

# **PROCLIVITY FOR OPEN INNOVATION: CONSTRUCT DEVELOPMENT, DETERMINANTS AND OUTCOMES**

**KAJA RANGUS**

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

# STRUCTURE

- **Proclivity for open innovation: construct development and cross-cultural validation**
- **The interplay between absorptive capacity and proclivity for open innovation in impacting innovation performance**
- **Different modes of openness and their influence on firm's innovation performance**

**Introduction**

**Lits +**

**Analysis + Results**

**Hypotheses**

**Implications**

**Limitations + Future  
research**

# RESEARCH GOALS

## Chapter 1

*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.

Chapter 2 + Chapter 3

# RESEARCH GOALS

## Chapter 2

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

## Chapter 3

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

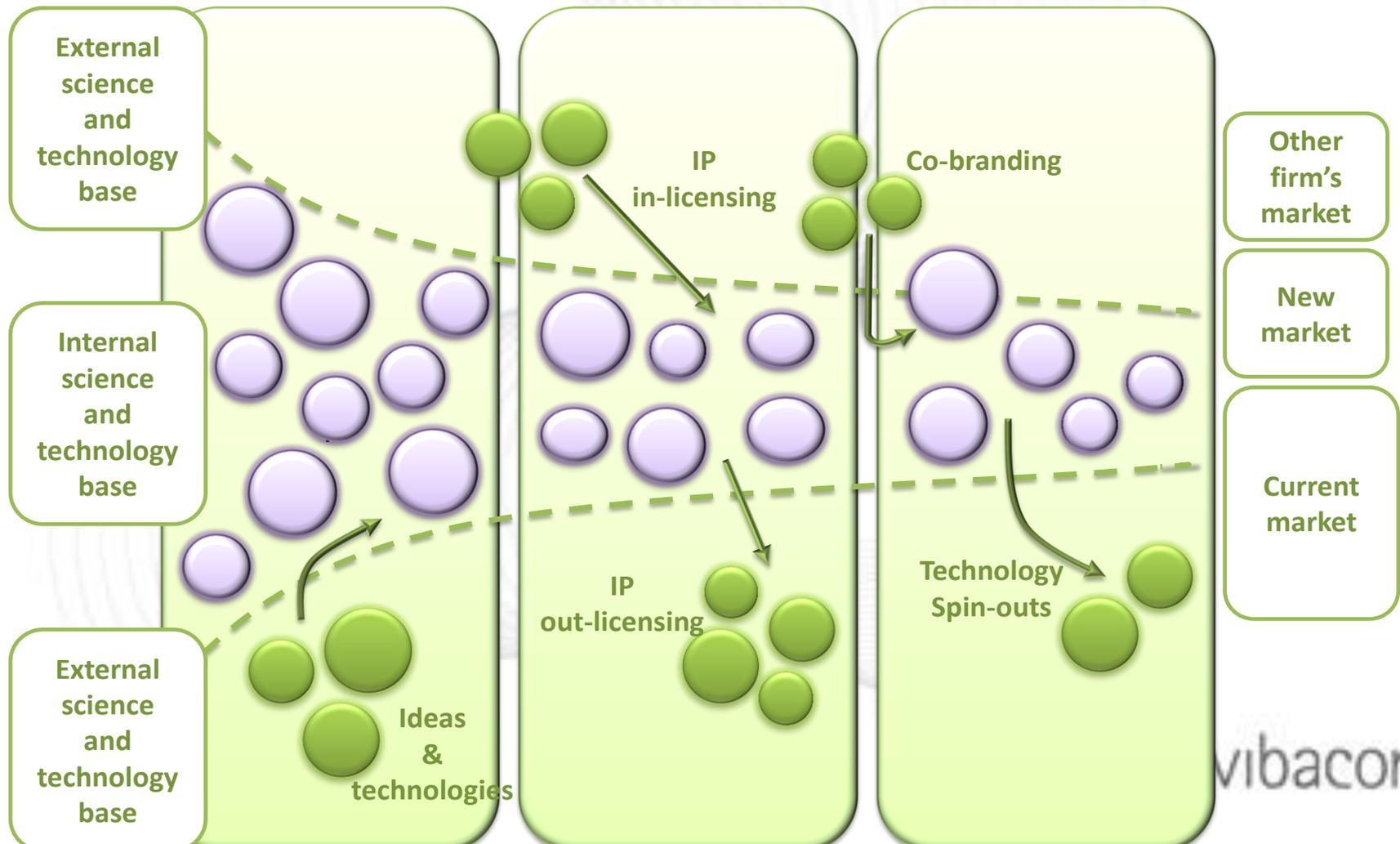
*Research goal 7:* To indicate different modes of open innovation.

