, from http://www.openinnovation.eu/topic/interviews/
133. van de Vrande, V., de Jong, J. P. J., Vanhaverbeke, W., & de Rochemont, M. (2009). Open innovation in SMEs: Trends, motives and management challenges. *Technovation, 29*(6–7), 423–437.
134. van de Vrande, V., Lemmens, C., & Vanhaverbeke, W. (2006). Choosing governance modes for external technology sourcing. *R&D Management, 36*(1), 347–363.
135. Vanhaverbeke, W. (2006). The inter-organizational context of open innovation. In H. W. Chesbrough, W. Vanhaverbeke & J. West (Eds.), *Open innovation: researching a new paradigm* (pp. 205-219). Oxford: Oxford University Press.
136. Vega-Jurado, J., Gutierrez-Gracia, A., & Fernandez-de-Lucio, I. (2008). Analyzing the determinants of firm's absorptive capacity: Beyond R&D. *R&D Management, 38*(4), 392–405.
137. Verdu, A. J., Tamayo, I., & Ruiz-Moreno, A. (2012). The moderating effect of environmental uncertainty on the relationship between real options and technological innovation in high-tech firms. *Technovation, 32*(9–10), 579–590.
138. von Hippel, E. (1988). *The sources of innovation*. New York: Oxford University Press.
139. Von Hippel, E. (2005). *The democratization of innovation*. England, London: The MIT Press.
140. von Hippel, E., & Katz, R. (2002). Shifting innovation to users via toolkits. *Management science, 48*(7), 821–833.
141. Wallin, M. W., & von Krogh, G. (2010). Organizing for open innovation: Focus on the integration of knowledge. *Organizational Dynamics, 39*(2), 145–154.
142. Wang, C., & Han, Y. (2011). Linking properties of knowledge with innovation performance: the moderate role of absorptive capacity. *Journal of Knowledge Management, 15*(5), 802–819.
143. Wang, C. L., & Ahmed, P. K. (2007). Dynamic capabilities: A review and research agenda. *International Journal of Management Reviews, 9*(1), 31–51.
144. Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal, 5*(2), 171–180. doi: 10.2307/2486175
145. West, J., & Gallagher, S. (2006a). Challenges of open innovation: The paradox of firm investment in open-source software. *R&D Management, 36*(3), 319–331.
146. West, J., & Gallagher, S. (2006b). Patterns of open innovation in open source software. In H. W. Chesbrough, W. Vanhaverbeke & J. West (Eds.), *Open innovation: researching a new paradigm* (pp. 82–106). Oxford: Oxford University Press.

147. Whelan, E., Parise, S., De Valk, J., & Aalbers, R. (2011). Creating employee networks that deliver open innovation. *MIT Sloan Management Review, 53*(1), 37–44.
148. Yoshida, D. T., Sendjaya, S., Hirst, G., & Cooper, B. (In Press). Does servant leadership foster creativity and innovation? A multi-level mediation study of identification and prototypicality. *Journal of Business Research*.
149. Zahra, S. A. (1993). Environment, corporate entrepreneurship, and financial performance: A taxonomic approach. *Journal of Business Venturing, 8*(4), 319–340.
150. Zahra, S. A., & George, G. (2002). Absorptive capacity: A review, reconceptualization, and extension. *Academy of Management Review, 27*(2), 185–203.
151. Zahra, S. A., & Hayton, J. C. (2008). The effect of international venturing on firm performance: The moderating influence of absorptive capacity. *Journal of Business Venturing, 23*(2), 195–220.
152. Zeng, S. X., Xie, X. M., & Tam, C. M. (2010). Relationship between cooperation networks and innovation performance of SMEs. *Technovation, 30*(3), 181–194.
153. Zhou, K. Z., Kin, C., & Tse, D. K. (2005). The effects of strategic orientations on technology-and market-based breakthrough innovations. *Journal of Marketing, 69*(2), 42–60.

APPENDICES

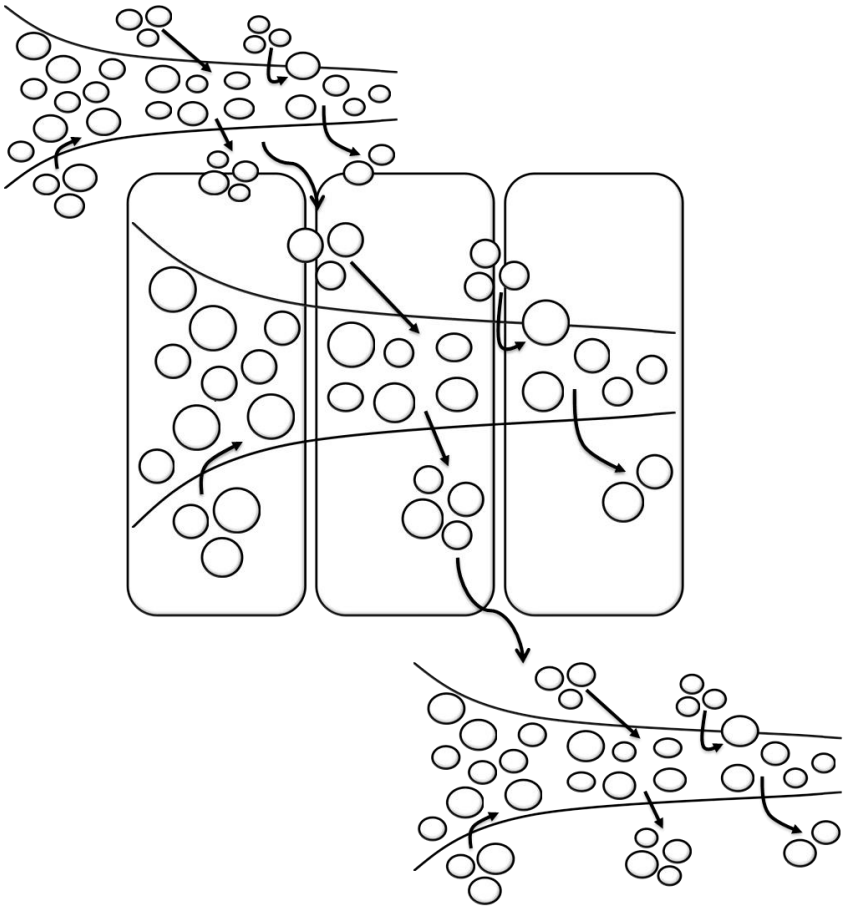
LIST OF APPENDICES

Appendix A: Slovene version of the questionnaire for the proclivity for open innovation validity study

vibacom

Naložba v vašo prihodnost
OPERACIJO DELNO FINANCIRA EVROPSKA UNIJA
Evropski socialni sklad

RAZISKAVA MED PODJETNIKI IN MANAGERJI



Kaja Rangus, mag. posl. ved
Doktorska študentka

Hvala za pomoč pri raziskavi. Za izpolnitev vprašalnika boste potrebovali približno 15 minut. Vaši odgovori so **zaupne narave**. Rezultati raziskave bodo objavljeni le v zbirni obliki, tako da posameznikovi odgovori ne bodo razvidni. **Prosim vas, da odgovorite na vsa vprašanja.**

1. Demografska vprašanja

Navedite vaš spol	Moški	Ženski
Ali ste lastnik oz. solastnik podjetja, kamor je bil vprašalnik poslan?	Da	Ne
Ali ste ustanovitelj oz. soustanovitelj podjetja, kamor je bil vprašalnik poslan?	Da	Ne

Vaša funkcija v podjetju

- ☐ Direktor podjetja
- ☐ Vodja razvoja
- ☐ Drugo: _____

Število zaposlenih v podjetju v letu 2011

- ☐ 0 do 4
- ☐ 5 do 9
- ☐ 10 do 49
- ☐ 50 do 249
- ☐ Več kot 249

Dejavnost podjetja v skladu z SKD 2008 oz. NACE Rev. 2 (napišite za vašo prevladujočo dejavnost)

_____

Leto ustanovitve podjetja

_____

Matična številka podjetja

_____

2. **Za navedene trditve, ki so povezane s pridobivanjem novega znanja/tehnologije, na lestvici od 1 do 7 navedite, kako močno se strinjate oz. ne strinjate s trditvijo. Številka 1 pomeni, da se s trditvijo močno ne strinjate, številka 7 pa pomeni, da se močno strinjate.**

Trditev	Močno se ne strinjam	Zmerno se ne strinjam	Malo se ne strinjam	Niti se strinjam niti se ne strinjam	Malo se strinjam	Zmerno se strinjam	Močno se strinjam
V razvoj novih proizvodov/storitev vključujemo tudi stranke/končne uporabnike.	1	2	3	4	5	6	7
Naši proizvodi/storitve so običajno razviti na podlagi želj/predlogov naših strank.	1	2	3	4	5	6	7
Našim uporabnikom smo pripravljeni ponuditi orodja, s katerimi lahko sami razvijejo svoj prototip proizvoda/storitve.	1	2	3	4	5	6	7
Naše uporabnike vključujemo v testiranje novega proizvoda/storitve.	1	2	3	4	5	6	7
Z namenom pridobitve novega znanja/tehnologije smo pripravljeni razkriti tudi del svojih pomembnih znanj/tehnologije.	1	2	3	4	5	6	7
V našem podjetju razvijamo nove proizvode/storitve izključno na podlagi idej, razvitih znotraj podjetja.	1	2	3	4	5	6	7
V našem podjetju vse raziskave, uporabljene pri razvoju novih proizvodov/storitev, izvedemo znotraj podjetja.	1	2	3	4	5	6	7
V podjetju verjamemo, da lahko z deljenjem svojega znanja/tehnologije ustvarimo nove poslovne priložnosti za naše podjetje.	1	2	3	4	5	6	7
V našem podjetju pri razvoju novih proizvodov/storitev sodelujemo tudi z ljudmi, ki delujejo zunaj našega podjetja.	1	2	3	4	5	6	7

3. **Za sodelovanja, ki so povezana s pridobivanjem novega znanja/tehnologije, na lestvici od 1 do 7 navedite, kako pogosto jih izvajate. Številka 1 pomeni, da za pridobivanje novega znanja/tehnologije omenjene aktivnosti nikoli ne izvajate, številka 7 pa pomeni, da omenjeno aktivnost vedno izvajate.**

Trditev	Nikoli	Zelo redko	Redko	Občasno	Pogosto	Zelo pogosto	Vedno
Z namenom pridobivanja novega znanja/tehnologije **s strankami sodelujemo…**	1	2	3	4	5	6	7
Z namenom pridobivanja novega znanja/tehnologije **z dobavitelji sodelujemo…**	1	2	3	4	5	6	7
Z namenom pridobivanja novega znanja/tehnologije **z inštitucijami znanja** (univerze, fakultete, inštituti, laboratoriji itd.) **sodelujemo….**	1	2	3	4	5	6	7
Z namenom pridobivanja novega znanja/tehnologije **s svetovalnimi podjetji sodelujemo …**	1	2	3	4	5	6	7
Z namenom pridobivanja novega znanja/tehnologije **s konkurenti sodelujemo…….**	1	2	3	4	5	6	7
Z namenom pridobivanja novega znanja/tehnologije **s podjetji, ki se ukvarjajo z drugačno dejavnostjo od naše, sodelujemo…**	1	2	3	4	5	6	7
Z namenom pridobivanja novega znanja/tehnologije **z visokotehnološkimi start-up podjetji sodelujemo…**	1	2	3	4	5	6	7
Z namenom pridobivanja novega znanja/tehnologije **s kreativnimi posamezniki sodelujemo …**	1	2	3	4	5	6	7
Novo znanje/tehnologijo pridobivamo **z najemanjem storitev raziskav in razvoja od inštitucij znanja kot so univerze, fakultete, inštituti, laboratoriji itd.**	1	2	3	4	5	6	7
Novo znanje/tehnologijo pridobivamo **z neformalnim druženjem z raziskovalci iz različnih laboratorijev.**	1	2	3	4	5	6	7
Novo znanje/tehnologijo pridobivamo **z mentoriranjem doktorskih študentov.**	1	2	3	4	5	6	7
Novo znanje/tehnologijo pridobivamo **z udeležbo na različnih dogodkih kot npr. poslovne in znanstvene konference, seminarji, sejmi itd.**	1	2	3	4	5	6	7