*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.

# OPEN INNOVATION

*„Open innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation“ (Chesbrough, 2006).*



# OPEN INNOVATION

Inbound open  
innovation

Technology  
exploration

*Acquiring of the  
knowledge and  
technology from outside*

Outbound open  
innovation

Technology  
exploitation

*Selling IP and transferring  
internal ideas outside  
firm`s boundaries*

## Proclivity for open innovation: construct development and cross-cultural validation

*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.

Kaja Rangus

dr. Mateja Drnovšek

dr. Alberto Di Minin

Aspects OI	Author(s)	Type of measure
Degree of openness	Barge-Gil (2010)	Adapted from CIS survey
	Lazzarotti, Manzini and Pellegrini (2010)	New measure
	Teirlinck and Spithoven (2008)	CIS
Open innovation proclivity	Hung and Chiang (2010)	New measure
Open innovation climate	Remneland-Wikhamn and Wikhamn (2011)	Adapted from Patterson et al.'s (2005)
Inbound open innovation	Bahemia and Squire (2010)	New measure (Conceptual model)
	Laursen and Salter (2006)	Adapted from U.K. innovation survey
	Inauen and Schenker-Wicki (2011)	New measure
Outbound open innovation	Inauen and Schenker-Wicki (2012)	New measure
	Lichtenthaler (2009)	Adapted from Gambarela 2007
Open innovation practices	Acha (2008)	Adapted from U.K. Innovation Survey
	Chesbrough and Crowther (2006)	New measure (Qualitative study)
	Lichtenthaler (2008), Lichtenthaler and Ernst (2009)	New measure
	Santamaría, Nieto and Barge-Gil (2010)	Spanish Business Strategies Survey (SBSS)
	Schroll and Mild (2011)	Adapted from different authors
	van de Vrande, de Jong, Vanhaverbeke and de Rochemont (2009)	Adapted from EIM Survey

Construct  
definition

Generation of  
an item pool

In depth literature review of open innovation

Venturing

Outward IP  
licensing

Employee  
involvement

Customer  
involvement

External  
networking

Outsourcing R&D

External  
participation

Inward IP  
licensing

**PROCLIVITY  
FOR OPEN  
INNOVATION**

„Firm's predisposition to perform open innovation activities, such as:

- venturing,
- outward IP licensing,
- employee involvement,
- customer involvement,
- external networking,
- external participation,
- inward IP licensing,
- outsourcing of R&D.”

## Content validity

10 experts  
from Slovenia

10  
entrepreneurs  
from Slovenia

16 foreign  
experts from 9  
different  
countries

## Pilot study

30 companies → evaluation  
of the performance of the  
individual item:

- item-scale correlations
  - items` variances
  - items` means
- frequencies of responses
  - content domain
- Cronbach`s alpha: 0.894

## Sampling and data analysis

September 2012

338 companies from Slovenia (17% response rate)

## Dimensionality

EFA:

- 6 factor solution – 30 variables
- factor loadings above 0.45
- 54.4% of the total variance

CFA - 26 variables:

- 1 variable nonsignificant loading
- 3 variables: standardized loadings below 0.5

## Reliability

Cronbach's alphas:  
from  
0.783 to 0.882

Construct reliability  
(CR): from 0.786 to  
0.886

## Construct validity

Convergent validity ✓

Discriminant validity ✓

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

# CONTENT VALIDITY

Literature review

identified 121 items

67 items

Revision by Slovenian experts and entrepreneurs

55 items

Revision by foreign experts

55 items

CONSTRUCT:  
PROCLIVITY FOR OPEN INNOVATION

Pilot study

45 items

26 items

# DIMENSIONALITY AND CONSTRUCT VALIDITY

Confirmatory factor analysis

30 items

Exploratory factor analysis

26 items

# PROCLIVITY FOR OPEN INNOVATION

7 items

1. Factor: External participation and inward IP licensing

6 items

2. Factor: Outsourcing R&D and external networking

4 items

3. Factor: Customer involvement

4 items

4. Factor: Employee involvement

3 items

5. Factor: Venturing

2 items

6. Factor: Outward IP licensing

# Cross-validation of the scale

97 companies from Italy (8% response rate)