4. **Za navedene trditve, ki so povezane s pridobivanjem novega znanja/tehnologije, na lestvici od 1 do 7 navedite, kako močno se z njimi strinjate oz. ne strinjate. Številka 1 pomeni, da se močno ne strinjate, številka 7 pa pomeni, da se s trditvijo močno strinjate.**

Trditev	Močno se ne strinjam	Zmerno se ne strinjam	Malo se ne strinjam	Niti se strinjam niti se ne strinjam	Malo se strinjam	Zmerno se strinjam	Močno se strinjam
Z namenom pridobitve novega znanja/tehnologije smo pripravljeni investirati v novo podjetje.	1	2	3	4	5	6	7
Z namenom pridobitve novega znanja/tehnologije podpiramo mlada start-up podjetja (finančno, z našim znanjem ipd.).	1	2	3	4	5	6	7
V podjetju verjamemo, da nam lastniki tveganega kapitala lahko pomagajo pri razvoju novih proizvodov/storitev.	1	2	3	4	5	6	7
V podjetju verjamemo, da bi skupna vlaganja v novonastalo podjetje našemu podjetju prinesla novo znanje/tehnologijo.	1	2	3	4	5	6	7
Za podporo k internemu razvoju smo pripravljeni kupiti industrijsko lastnino drugega podjetja (npr. patent, blagovno znamko).	1	2	3	4	5	6	7
V podjetju verjamemo, da uporaba zunanjega znanja/tehnologije pomembno vpliva na inovativnost našega podjetja.	1	2	3	4	5	6	7
V podjetju verjamemo, da kupljeno znanje/tehnologija pomeni nove poslovne priložnosti za naše podjetje.	1	2	3	4	5	6	7
V podjetju verjamemo, da je koristno, če ima podjetje opredeljene sistematične in formalne načine iskanja zunanjega znanja/tehnologije.	1	2	3	4	5	6	7
Za uspešen razvoj novih proizvodov/storitev običajno kupimo tudi industrijsko lastnino drugih podjetij.	1	2	3	4	5	6	7

5. **Za navedene trditve, ki so povezane z aktivnostjo vašega podjetja, na lestvici od 1 do 7 navedite, kako močno se z njimi strinjate oziroma ne strinjate. Številka 1 pomeni, da se močno ne strinjate, številka 7 pa pomeni, da se s trditvijo močno strinjate.**

Trditev	Močno se ne strinjam	Zmerno se ne strinjam	Malo se ne strinjam	Niti se strinjam niti se ne strinjam	Malo se strinjam	Zmerno se strinjam	Močno se strinjam
Pri razvoju novih dejavnosti, ki so povezane s trenutnim poslovanjem podjetja, smo pripravljeni sodelovati z zunanjimi partnerji.	1	2	3	4	5	6	7
Pri razvoju novih dejavnosti, ki so povezane s trenutnim poslovanjem podjetja, izkoriščamo tudi zunanje vire znanja/tehnologije.	1	2	3	4	5	6	7
Pri vpeljavah <u>naših</u> novih proizvodov/storitev na trg sodelujemo z zunanjimi partnerji.	1	2	3	4	5	6	7
Proizvode/storitve, ki smo jih razvili, smo pripravljeni na trg vpeljati s partnerji preko skupnih vlaganj v nova podjetja.	1	2	3	4	5	6	7
Pripravljeni smo prodati del svoje industrijske lastnine (npr. patent, blagovno znamko).	1	2	3	4	5	6	7
V podjetju verjamemo, da prodaja industrijske lastnine škodi našemu podjetju, saj s tem konkurentom omogočimo dostop do našega znanja/tehnologije.	1	2	3	4	5	6	7
Drugim podjetjem omogočamo dostop do naše industrijske lastnine, saj to predstavlja poslovno priložnost za naše podjetje.	1	2	3	4	5	6	7
Svoje raziskave pogosto objavljamo (npr. predstavitev na konferencah, objava v publikacijah ali znanstvenih člankih).	1	2	3	4	5	6	7
Stranski učinki (koncepti, ideje polproizvodi itd.), ki nastanejo pri razvoju novih proizvodov/storitev, so za naše podjetje nekoristni.	1	2	3	4	5	6	7
Pri razvoju novih idej pogosto upoštevamo nasvete zaposlenih, ki niso vključeni v proces raziskav in razvoja.	1	2	3	4	5	6	7
V našem podjetju aktivno spodbujamo komunikacijo med nepovezanimi skupinami zaposlenih v podjetju.	1	2	3	4	5	6	7
Praksa našega podjetja je, da zaposleni med področji delovnih nalog rotirajo.	1	2	3	4	5	6	7
Med zaposlenimi v podjetju imamo iskalce idej, ki potencialno uporabno znanje/tehnologijo iščejo zunaj podjetja.	1	2	3	4	5	6	7
Svoje zaposlene seznanjamo s poslovnim pomenom inovacij.	1	2	3	4	5	6	7
Svoje zaposlene dodatno nagradimo, če v podjetje prinesejo znanje/tehnologijo iz okolja, ki pripomore k izboljšavi naših proizvodov/storitev.	1	2	3	4	5	6	7

6. **Za navedene trditve, ki so povezane z inovativnostjo vašega podjetja, na lestvici od 1 do 7 navedite, kako uspešno je bilo vaše podjetje v primerjavi s konkurenti v obdobju zadnjih treh let. Številka 1 pomeni, da je bilo vaše podjetje veliko slabše od konkurentov, številka 7 pa pomeni, da je bilo vaše podjetje veliko boljše od konkurentov.**

V zadnjih 3 letih (če podjetje deluje manj časa upoštevajte krajše časovno obdobje) **je bilo naše podjetje slabše/boljše od konkurence glede…**	Veliko slabše od konkurence	Zmerno slabše od konkurence	Malo slabše od konkurence	Enako kot konkurenca	Malo boljše od konkurence	Zmerno boljše od konkurence	Veliko boljše od konkurence
…števila novih proizvodov/storitev.	1	2	3	4	5	6	7
…uvedbe novih proizvodov/storitev (bili ste med prvimi, ki ste uvedli nov izdelek/storitev).	1	2	3	4	5	6	7
...truda, vloženega v razvoj novih proizvodov/storitev, pri čemer upoštevajte število ur, oseb, timov in izobraževanj.	1	2	3	4	5	6	7
...števila uvedenih sprememb v procesih.	1	2	3	4	5	6	7
...vpeljave novih procesov (ste eni izmed prvih, ki so uvedli nov proces).	1	2	3	4	5	6	7
…odziva na nove procese, ki so jih vpeljala druga podjetja v vaši panogi.	1	2	3	4	5	6	7
...števila novosti v sistemu managementa (npr. novosti v novih postopkih, politikah in organizacijskih vzorcih).	1	2	3	4	5	6	7
...iskanja novih sistemov managementa (npr. novosti v novih postopkih, politikah in organizacijskih vzorcih) s strani vodij.	1	2	3	4	5	6	7
...vpeljave novih sistemov managementa (ste med prvimi uvedli nove postopke, politike in organizacijske vzorce).	1	2	3	4	5	6	7

Zahvaljujem se vam za trud pri izpolnjevanju vprašalnika. Zelo cenim vašo pomoč pri pridobivanju informacij.

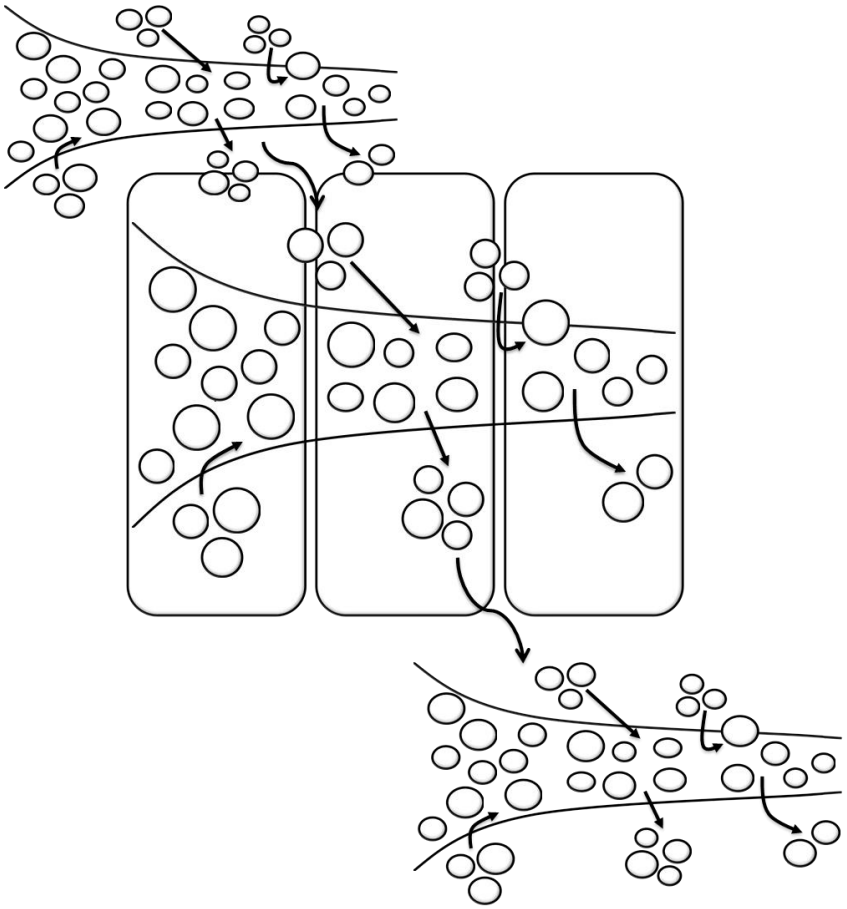
Če bi želeli še kaj dodati, napišite to v prazen prostor spodaj ali pa pošljite sporočilo na elektronski naslov kaja.rangus@gmail.com. Če želite prejeti rezultate raziskave, dodajte tudi vaš elektronski naslov.

Appendix B: English version of the questionnaire for the proclivity for open innovation validity study

vibacom

Investing in your future
OPERATION PART FINANCED BY THE EUROPEAN UNION
European Social Fund

RESEARCH AMONG ENTREPRENEURS AND MANAGERS



Kaja Rangus, MBS (master of business studies)
Ph.D. candidate

Thank you for your assistance in this study. Filling in this questionnaire will take around 10 minutes. Your responses are **confidential.** The results of this study will only be published in a collective form so that no individual responses will be apparent. **Please answer all the questions.**

1. Demographic questions

Please specify your gender.	Male	Female
Are you the owner or co-owner of the company this questionnaire was sent to?	Yes	No
Are you the founder or co-founder of the company this questionnaire was sent to?	Yes	No

Your position in the company

- ☐ Director
- ☐ Head of development
- ☐ Other: _____

Number of employees in the company in 2011

- ☐ Between 0 and 4
- ☐ Between 5 and 9
- ☐ Between 10 and 49
- ☐ Between 50 and 249
- ☐ Over 249

Company activities according to SKD 2008 or NACE Rev. 2 (please specify your prevailing activity):

_____

Which year was your company established:

_____

Company identification number:

_____

2. **For each of the below statements related to acquiring new know-how/technology, specify on a scale of 1 to 7 the degree to which you agree or disagree with each statement. The number 1 denotes that you strongly disagree with the statement, while the number 7 denotes strong agreement.**

Statement	Strongly disagree	Disagree to a great extent	Partly disagree	Neither agree nor disagree	Partly agree	Agree to a great extent	Strongly agree
Clients/end users are also involved in the process of new product/service development.	1	2	3	4	5	6	7
Our products/services are usually developed in light of customer/client wishes and suggestions.	1	2	3	4	5	6	7
We are willing to offer our users tools allowing them to develop their own product/service prototypes.	1	2	3	4	5	6	7
Our users are involved in the process of testing new products/services.	1	2	3	4	5	6	7
We are prepared to disclose part of our important know-how/technology in order to develop new know-how/technology.	1	2	3	4	5	6	7
Our company develops new products/services exclusively on the ideas generated within the company.	1	2	3	4	5	6	7
All the research relating to the development of new products/services is carried out within our company.	1	2	3	4	5	6	7
We believe that by sharing our know-how/technology we can create new opportunities for our company.	1	2	3	4	5	6	7
In the process of the new product/service creation we cooperate also with individuals from outside the company.	1	2	3	4	5	6	7

3. **Specify on a scale of 1 to 7 how often you forge cooperation related to acquiring new know-how/technologies. Number 1 denotes that you never perform the specified activity in acquiring new know-how/technologies, while the number 7 denotes that you regularly perform the specified activity.**

Statement	Never	Very rarely	Rarely	From time to time	Often	Very often	Always
In order to acquire new know-how/ technology we **cooperate with our customers/clients...**	1	2	3	4	5	6	7
In order to acquire new know-how/ technology **we cooperate with our suppliers...**	1	2	3	4	5	6	7
In order to acquire new know-how/ technology **we cooperate with knowledge institutions such as universities, faculties, institutes, laboratories...**	1	2	3	4	5	6	7
In order to acquire new know-how/ technology **we cooperate with consultancy companies...**	1	2	3	4	5	6	7
In order to acquire new know-how/ technology **we cooperate with our competitors...**	1	2	3	4	5	6	7
In order to acquire new know-how/ technology **we cooperate with companies engaged in activities different from ours...**	1	2	3	4	5	6	7
In order to acquire new know-how/ technology **we cooperate with high-tech start-up companies...**	1	2	3	4	5	6	7
In order to acquire new know-how/ technology **we cooperate with creative individuals...**	1	2	3	4	5	6	7
We acquire new know-how/technology through **research and development services provided by knowledge institutions such as universities, faculties, institutes, laboratories, etc**.	1	2	3	4	5	6	7
We acquire new know-how/technology through **informal ties with researchers from various laboratories**.	1	2	3	4	5	6	7
We acquire new know-how/technology **through mentoring doctoral students**.	1	2	3	4	5	6	7
We acquire new know-how/technology **by participating in events such as business and science conferences, seminars, trade fairs, etc**.	1	2	3	4	5	6	7

4. **For each of the below statements related to acquiring new know-how / technologies, specify on a scale of 1 to 7 the degree to which you agree or disagree with each statement. The number 1 denotes that you strongly disagree with the statement, while the number 7 denotes strong agreement.**

Statement	Strongly disagree	Disagree to a great extent	Partly disagree	Neither agree nor disagree	Partly agree	Agree to a great extent	Strongly agree
In order to acquire new know-how/technology we are willing to invest in a new company.	1	2	3	4	5	6	7
In order to acquire new know-how/ technology we support new start-up companies (e.g. financially, with our know-how, etc.).	1	2	3	4	5	6	7
In our company we believe that the owners of venture capital can help us in the process of developing new products/services.	1	2	3	4	5	6	7
In our company, we believe that investing in a new joint venture could result in new know-how/technology for our company.	1	2	3	4	5	6	7
We are willing to buy the intellectual property of other companies (e.g. patent, trademark) to support our internal development.	1	2	3	4	5	6	7
In our company we believe the use of know-how/technology from the outside can significantly contributes to the innovation of our company.	1	2	3	4	5	6	7
In our company, we believe that know-how/technology we have bought can create new opportunities for the company.	1	2	3	4	5	6	7
In our company, we believe it is beneficial to determine systemic and formal ways of searching for external know-how/technology.	1	2	3	4	5	6	7
To ensure successful development of new products/services we usually buy the intellectual property of other companies.	1	2	3	4	5	6	7

5. **For each of the below statements related to activities of your company, specify on a scale of 1 to 7 the degree to which you agree or disagree to each statement. The number 1 denotes that you strongly disagree with the statement, while the number 7 denotes strong agreement.**

Statement	Strongly disagree	Disagree to a great extent	Partly disagree	Neither agree nor disagree	Partly agree	Agree to a great extent	Strongly agree
When developing new activities related to the present operation of our company, we are willing to cooperate with the partners from the outside.	1	2	3	4	5	6	7

Statement	Strongly disagree	Disagree to a great extent	Partly disagree	Neither agree nor disagree	Partly agree	Agree to a great extent	Strongly agree
When developing new activities related to the present operation of our company we use external sources of know-how/technology.	1	2	3	4	5	6	7
When launching our own new products/services on the market we cooperate with external partners.	1	2	3	4	5	6	7
We are prepared to introduce products/services we have developed through investing into a new joint venture.	1	2	3	4	5	6	7
We are willing to sell part of our intellectual property (e.g. patent, trademark).	1	2	3	4	5	6	7
In our company, we believe that selling our intellectual property could harm our company as it would give competitors access to our know-how / technologies.	1	2	3	4	5	6	7
We provide other companies access to our intellectual property as this represents a business opportunity to our company.	1	2	3	4	5	6	7
Our research is often disseminated (e.g. present at conferences, publish in publications or prepare scientific papers).	1	2	3	4	5	6	7
The spillovers (such as concepts, ideas, semi-products, etc.) resulting from developing new products/services have no use for our company.	1	2	3	4	5	6	7
When developing new ideas we often consider the suggestions of employees not included in research and development process.	1	2	3	4	5	6	7
In our company, we actively encourage communication among unrelated groups of employees in the company.	1	2	3	4	5	6	7
It is a common practice in our company that the employees rotate between different tasks.	1	2	3	4	5	6	7
Members of our staff include idea seekers, who look for potentially useful know-how/technologies outside the company.	1	2	3	4	5	6	7
We inform our employees about the importance of innovation to our business.	1	2	3	4	5	6	7
We additionally award our employees if they bring external know-how/technology that improves our products / services.	1	2	3	4	5	6	7

6. **For each of the statements regarding <u>innovation</u>, indicate on a scale of 1 to 7 <u>how did your firm perform compared to competitors in the last 3 years</u>, where 1 means that your firm performed much worse than competitors and 7 means that your firm performed much better than competitors.**

In the last 3 years our firm has performed worse/better than competitors in regard to… (Note: If your firm is less than 3 years old, please, rate for the period from its establishment until now.)	Much worse than com-petitors	Moderately worse than com-petitors	Slightly worse than com-petitors	The same as com-petitors	Slightly better than com-petitors	Moderately better than com-petitors	Much better than com-petitors
…the number of new products/services launched.	1	2	3	4	5	6	7
…pioneering the introduction of new products/services (you were one of the first to introduce a new product/service).	1	2	3	4	5	6	7
…the effort invested in the development of new products/services, taking into consideration the number of hours, people, teams and trainings.	1	2	3	4	5	6	7
...the number of introduced changes in processes.	1	2	3	4	5	6	7
...pioneering newly introduced processes (you've been one of the first to introduce new processes).	1	2	3	4	5	6	7
…responding to new processes introduced by other companies in your field.	1	2	3	4	5	6	7
...the number of novelties in the administration system (i.e. novelties in new procedures, policies and organisation patterns).	1	2	3	4	5	6	7
...searching for new administration systems (i.e. novelties in new procedures, policies and organisation patterns) **by managers.**	1	2	3	4	5	6	7
...pioneering new administration systems (you were first to introduce new procedures, policies and organisation patterns).	1	2	3	4	5	6	7

Thank you for your time completing this questionnaire. I truly value your help in providing this data.

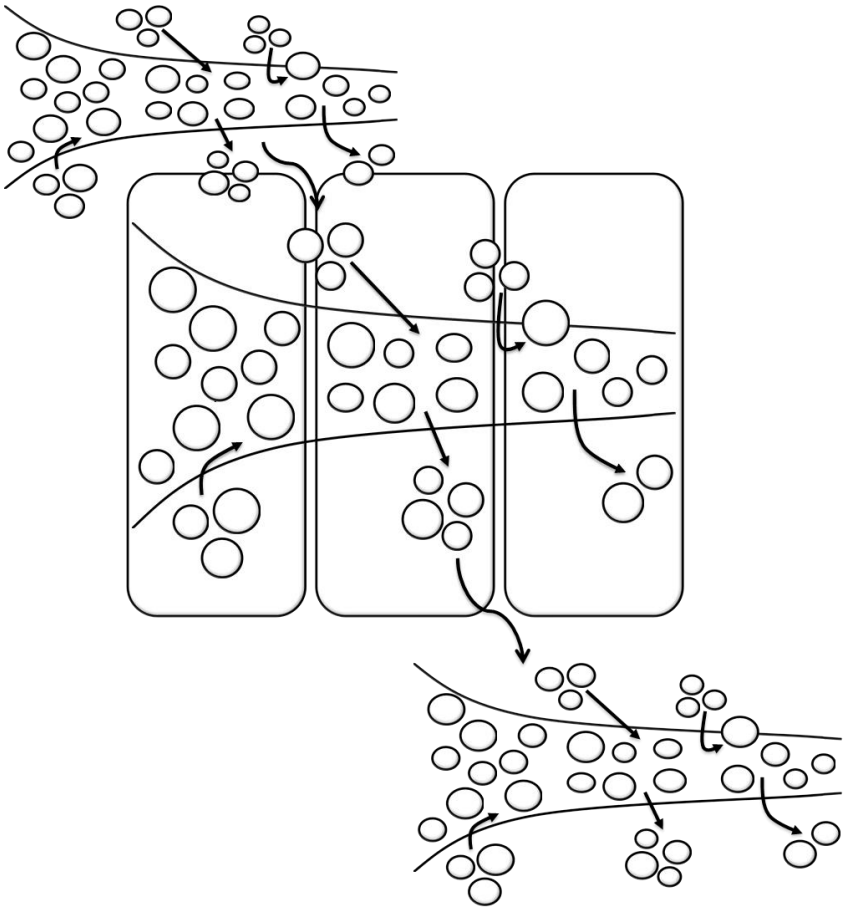
In case you would like to add anything you may enter it in the box below or contact me at the following email address: kaja.rangus@gmail.com. If you are intrested in the results of the research, please write your email address.