## Dimensionality

- CFA:
- 5 factor solution – 22 variables
  - 6. factor “outward IP licensing” not supported

## Reliability

Cronbach’s alphas:  
from  
0.761 to 0.877

Construct reliability  
(CR): from 0.808 to  
0.880

## Construct validity

Convergent  
validity ✓

Discriminant  
validity ✓

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

# CONTRIBUTIONS

- A revision of the existing definition of open innovation proclivity, empirical validation of its reliability, convergent and discriminant validity.
- The interrelatedness of different dimensions of open innovation.
- The study can help managers to identify competencies that their organizations possess to exploit internal and explore the potential of the outside knowledge and technology.

# LIMITATIONS and FUTURE RESEARCH

- Potential problem: the common method variance.
- Longitudinal analyses are needed in the future to assess organizational parameters that tend to vary over time.
- Conceptual model tested only on a sample of companies from one country → Forthcoming research should test the measure in other organizational and ecological settings.
- Quantitative studies exploring mediating and moderating mechanisms between OI and firm`s performance.

# The interplay between absorptive capacity and proclivity for open innovation in impacting innovation performance

Kaja Rangus  
dr. Mateja Drnovšek  
dr. Alberto Di Minin  
dr. André Spithoven

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

# ABSORPTIVE CAPACITY

*„A firm's ability to recognize the value of new information, assimilate it, and apply it to commercial ends“ (Cohen & Levinthal, 1990).*

*„A set of organizational routines and processes by which firms acquire, assimilate, transform and exploit knowledge to produce a dynamic organizational capability“ (Zahra & George, 2002).*

Absorptive capacity

Open innovation



Laursen and Salter (2006)

Absorptive capacity



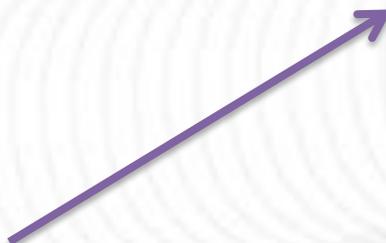
Escribano, Fosfuri, and Tribó (2009)

Open innovation



Innovation performance

Absorptive capacity



Fosfuri and Tribó (2008)

Open innovation



Innovation performance

com

# Theoretical background

- Resource-based view (Barney, 1986, 1991; Wernerfelt, 1984): „Valuable, rare, imperfectly imitable and non-substitutable resources enable sustained competitive advantage of an organization.“
- Dynamic capabilities (Teece et al., 1997): „firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments.“

# Theoretical background

- 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. Proclivity for open innovation can be seen as a firm's dynamic capability since it integrates the processes that are needed in adapting to the environmental changes.
- Absorptive capacity has been recognized as an important component of firm's dynamic capabilities as it enables firms to learn from partners, reach external information and transform and integrate it with its existing knowledge base (Wang & Ahmed, 2007).

# Hypotheses development

- Organizations that have 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 exploitation of more innovative opportunities, which positively impacts a firm's innovation performance (Laursen & Salter, 2006).

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

# Hypotheses development

- Studies have shown that significant antecedents to absorptive capacity involve interaction with external knowledge sources, such as licensing and contractual agreements, collaboration with different partners, including R&D consortia, alliances, and joint ventures (Zahra & George, 2002), which all 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 helps organizations to develop better routines for understanding and dealing with external knowledge flows (Fosfuri & Tribó, 2008).