Appendix C: English version of the questionnaire for the study on proclivity for open innovation relations

vibacom

Investing in your future
OPERATION PART FINANCED BY THE EUROPEAN UNION
European Social Fund

RESEARCH ON INNOVATION



Kaja Rangus, MBS (master of business studies)
Ph.D. candidate

Thank you for your assistance in this study. Filling out this questionnaire will take around 15–20 minutes. Your responses are **confidential.** The results of this study will only be published in a collective form; no individual responses will be visible. **Please answer all the questions.**

1. Basic data

Please specify your gender	Male	Female
Your position in the company ☐ CEO ☐ Head of research and development ☐ Other: _____		
Are you in the top management team of the company?	Yes	No
How many people are included in the top management team of the company: ☐ 1 ☐ 2 ☐ Between 3 and 5 ☐ More than 5		
Are you the owner or co-owner of the company this questionnaire was sent to? **If yes, please specify the percentage of your share of ownership: _____**	Yes	No
Are you the founder or co-founder of the company this questionnaire was sent to?	Yes	No
Please specify the number of years of working experience in the current industry: 0–2 years 2–5 years 5–10 years 10–15 years More than 15 years		
Please specify the total of years of working experience. Indicate the number of years from your first job until now: 0–2 years 2–5 years 5–10 years 10–15 years More than 15 years		
Indicate your highest level of education □ **Primary education** □ **Middle School education** □ **High School education** □ **Bachelor's degree** □ **Master's degree** □ **Professional degree** □ **Doctorate degree**		

Number of employees in the company in 2012

- ☐ Between 0 and 5
- ☐ Between 6 and 9
- ☐ Between 10 and 49
- ☐ Between 50 and 249
- ☐ More than 249

Company activities according to NACE Rev. 2 (please specify your prevailing activity):

A Agriculture, forestry and fishing
B Mining and quarrying
C Manufacturing
D Electricity, gas, steam and air conditioning supply
E Water supply, sewerage, waste management and remediation activities
F Construction
G Wholesale and retail trade, repair of motor vehicles and motorcycles
H Transportation and storage
I Accommodation and food service activities
J Information and communication
K Financial and insurance activities
L Real estate activities
M Professional, scientific and technical activities
N Administrative and support service activities
O Public administration and defence, compulsory social security
P Education
Q Human health and social work activities
R Arts, entertainment and recreation
S Other service activities
T Activities of households as employers, undifferentiated goods- and services-producing activities of households for own use
U Activities of extraterritorial organisations and bodies

Would you define your company as high-tech?	Yes	No

Which year was your company established:

_____

Please specify the percentage share of R&D investments of total sales in 2012:

- ☐ **0%**
- ☐ **Between 0% and 2%**
- ☐ **Between 2% and 5%**
- ☐ **Between 5% and 10%**
- ☐ **Between 10% and 20%**
- ☐ **More than 20%**

Company registration number:

_____

2. Acquiring new know-how/technology

2.1. Customer involvement and acquiring new know-how/technology

For each of the statements below related to activities of your company, specify the degree to which you agree or disagree with each statement. Number 1 denotes that you strongly disagree with the statement, while number 7 denotes strong agreement.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Our clients/end users are usually involved in the process of new product/service development.	1	2	3	4	5	6	7
Our products/services are usually developed in light of customer/client wishes and suggestions.	1	2	3	4	5	6	7
We believe that investing in a new joint venture could result in new know-how/technology for our company.	1	2	3	4	5	6	7
We are willing to buy the intellectual property of other companies (e.g. patent, trademark) to support our internal development.	1	2	3	4	5	6	7
We believe the use of know-how/technology from the outside can significantly contribute to the innovation outcomes of our company.	1	2	3	4	5	6	7
We believe that know-how/technology we have bought can create new opportunities for the company.	1	2	3	4	5	6	7
We believe it is beneficial to determine systematic and formal ways of searching for external know-how/technology.	1	2	3	4	5	6	7

2.2. Cooperation with different partners

Specify how often you perform the specified activity in the process of acquiring new know-how/technology. Number 1 denotes that you never perform the specified activity in acquiring new know-how/technology, while number 7 denotes that you always perform the specified activity.

	Never	Very rarely	Rarely	From time to time	Often	Very often	Always
In order to acquire new know-how/ technology, we cooperate with our customers/clients...	1	2	3	4	5	6	7
In order to acquire new know-how/ technology, we cooperate with knowledge institutions such as universities, faculties, institutes, laboratories...	1	2	3	4	5	6	7
In order to acquire new know-how/ technology, we cooperate with high-tech start-up companies...	1	2	3	4	5	6	7
We acquire new know-how/technology through research and development services provided by knowledge institutions such as universities, faculties, institutes, laboratories, etc.	1	2	3	4	5	6	7
We acquire new know-how/technology through informal ties with researchers from various laboratories.	1	2	3	4	5	6	7
We acquire new know-how/technology through mentoring doctoral students.	1	2	3	4	5	6	7

2.3. IP management and employee involvement

For each of the statements below related to activities of your company, specify the degree to which you agree or disagree to each statement. Number 1 denotes that you strongly disagree with the statement, while number 7 denotes strong agreement.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
When developing new activities related to the present operation of our company, we are willing to cooperate with the partners from the outside.	1	2	3	4	5	6	7
When developing new activities related to the present operation of our company, we use external sources of know-how/technology.	1	2	3	4	5	6	7
When launching our own new products/services on the market, we cooperate with external partners.	1	2	3	4	5	6	7
We are prepared to introduce products/services we have developed through investing into a new joint venture.	1	2	3	4	5	6	7
We are willing to sell part of our intellectual property (e.g. patent, trademark).	1	2	3	4	5	6	7
We believe that selling our intellectual property could harm our company as it would give competitors access to our know-how / technology.	1	2	3	4	5	6	7
When developing new ideas, we often consider the suggestions of employees not included in research and development process.	1	2	3	4	5	6	7
We actively encourage communication among unrelated groups of employees in the company.	1	2	3	4	5	6	7
We inform our employees about the importance of innovation to our business.	1	2	3	4	5	6	7
We additionally award our employees if they bring external know-how/technology that improves our products/services.	1	2	3	4	5	6	7

3. Company activities

3.1. Absorptive capacity

For each of the statements below related to absorptive capacity, specify the degree to which you agree or disagree to each statement. Number 1 denotes that you strongly disagree with the statement, while number 7 denotes strong agreement.

We have the capability to…	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
…adapt acquired new knowledge to fit the firm's development need.	1	2	3	4	5	6	7
…develop new products/services by using assimilated new knowledge.	1	2	3	4	5	6	7
…develop new applications by applying assimilated new knowledge.	1	2	3	4	5	6	7
…find alternative uses of assimilated new knowledge.	1	2	3	4	5	6	7
…fuse assimilated new knowledge with existing knowledge.	1	2	3	4	5	6	7
…revise manufacturing/service processes based on acquired new knowledge.	1	2	3	4	5	6	7
…revise business procedures based on acquired new knowledge.	1	2	3	4	5	6	7
…introduce product/service innovation based on acquired new knowledge.	1	2	3	4	5	6	7
…revise quality control operations based on acquired new knowledge.	1	2	3	4	5	6	7

3.2. Innovation

For each of the statements regarding <u>innovation</u>, indicate <u>how your firm performed compared to competitors in the previous three years</u>. Number 1 means that your firm performed much worse than competitors and 7 means that your firm performed much better than competitors.

In the last 3 years, our firm has performed worse/better than competitors in regard to… (Note: If your firm is less than 3 years old, please, rate for the period from its establishment until now.)	Much worse than com-petitors	Moderately worse than com-petitors	Slightly worse than com-petitors	The same as com-petitors	Slightly better than com-petitors	Moderately better than com-petitors	Much better than com-petitors
…the number of new products/services launched.	1	2	3	4	5	6	7
…pioneering the introduction of new products/services (you were one of the first to introduce a new product/service).	1	2	3	4	5	6	7
…the effort invested in the development of new products/services, taking into consideration the number of hours, people, teams and trainings.	1	2	3	4	5	6	7
...the number of introduced changes in processes.	1	2	3	4	5	6	7
...pioneering newly introduced processes (you've been one of the first to introduce new processes).	1	2	3	4	5	6	7
…responding to new processes introduced by other companies in your field.	1	2	3	4	5	6	7
...the number of incremental innovations (new or improved products/services that are new to the firm).	1	2	3	4	5	6	7
...the number of radical innovations (breakthrough innovations that are new to the market).	1	2	3	4	5	6	7

Provide a short description of the most important innovation in your company – you can describe your product/service or provide a brandname:

---

4. Technological turbulence, market uncertainty and organizational culture

For each of the statements below related to technological turbulence, market uncertainty and organizational culture, specify the degree to which you agree or disagree to each statement. Number 1 denotes that you strongly disagree with the statement, while number 7 denotes strong agreement.

	Strongly disagree	Modera-tely disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Modera-tely agree	Strongly agree
The technology in our industry is changing rapidly.	1	2	3	4	5	6	7
Technological changes provide major opportunities in our industry.	1	2	3	4	5	6	7
A large number of new product/service ideas have been made possible through technological breakthroughs in our industry.	1	2	3	4	5	6	7
Technological developments in our industry are rather minor.	1	2	3	4	5	6	7
The market of our industry has been growing at a satisfactory rate.	1	2	3	4	5	6	7
Forecasting the market potential for a new product/service has become more difficult than 3 or 5 years ago.	1	2	3	4	5	6	7
Customer needs and preferences have been changing at a faster pace than 3 or 5 years ago.	1	2	3	4	5	6	7
The market of our industry is currently made up of heterogeneous, diverse customers.	1	2	3	4	5	6	7
Understanding customers' needs has become more difficult than ever before.	1	2	3	4	5	6	7
Our company is open to change.	1	2	3	4	5	6	7
Our company encourages employees to challenge the status quo.	1	2	3	4	5	6	7
Our company is decentralized in its decision making.	1	2	3	4	5	6	7
Our company maintains open communications channels in its operations.	1	2	3	4	5	6	7

Thank you for your time completing this questionnaire. I truly value your help in providing this data.

In case you would like to add anything, you may enter it in the box below or contact me at the following email address: kaja.rangus@gmail.com. If you are interested in the results of the research, please write your email address.

Appendix D: Summary in Slovenian language

DALJŠI POVZETEK DOKTORSKE DISERTACIJE V SLOVENSKEM JEZIKU

»Nobeno podjetje nima moči ali finančnih sredstev, da bi lahko ustvarjalo samo. Zato potrebujemo odprto inoviranje.«
-- John Tau, nekdanji podpredsednik odprtega inoviranja v podjetju Weyerhaeuser (Arndt, 2009)

Koncept odprtega inoviranja se v zadnjem času uvršča med enega od najaktualnejših konceptov s področja managementa inovacij (Chiaroni et al., 2010; Huizingh, 2011) in pridobiva na pomembnosti že od objave prve knjige prof. dr. Chesbrougha (2003b). Glavna ideja tega koncepta je odprtost procesa inoviranja do drugih podjetij, posameznikov, raziskovalnih laboratorijev, univerz, kupcev, dobaviteljev (Chesbrough, 2006b), z namenom omogočiti nemoten pretok idej znotraj in zunaj organizacije ter tako izkoristiti prednosti notranjih in zunanjih virov (Chesbrough, 2003b). Glavne prednosti odprtega inoviranja so dostop do zunanjega znanja, manjši stroški tehnološkega razvoja in izboljšav, hitrejši čas vstopa na trg in boljša kakovost proizvodov (Wallin & von Krogh, 2010).

Organizacije odprejo svoj inovacijski proces z namenom integriranja baze znanja, pospešitve povečanja kreativnosti in prilagodljivosti ter z namenom doseganja odličnosti v proizvodnji znanja (Lazzarotti et al., 2010). Glavni motivi inovacijske odprtosti so torej povezani s trgom: izboljšati kakovost proizvodov, biti v koraku z razvojem trga, zadovoljiti potrebe strank, z višjim ciljem doseganja rasti, boljšo finančno uspešnostjo ali večjim tržnim deležem (van de Vrande et al., 2009). Naraščajoča uporaba odprtega inoviranja z namenom doseganja konkurenčne prednosti je razvidna iz poslovne prakse. Na primer, ne dolgo nazaj so bile multinacionalke, kot so IBM, AT & T in Merck, vodilna raziskovalna podjetja, vendar je odprto inoviranje omogočilo novim manjšim podjetjem, kot so Intel, Sun in Cisco, vstop na trg in pridobitev konkurenčnega položaja z izkoriščanjem raziskovalnih ugotovitev drugih organizacij (Chesbrough, 2004). Pridobitev konkurenčne prednosti vključevanja zunanjih partnerjev v inovacijski proces je razvidna tudi iz primera podjetja Apple, ki mu je uspelo pritegniti številne aplikacije in rešitve zunanjih oseb ter s tem ustvariti nove izkušnje za Applove uporabnike (Chesbrough, 2011). Graham Cross iz podjetja Unilever je poudaril: »V podjetju morate začeti ustvarjati kulturo, ki spodbuja uporabo zunanjih sposobnosti. To mora postati stvar ponosa, da si tisti, ki mu je uspelo najti nekaj čudovitega zunaj podjetja« (van de Vrande, 2006).

Odprto inoviranje je večdimenzionalni konstrukt, ki pod eno streho združuje številne organizacijske aktivnosti (Huizingh, 2011), kot so vključevanje uporabnikov (npr. Antikainen et al., 2010; Di Gangi & Wasko, 2009; Prugl & Schreier, 2006), zunanje partnerstvo (npr. Asakawa et al., 2010; Tether & Tajar, 2008), licenciranje intelektualne lastnine, ustanavljanje

novih podjetij (npr. Gruber & Henkel, 2006), ipd. Literatura na temo odprtega inoviranja je s konceptualizacijo odprtega inoviranja (npr. Almirall & Casadesus-Masanell, 2010; Chesbrough, 2006b; Chesbrough & Garman, 2009; Mäkipää et al., 2006) in predstavitvijo študij primerov (npr. Chesbrough, 2003b; Di Gangi & Wasko, 2009; Langvardt, 2010; Pontiskoski & Asakawa, 2009; Rohrbeck et al., 2009) poglavitno pripomogla k razumevanju omenjenega koncepta. Le peščica študij pa obravnava odprto inoviranje na podlagi kvantitativnih analiz na velikih vzorcih (npr. Inauen & Schenker-Wicki, 2011; Lichtenthaler, 2008; van de Vrande et al., 2009), pri čemer nobena od njih ne poda veljavnosti in zanesljivosti uporabljenih mer. Poleg tega je večina študij analizirala samo del odprtega inoviranja, npr. aktivnosti, vezane na pridobivanje in vpeljavo zunanjih virov navznoter (npr. Buganza & Verganti, 2009; Parida et al., 2012; Spithoven et al., 2010) ali notranjih virov navzven (npr. Kutvonen, 2011; Lichtenthaler, 2009), ali pa je obravnavala le eno od dimenzij odprtega inoviranja. Čeprav številni raziskovalci poudarjajo pomen odprtega inoviranja za uspešnost podjetja, literaturi s tega področja primanjkuje konceptualizacije konstrukta ter sposobnosti merjenja le-tega. Literatura na temo odprtega inoviranja zato potrebuje empirično veljavno definicijo aktivnosti in elementov tega večdimenzionalnega konstrukta, ki bi omogočila podlago za njegovo sistematično raziskovanje in tako prispevala h generalizaciji ugotovitev, vezanih na vpliv odprtega inoviranja v organizacijah.

Poleg tega je potrebnih več kvantitativnih analiz, vezanih na izgradnjo modelov odvisnih spremenljivk, in njihovo testiranje ter tako zagotoviti dokaze o odnosih med odprtim inoviranjem in drugimi pomembnimi organizacijskimi korelati (Huizingh, 2011). Raziskovalci (npr. Hughes & Wareham, 2010; Spithoven et al., 2010) menijo, da je za uspešno izrabo zunanjega znanja in informacij potrebna absorpcijska sposobnost, kljub temu pa so dosedanji dokazi kvantitativnih analiz na to temo neskladni – avtorji treh različnih študij so identificirali tri različne vloge absorpcijske sposobnosti v povezavi z odprtim inoviranjem: vlogo substituta (Laursen & Salter, 2006), vlogo moderatorja (Escribano et al., 2009) in vlogo mediatorja (Fosfuri & Tribó, 2008). Razlike v rezultatih so lahko posledica uporabe približnih mer, ki so temeljile na že razvitih statističnih inštrumentih, kot so vprašalniki CIS (ang. Community Innovation Survey). Lane, Koka in Pathak (2006) menijo, da absorpcijska sposobnost ne bi smela biti merjena v raziskovalno-razvojnih kontekstih, temveč bi morala mera upoštevati večdimenzionalno naravo tega konstrukta. Podobno bi morala mera za odprto inoviranje upoštevati njegovo večdimenzionalnost (Schroll & Mild, 2011). Uporaba približnih mer lahko pripelje do navzkrižnih in zavajajočih ugotovitev (Flatten et al., 2011), zaradi česar so potrebne študije, ki uporabljajo veljavne mere.

Raziskovalni problem in namen

Doktorska disertacija obravnava tri glavne raziskovalne probleme. Prvič, čeprav je literatura na temo odprtega inoviranja poglavitno prispevala k razumevanju pomena odprtega inoviranja v organizacijah, ostaja vprašanje, katere organizacijske aktivnosti so v središču odprtega inoviranja, nenaslovljeno. Obstoječe mere za merjenje odprtega inoviranja ne upoštevajo večdimenzionalnosti omenjenega konstrukta; ne vključujejo specifikacije dimenzij in elementov odprtega inoviranja, zaradi česar je omejeno sistematično raziskovanje tega koncepta. Literatura, vezana na odprto inoviranje, tako potrebuje veljavno in empirično testirano mero za odprto inoviranje. Drugič, čeprav številne predhodne študije nakazujejo pozitiven vpliv odprtega inoviranja na inovativnost podjetij, v literaturi primanjkuje dokazov o mehanizmih, ki bi pojasnili omenjena razmerja. Vpeljava konstrukta odprtega inoviranja v strukturni model z drugimi organizacijskimi sposobnostmi bi tako pokazala, kako odprto inoviranje vpliva na druge konstrukte v teoretičnem modelu. Tretjič, študije na temo odprtega inoviranja večinoma obravnavajo le posamezen vidik omenjenega koncepta, zaradi česar so dokazi o pomembnosti in vplivu posamezne dimenzije odprtega inoviranja razdrobljeni po različnih študijah. Dosedanje raziskave na temo odprtega inoviranja ne prispevajo teoretične in empirične podlage za odgovore na pomembnejša vprašanja, vezana na praktične implikacije odprtega inoviranja, kot je npr. vprašanje, katera dimenzija odprtega inoviranja bolj pomembno vpliva na inovativnost podjetij. Omenjeno otežuje razumevanje kompleksnosti odprtega inoviranja ter z njim povezanih aktivnosti. Poleg tega dosedanje študije ne dajejo informacije o tem, kako implementirati posamezno dimenzijo z upoštevanjem ključnega elementa za uspešno implementacijo, tj. človeške naravnanosti. Ta informacija bi bila v veliko pomoč managerjem pri odločitvah o razdelitvi (redkih) organizacijskih virov po posameznih aktivnostih odprtega inoviranja.

Cilj doktorske disertacije

Cilj disertacije je prispevanje k boljšemu razumevanju koncepta odprtega inoviranja z naslednjimi raziskovalnimi podcilji:

1. Definirati dimenzije in njihove elemente, ki sestavljajo konstrukt nagnjenosti k odprtemu inoviranju.
2. Konceptualizirati in operacionalizirati konstrukt nagnjenosti k odprtemu inoviranju.
3. Zagotoviti veljavnost in zanesljivost mere za nagnjenost k odprtemu inoviranju.
4. Zagotoviti generalizacijo nove mere za nagnjenost k odprtemu inoviranju.
5. Prikazati razmerje med nagnjenostjo k odprtemu inoviranju, absorpcijsko sposobnostjo in inovativnostjo podjetja.
6. Podati empirične dokaze o povezanosti med posamezno dimenzijo odprtega inoviranja z inovativnostjo podjetja.
7. Identificirati različne oblike odprtega inoviranja.
8. Podati opis možnih načinov implementiranja dimenzij odprtega inoviranja.
9. Identificirati pomen človeške naravnanosti pri vpeljavi procesov odprtega inoviranja.

Povzetek glavnih ugotovitev

Namen doktorske disertacije je prispevati k boljšemu razumevanju koncepta odprtega inoviranja: 1) z opredelitvijo veljavne in zanesljive mere za nagnjenost k odprtemu inoviranju; 2) s prikazom vpliva nagnjenosti k odprtemu inoviranju na druge korelate v teoretičnem modelu; 3) z obsežno predstavitvijo različnih dimenzij odprtega inoviranja, njihovih prednosti, njihovega vpliva na inovativnost podjetja in napotkov za uspešno implementacijo odprtega inoviranja, ki upošteva pomen človeškega faktorja.

V nadaljevanju je podan povzetek glavnih ugotovitev glede na zastavljene raziskovalne podcilje.

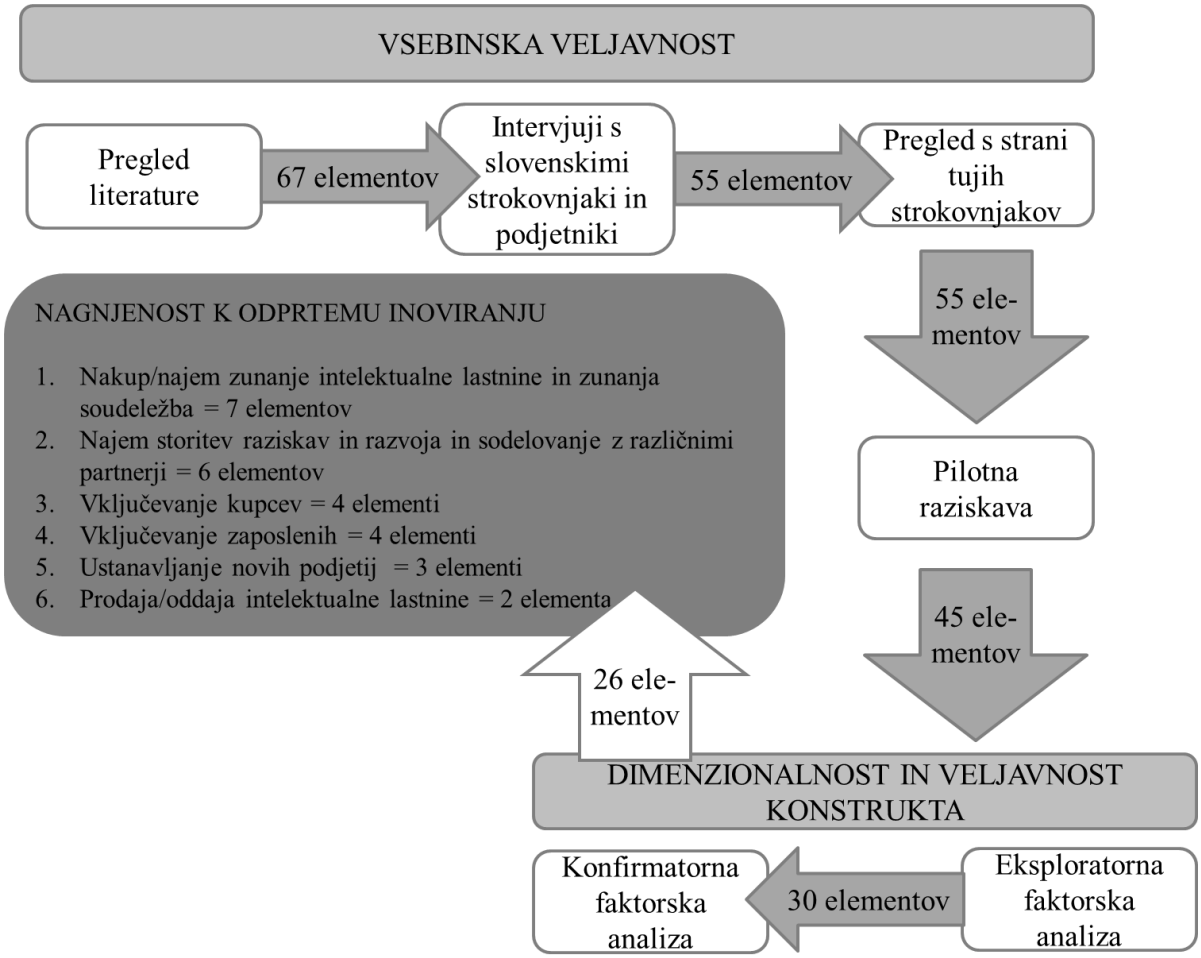
Razvoj veljavne in zanesljive mere za nagnjenost k odprtemu inoviranju

Prvo poglavje doktorske disertacije opisuje razvoj mere za nagnjenost podjetij k odprtemu inoviranju in naslavlja prve štiri cilje, zastavljene v okviru doktorske disertacije. Na podlagi poglobljenega pregleda literature, vezane na koncept odprtega inoviranja, je podana začetna lista vseh potencialnih dimenzij in njihovih elementov za konstrukt nagnjenosti k odprtemu inoviranju. V tem koraku je bilo identificiranih osem potencialnih dimenzij in 121 potencialnih elementov nagnjenosti k odprtemu inoviranju. Pri konceptualizaciji konstrukta nagnjenosti k odprtemu inoviranju smo upoštevali multidimenzionalno naravo omenjenega koncepta. Na podlagi literature in empiričnih raziskav smo dopolnili Hungovo in Chiangovo (2010) definicijo nagnjenosti k odprtemu inoviranju in predlagali, da se nagnjenost k odprtemu inoviranju navezuje na predispozicije podjetja, ki omogočajo izvajanje različnih aktivnosti odprtega inoviranja, kot so zunanja soudeležba, nakup/najem zunanje intelektualne lastnine, sodelovanje z različnimi partnerji, najem storitev raziskav in razvoja, vključevanje kupcev, vključevanje zaposlenih, ustanavljanje novih podjetij in prodaja/oddaja intelektualne lastnine. Mero za nagnjenost k odprtemu inoviranju smo nadalje operacionalizirali z osebnimi intervjuji s številnimi strokovnjaki s področja odprtega inoviranja, s katerimi smo pregledali in prečistili listo potencialnih elementov za konstrukt nagnjenosti odprtega inoviranja (ki so bili identificirani na podlagi literature). Akademski vidik smo zajeli z intervjuji s profesorji in doktorskimi študenti, ki raziskujejo področje odprtega inoviranja, medtem ko smo poslovni vidik pridobili z intervjuji z direktorji svetovalnih podjetij, ki svetujejo na omenjenem področju, in s predstavniki podpornih institucij (razvojne agencije ipd.). S tem smo zajeli različne vidike proučevanega koncepta. Poleg tega smo intervjuvali podjetnike, s čimer smo dobili vpogled v razumevanje, variabilnost in obsežnost vprašalnika ter zmožnost podajanja odgovorov na zastavljena vprašanja. Nadalje smo listo potencialnih elementov pregledali s šestnajstimi strokovnjaki z obravnavanega področja iz devetih različnih držav. Omenjeni koraki v razvoju mere so nam omogočili maksimirati vsebinsko veljavnost mere.

Vprašalnik za kvantitativno analizo je bil pripravljen po korakih, ki so jih predlagali avtorji Dillman, Smyth in Christian (2009). Ker je bila raziskava narejena v dveh različnih državah,

je bil vprašalnik iz angleščine najprej preveden v slovenščino in nato nazaj v angleščino. S tem smo zagotovili vsebinsko enakost vprašanj. Vprašalnik je bil nato pilotno testiran na 30 podjetjih, ki se ukvarjajo z različnimi dejavnostmi. Na podlagi pilotne študije smo ocenili uspešnost posameznega elementa nagnjenosti odprtega inoviranja, kot priporoča DeVellis (2003). Na podlagi te ocene smo izključili dodatnih 10 elementov. Elektronsko anketo smo septembra 2012 poslali dva tisoč slovenskim podjetjem, ki smo jih naključno izbrali iz Poslovnega informatorja Republike Slovenije (PIRS). Prejeli smo 340 uporabnih veljavnih odgovorov (17% stopnja odziva). Ker je bil vzorec dovolj velik, smo ga naključno razdelili na dva dela ter izvedli eksploratorno faktorsko analizo na prvem delu in konfirmatorno faktorsko analizo na drugem delu vzorca. Eksploratorna faktorska analiza je pokazala šestfaktorsko rešitev s 30 spremenljivkami. Na podlagi konfirmatorne faktorske analize pa smo dodatno izključili še štiri spremenljivke. Rezultati so v splošnem potrdili zanesljivost, konvergentno in diskriminantno veljavnost mere. Zanesljivost je bila dosežena, saj je bila večina Cronbach alf višjih od določene najnižje meje 0,7. Cronbach alfa zadnjega faktorja je bila sicer malo pod mejo (0,675), vendar Hair, Black, Babin, Anderson in Tatham (2010) v eksploratorne namene dovoljujejo nižjo mejo (0,6). Na splošno sta bili doseženi tudi konvergentna veljavnost mere, saj so se povprečne pridobljene variance faktorjev gibale med 0,424 in 0,689, in diskriminantna veljavnost, ki je vezana na primerjavo povprečnih pridobljenih varianc faktorjev s skupnimi variancami med faktorji. Rezultati na slovenskem vzorcu so tako pokazali, da je nagnjenost k odprtemu inoviranju šestfaktorski konstrukt s 26 spremenljivkami. Mero smo nato testirali tudi na vzorcu italijanskih podjetij. Oktobra 2012 smo vprašalnik poslali 1250 italijanskim podjetjem, ki smo jih naključno izbrali iz Amadeusove baze, in pridobili 101 uporaben veljaven odgovor (8% stopnja odziva). Analiza na italijanskem vzorcu je v splošnem potrdila zanesljivost, konvergentno in diskriminantno veljavnost mere. Odstopanje je bilo le pri zadnjem faktorju »prodaja/oddaja intelektualne lastnine«, ki na italijanskem vzorcu ni bil potrjen. Tako rezultati italijanskega vzorca predlagajo, da je nagnjenost k odprtemu inoviranju petfaktorski konstrukt z 22 spremenljivkami. Dodaten prispevek k validaciji mere smo naredili tudi z raziskavama, predstavljenima v poglavju 2 in 3, kjer smo mero vnovič testirali na novem vzorcu slovenskih podjetij in na vzorcu podjetij iz Belgije. Rezultati so na obeh vzorcih na splošno potrdili petfaktorski konstrukt nagnjenosti k odprtemu inoviranju. S tem smo dosegli tudi četrti cilj, zastavljen v okviru doktorske disertacije, ki se navezuje na zagotovitev generalizacije nove mere za nagnjenost k odprtemu inoviranju. Opisani koraki razvoja mere za nagnjenost k odprtemu inoviranju so predstavljeni v sliki 1.

Slika 1: Koraki razvoja mere za nagnjenost podjetja k odprtemu inoviranju

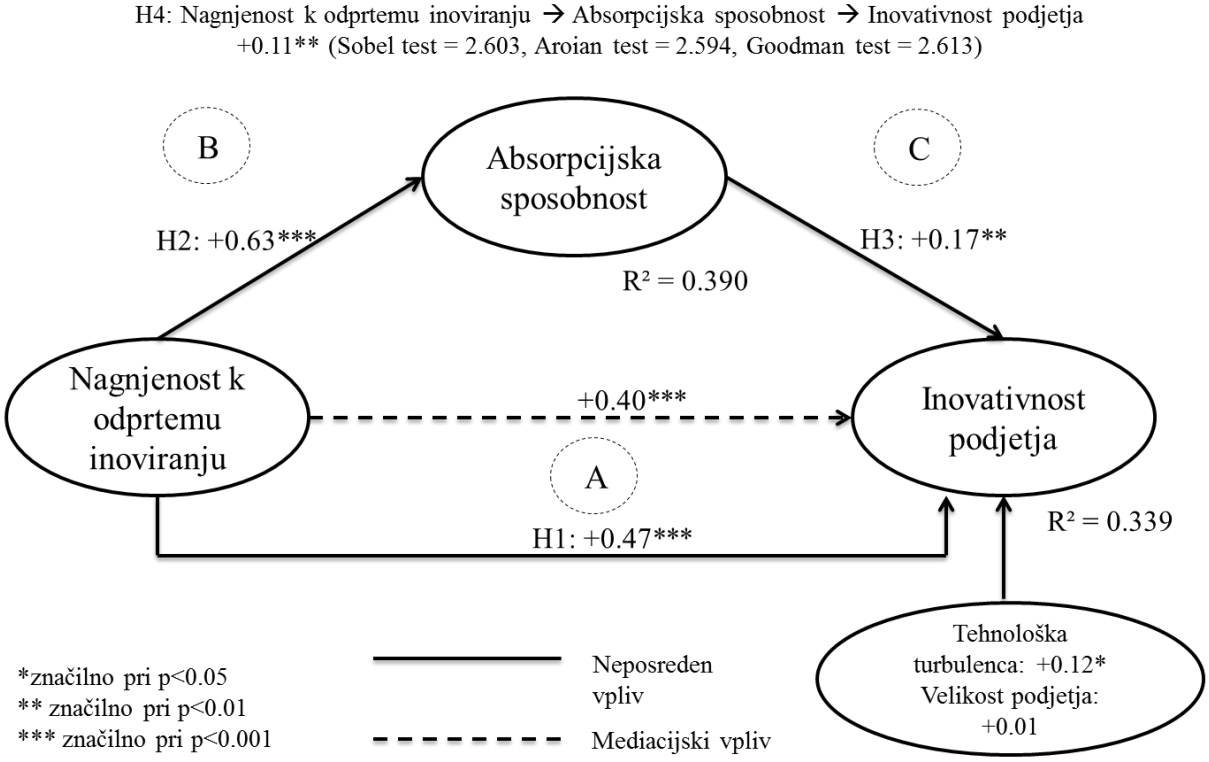


Razmerje med nagnjenostjo k odprtemu inoviranju, absorpcijsko sposobnostjo in inovativnostjo podjetja

V drugem poglavju doktorske disertacije konstrukt nagnjenosti odprtega inoviranja obravnavamo kot formalni konstrukt in empirično preverimo njegov vpliv na inovativnost podjetij. Namen tega dela disertacije je raziskati, s katerimi organizacijskimi sposobnostmi nagnjenost k odprtemu inoviranju vzajemno vpliva na inovativnost podjetja. Na podlagi teorije resursov in perspektive dinamičnih zmogljivosti smo konceptualizirali in empirično preverili model inovativnosti podjetij in njegovih determinant: nagnjenosti k odprtemu inoviranju in absorpcijska sposobnost. Na podlagi pregleda literature smo predpostavljali, da nagnjenost k odprtemu inoviranju neposredno vpliva na inovativnost podjetja in absorpcijsko sposobnost, absorpcijska sposobnost neposredno vpliva na inovativnost podjetij ter posledično igra vlogo mediatorja med nagnjenostjo k odprtemu inoviranju in inovativnostjo podjetja. Podano hipotezo neposrednega in posrednega vpliva nagnjenosti k odprtemu inoviranju in absorpcijske sposobnosti na inovativnost podjetja smo maja 2013 preverili na vzorcu 421 slovenskih podjetij iz številnih dejavnosti (večino podjetij se je uvrščalo med proizvodna podjetja, informacijsko in komunikacijsko dejavnost ter storitvena podjetja). Pred

izvedbo strukturnega modeliranja smo preverili zanesljivost, konvergentno in diskriminantno veljavnost mer, ki smo jih vključili v model. Mediacijsko vlogo absorpcijske sposobnosti smo preverili na podlagi treh korakov: postopno vključevanje povezav med konstrukti in ocena najprimernejšega modela; Sobelov, Aronianov in Goodmanov test ter koraki, ki jih priporočata Baron in Kenny (1986). Vsi trije testi so potrdili hipotezo, da ima absorpcijska sposobnost vlogo mediatorja v razmerju med nagnjenostjo k odprtemu inoviranju in inovativnostjo podjetja. Rezultati obravnavanega modela so prikazani v sliki 2.

Slika 2: Povezava med nagnjenostjo k odprtemu inoviranju, absorpcijsko sposobnostjo in inovativnostjo podjetja



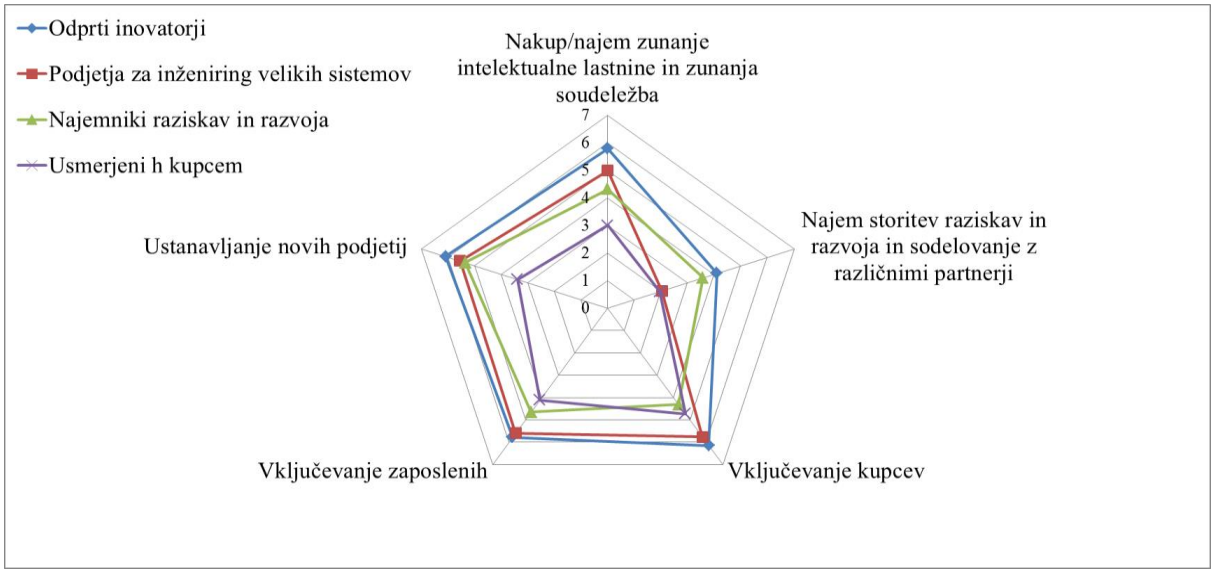
Povezanost posamezne dimenzije odprtega inoviranja z inovativnostjo podjetja in koraki za uspešno implementacijo

Tretje poglavje doktorske disertacije poda obsežen pregled aktivnosti odprtega inoviranja, njihovih prednosti in različnih načinov njihove implementacije. Na velikem vzorcu podjetij (693 podjetij) iz treh različnih držav (Slovenija, Italija in Belgija) smo opravili regresijsko analizo in tako prikazali vpliv posamezne dimenzije odprtega inoviranja na inovativnost podjetja. Rezultati te raziskave so pokazali, da vse dimenzije odprtega inoviranja pozitivno vplivajo na inovativnost podjetja (najem storitev raziskav in razvoja ter sodelovanje z različnimi partnerji: β=+0,11, $p<0.001$; vključevanje kupcev: β=+0,09, $p<0,05$; vključevanje zaposlenih: β=+0,36, $p<0,001$; ustanavljanje novih podjetij: β=+0,12, $p<0,001$), pri čemer je vpliv dimenzije nakup/najem zunanje intelektualne lastnine in zunanja soudeležba neznačilen.

Študija je pokazala, da ima največji vpliv na inovativnost podjetja od izbranih dimenzij odprtega inoviranja dimenzija vključevanje zaposlenih.

Naš vzorec podjetij iz tretje raziskave smo nato razvrstili glede na njihov rezultat izvajanja posamezne dimenzije odprtega inoviranja in tako prikazali različne oblike odprtega inoviranja, tj. različne kombinacije združevanja različnih dimenzij odprtega inoviranja. Prvo skupino smo poimenovali odprti inovatorji, saj so podjetja v tej skupini nagnjena k izvedbi vseh aktivnosti odprtega inoviranja. V skupini prevladuje delež velikih podjetij (v primerjavi z drugimi identificiranimi skupinami). Podjetja v drugi skupini so v večji meri usmerjena na trg B2B (ang. Business to Business) in izvajajo vse aktivnosti odprtega inoviranja, razen najema storitev raziskav in razvoja. To obliko odprtega inoviranja smo poimenovali podjetja za inženiring velikih sistemov. V tretjo skupino so se uvrstila podjetja, ki v večji meri izvajajo najem raziskav in razvoja, zato smo to obliko odprtega inoviranja poimenovali najemniki raziskav in razvoja. V četrti skupini pa so se znašla manjša, potrošniško usmerjena podjetja, ki od omenjenih aktivnosti odprtega inoviranja aktivno izvajajo le vključevanje uporabnikov v proces razvoja novih inovacij, zato smo to obliko odprtega inoviranja poimenovali usmerjeni h kupcem. Različne oblike odprtega inoviranja so predstavljene v sliki 3.

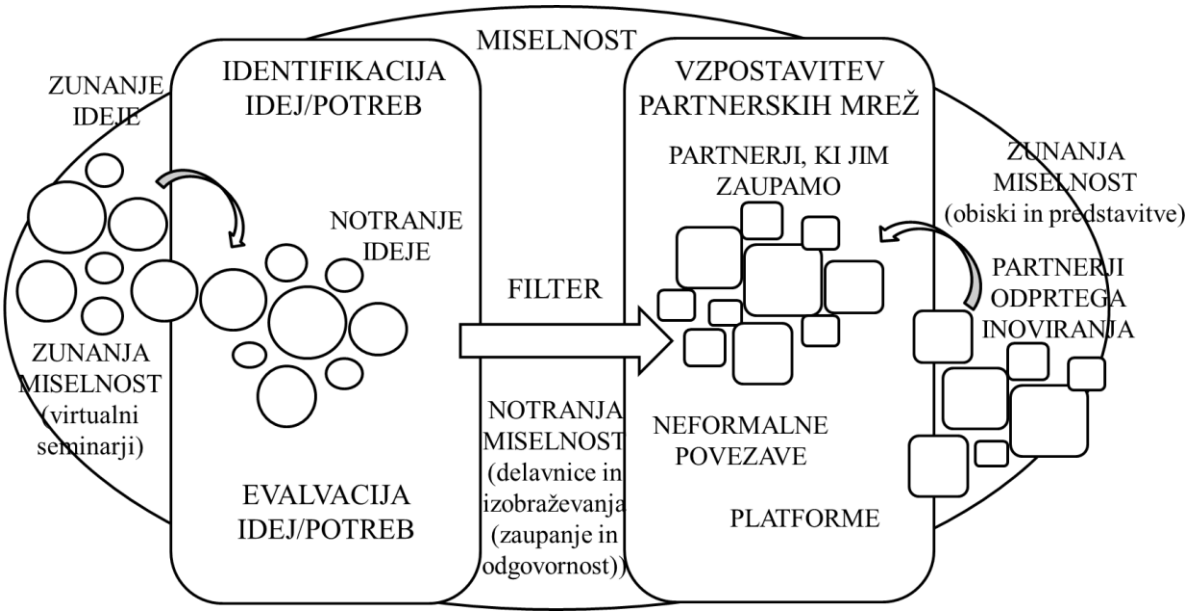
Slika 3: Različne oblike odprtega inoviranja



Tretje poglavje doktorske disertacije poda tudi napotke, kako uspešno implementirati odprto inoviranje v organizaciji. Na podlagi intervjujev z direktorji podjetij smo podali štiri glavne korake uspešne integracije. Prvi korak se nanaša na identifikacijo potencialnih idej za nove/izboljšane proizvode/storitve znotraj in zunaj podjetja. Drugi korak se nanaša na evalvacijo identificiranih idej na podlagi treh meril (priložnost za kupce, priložnost za podjetje in partnerske možnosti). Tretji korak predstavlja vzpostavitev partnerske mreže z različnimi (poznanimi in nepoznanimi) partnerji, ki lahko pripomorejo k razvoju inovacije. Četrti korak pa se nanaša na pomen človeškega faktorja pri implementaciji odprtega

inoviranja, tj. spodbuda za razvoj odprte miselnosti znotraj in zunaj podjetja. Koraki uspešne implementacije odprtega inoviranja so predstavljeni v sliki 4.

Slika 4: Koraki za uspešno implementacijo odprtega inoviranja



Povzetek implikacij

Doktorska disertacija prispeva k teoretičnemu delu na temo odprtega inoviranja, k metodologiji in k poslovni praksi, kot je predstavljeno v nadaljevanju.

Teoretične implikacije

Prvi prispevek k teoriji se nanaša na konceptualizacijo in empirično preverbo mere za nagnjenost k odprtemu inoviranju. Čeprav je vedno več raziskav na temo odprtega inoviranja, v literaturi primanjkuje konceptualizacije in empirične preverbe konstrukta, ki upošteva večdimenzionalnost odprtega inoviranja. Tako z opredelitvijo in integracijo dimenzij odprtega inoviranja v skladen konstrukt nagnjenosti k odprtemu inoviranju in njegovo empirično preverbo na štirih različnih vzorcih prispevamo osnovo za prihodnje sistematično raziskovanje odprtega inoviranja. Poleg tega k teoretičnemu in empiričnemu delu na temo odprtega inoviranja prispevamo s prikazom medsebojne povezanosti različnih dimenzij nagnjenosti k odprtemu inoviranju. Na podlagi rezultatov razkrijemo, da dimenziji zunanja soudeležba in nakup/najem zunanje intelektualne lastnine kreirata eno razsežnost odprtega inoviranja. Podobno sta se dimenziji najem storitev raziskav in razvoja ter sodelovanje z različnimi partnerji združili v eno. Ob tem, v skladu z literaturo, pokažemo, da sta izraba notranjih virov ter raziskovanje in izkoriščanje zunanjih virov dve razsežnosti znotraj odprtega inoviranja s skupnim ciljem izboljšati uspešnost organizacije. Omenjene ugotovitve pomembno prispevajo k literaturi na temo odprtega inoviranja, saj omogočajo boljše

razumevanje mehanizmov in njihovih povezav, ki stojijo za konceptom odprtega inoviranja. Poleg tega z razvojem in empirično preverbo mere za nagnjenost k odprtemu inoviranju, ki je lahko uporabljena v različnih geografskih in organizacijskih okvirjih ter prilagojena za različne dejavnosti podjetij, omogočimo boljšo podlago za nadaljnje kvalitativne študije na to temo.

Drug prispevek k teoriji se nanaša na rezultate strukturnega modeliranja enačb. S postavitvijo konstrukta nagnjenosti podjetja k odprtemu inoviranju v teoretični model soodvisnosti z drugimi organizacijskimi konstrukti pokažemo njihov skupni vpliv na uspešnost podjetja. Naša študija se razlikuje od obstoječih, saj vključuje večdimenzionalno naravo konstruktov nagnjenosti k odprtemu inoviranju in absorpcijske sposobnosti. S tem pripomoremo k boljšemu razumevanju njunega skupnega vpliva na inovativnost podjetja. Obstoječe raziskave so verjetno neskladne ravno zaradi uporabe približnih mer. Gre za eno od redkih študij, vezanih na odprto inoviranje, ki temelji na kvantitativni raziskavi in uporablja tehnike multivariatne analize. Tako k literaturi na temo odprtega inoviranja prispevamo s prikazom, kako nagnjenost k odprtemu inoviranju z drugimi organizacijskimi korelati sovpliva na inovativnost podjetja. K teoriji absorpcijske sposobnosti prispevamo s prikazom predhodnikov te sposobnosti, ki so v literaturi slabo zastopani (Jansen et al., 2005). Poleg tega prispevamo k teoriji resursov s prikazom, kako različne organizacijske sposobnosti skupno vplivajo na inovativnost podjetja. Raziskava poudarja pomen interakcij med organizacijskimi zmožnostmi pri doseganju boljše inovativnosti podjetja. S prikazom, kako morajo podjetja usmeriti svoje zmožnosti, da od njih pridobijo največji izkoristek, prispevamo tudi k perspektivi dinamičnih zmogljivosti, kateri primanjkuje dokazov o soodvisnem delovanju le-teh.

Tretji prispevek k teoriji je vezan na obsežen pregled različnih aktivnosti odprtega inoviranja. V tretjem poglavju podamo sistematičen pregled večdimenzionalnega konstrukta odprtega inoviranja in njegovih aktivnosti, ki so v literaturi razpršene po različnih študijah. Poleg tega prikažemo, kako posamezna dimenzija odprtega inoviranja vpliva na inovativnost podjetja, kako so različne oblike odprtega inoviranja povezane z inovativnostjo podjetja, ter podamo nasvete, kako uspešno implementirati procese odprtega inoviranja v organizaciji z upoštevanjem človeškega faktorja. Omenjeni empirični dokazi prispevajo k literaturi na temo odprtega inoviranja, ki ji primanjkuje obravnave večdimenzionalnega konstrukta kot celote ter razlage vpliva različnih dimenzij in oblik odprtega inoviranja na inovativnost podjetja. Poleg tega večina obstoječih študij na temo odprtega inoviranja kljub njegovi pomembnosti ne upošteva človeškega vidika, ki je vpeljan in predstavljen v naši tretji raziskavi.

Metodološke implikacije

Doktorska disertacija prispeva številne metodološke implikacije. Prva se nanaša na razvoj in uporabo zanesljive in veljavne mere za nagnjenost k odprtemu inoviranju. Razvijajoča znanstvena spoznanja morajo temeljiti na razvitih in operacionaliziranih konstruktih, ki omogočajo testiranje teorije (Netemeyer et al., 2003). Le veljavne in zanesljive mere prispevajo k naraščajočemu razvoju tematike (Crook et al., 2010). Gre za prvo študijo, ki je konceptualizirala, operacionalizirala in empirično testirala konstrukt, vezan na koncept odprtega inoviranja, ter pri tem upoštevala večdimenzionalnost omenjenega koncepta.

Drugič, s kvalitativno raziskavo na velikem empiričnem vzorcu metodološko prispevamo tako k literaturi na temo odprtega inoviranja kot tudi k perspektivi dinamičnih zmožnosti, ki sta v preteklosti večinoma temeljili na konceptualnih člankih in študijah primerov s ciljem graditve teorije. S strukturnim modeliranjem enačb naslovimo željo Huizingha (2011) po raziskavah, vezanih na odprto inoviranje, ki bi vključevale kompleksnejše modele (z vključenimi moderacijskimi in/ali mediacijskimi vplivi) ter prispevale k boljšemu razumevanju verige vplivov povezanih konstruktov.

Tretjič, raziskave smo opravili v treh različnih nacionalnih okoljih. Razvoj in empirično preverbo mere za nagnjenost k odprtemu inoviranju smo opravili v Sloveniji ter validirali v Italiji, strukturno modeliranje enačb smo naredili na podlagi ankete, opravljene na novem vzorcu v Sloveniji, tretja analiza pa je poleg slovenskega in italijanskega vzorca vključevala še podjetja iz Belgije. Testiranje novorazvite mere na različnih vzorcih, v različnih geografskih in časovnih okvirjih prispeva h generalizaciji mere (Netemeyer et al., 2003). Čeprav smo bili pri konceptualizaciji in samem procesu razvoja mere zelo natančni in je bila mera testirana na štirih različnih vzorcih, so potrebna dodatna testiranja še na drugih vzorcih in v drugih geografskih okoliščinah. Ta bodo potrdila, zavrnila ali dopolnila listo dimenzij in elementov konstrukta nagnjenosti k odprtemu inoviranju, ki smo jih identificirali v naši študiji.

Četrtič, v treh študijah smo vpeljali in združili kvalitativne in kvantitativne raziskovalne metode. Kvalitativne metode smo uporabili pri prvih korakih razvoja mere, pri raziskovanju osnov koncepta odprtega inoviranja, s poglobljenim pregledom literature. Preiskali smo številne spletne bibliografske baze podatkov, kot so Science Direct, Proquest, EBSCOhost, Emerald Fulltext in druge. Poleg tega smo pregledali najnovejše izdaje najpomembnejših revij s področja inovativnosti, managementa in podjetništva, kot so Technovation, Research Policy, R&D Management, Academy of Management Journal in druge. Nadaljevali smo z intervjuji s številnimi strokovnjaki s področja odprtega inoviranja s ciljem prečistiti mero. Intervjuvali smo tudi direktorje slovenskih podjetij z namenom testiranja mere. Kvalitativno raziskovalno metodo v obliki intervjujev smo opravili tudi pri tretji raziskavi z željo po razjasnitvi in boljšem razumevanju aktivnosti, ki se skrivajo za posameznimi dimenzijami odprtega inoviranja ter identificiranju njihovih prednosti. Kvantitativne raziskovalne tehnike smo

uporabili za testiranje in validiranje mere za nagnjenost k odprtemu inoviranju, pri raziskovanju njenega vpliva na druge teoretično povezane konstrukte, pri opredelitvi vpliva posamezne dimenzije odprtega inoviranja na inovativnost podjetja ter za razvrstitev podjetij v skupine glede na njihovo izvedbo dimenzij nagnjenosti k odprtemu inoviranju. Zbrani podatki so bili analizirani s pomočjo opisnih statistik, analize korelacije, analize variance, analize zanesljivosti, eksploratorne faktorske analize, konfirmatorne faktorske analize, modeliranja strukturnih enačb, regresijske analize in analize skupin.

Praktične implikacije

Disertacija poleg teoretičnih in metodoloških implikacij prispeva tudi številne implikacije za poslovno prakso.

Prvič, z identificiranjem in definiranjem glavnih dimenzij in elementov nagnjenosti k odprtemu inoviranju pomagamo managerjem pri identifikaciji možnosti, ki jih ima njihovo podjetje za izkoriščanje notranjih virov ter znanja in tehnologije od zunaj. Poleg tega opišemo številne načine implementiranja različnih aktivnosti odprtega inoviranja, na podlagi česar lahko managerji ocenijo in se odločijo, katere aktivnosti so najbolj primerne za njihovo poslovanje. Prva študija poudarja pomen razvoja različnih dimenzij odprtega inoviranja in ne le fokusiranja na specifično dimenzijo. V drugem poglavju pokažemo, da združitev vseh dimenzij nagnjenosti k odprtemu inoviranju pozitivno vpliva na inovativnost podjetja. Miselnost, da združitev različnih dimenzij odprtega inoviranja pozitivno vpliva na uspešnost podjetja, je razvidna tudi iz poslovne prakse. Na primer, multinacionalka Deutsche Telekom je uspešno spodbudila svoje inovacijske sposobnosti z vključitvijo številnih aktivnosti odprtega inoviranja, kot so sodelovanje z različnimi partnerji, vključevanje kupcev in zunanja soudeležba (Rohrbeck et al., 2009). Podobno se je podjetje Nokia konec 20. stoletja spoprijelo s spreminjajočim se tehnološkim okoljem: z vključitvijo različnih aktivnosti odprtega inoviranja (kot so sodelovanje z različnimi partnerji, najem storitev raziskav in razvoja, nakup/najem zunanje intelektualne lastnine) v proces razvoja novih proizvodov so sledili cilju vstopa na nove trge (Dittrich & Duysters, 2007). Glede na to, da večja odprtost pomeni več priložnosti za razvoj novih proizvodov/storitev in vstop na nove trge, bi morali managerji stremeti k razvoju vseh aktivnosti odprtega inoviranja.

Drugič, naša študija poudarja pomen mreženja in sodelovanja, ki omogoča dostop do zunanjih virov. Z raziskavo prikažemo, da sodelovanje z različnimi partnerji (v povezavi z drugimi dimenzijami odprtega inoviranja) pozitivno vpliva na inovativnost podjetja. Pomen povezovanja z različnimi deležniki je na primer razviden v biofarmacevtski industriji, kjer podjetja vzpostavijo sodelovanje z različnimi partnerji, od velikih farmacevtskih multinacionalk do majhnih biotehnoloških podjetij in univerz, odvisno od cilja, ki ga zasledujejo; pridobiti ali komercializirati znanje in tehnologijo (Bianchi et al., 2011).

Tretjič, disertacija poudarja pomen medsebojne povezanosti različnih organizacijskih zmožnosti. Druga raziskava pokaže, da ima implementacija odprtega inoviranja večji vpliv na inovativnost podjetja, ko so zraven sprožene tudi druge organizacijske zmožnosti. Pozitiven vpliv odpiranja inovacijskega procesa na inovativnost podjetja je namreč povečan, če ima podjetje absorpcijsko sposobnost, tj. sposobnost modifikacije in združitve na novo pridobljenega znanja z obstoječim. Zato morajo biti managerji pozorni, katero organizacijsko sposobnost bodo spodbudili, saj lahko ta pozitivno ali negativno vpliva tudi na druge.

Četrtič, obsežna predstavitev odprtega inoviranja in njegovih aktivnosti lahko pomaga managerjem uvideti obilje in neskončne možnosti, ki jih ta koncept ponuja. Z opredelitvijo vpliva posamezne dimenzije odprtega inoviranja na inovativnost podjetja ter s prikazom različnih oblik odprtega inoviranja lahko pripomoremo k lažji odločitvi managerjev, katero dimenzijo odprtega inoviranja najbolj stimulirati. Rezultati so pokazali, da več aktivnosti odprtega inoviranja podjetje izvaja, večja je možnost povečane inovativnosti podjetja, zato morajo managerji stremeti k temu, da bi spodbudili čim več aktivnosti odprtega inoviranja. Z opredelitvijo korakov za uspešno implementacijo odprtega inoviranja pomagamo managerjem razumeti, kako uspešno implementirati procese odprtega inoviranja v njihovih organizacijah. Ob tem naša raziskava poudarja pomen človeškega faktorja in vključevanja zaposlenih, kar nakazuje, da morajo managerji veliko pozornosti posvetiti tudi razvoju odprte miselnosti zaposlenih in zunanjih partnerjev ter osebnemu razvoju in aktivni participaciji vseh zaposlenih.