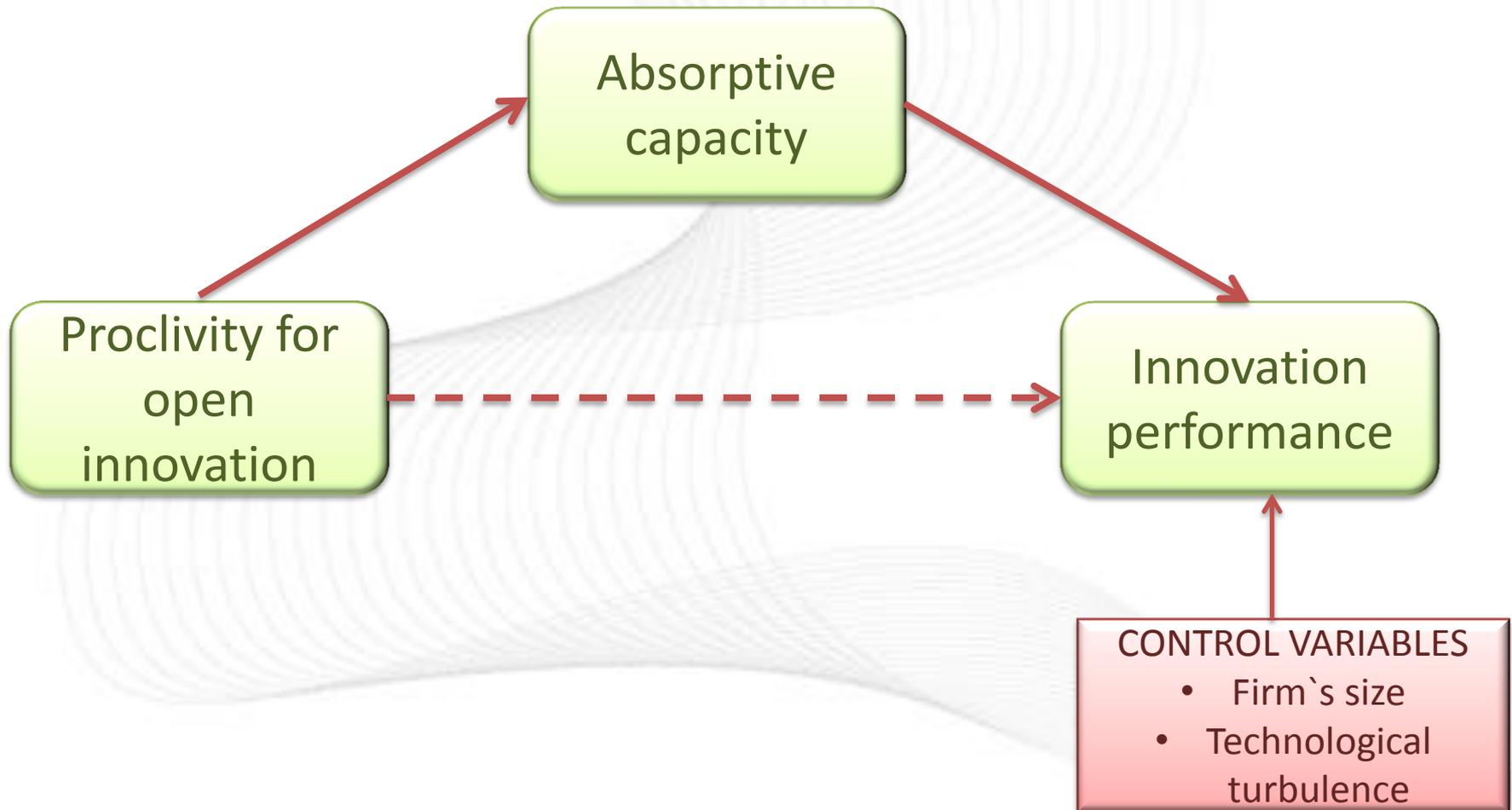
*H2: There is a direct positive relationship between proclivity for open innovation and absorptive capacity.*

# Hypotheses development

- 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 a 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).

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

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



## Sampling and data analysis

May/June 2013

421 companies from Slovenia (21.1% valid response rate)

## Measures

- Proclivity for open innovation (Rangus, Drnovšek & Di Minin, 2013)
- Realized absorptive capacity (Kotabe, Jiang & Murray, 2011)
  - Innovation (Jiménez-Jiménez & Sanz-Valle, 2011)
    - Firm`s size (Employees, TA, TS)
  - Market uncertainty (Kotabe, Jiang & Murray, 2011)

## Data analyses

Internal consistency, dimensionality and validity

- IBM SPSS Statistics 20, Lisrel 8.80

Structural equation modelling (testing the hypothesis)

- Lisrel 8.80

Three tests for checking for the mediation effect of absorptive capacity:

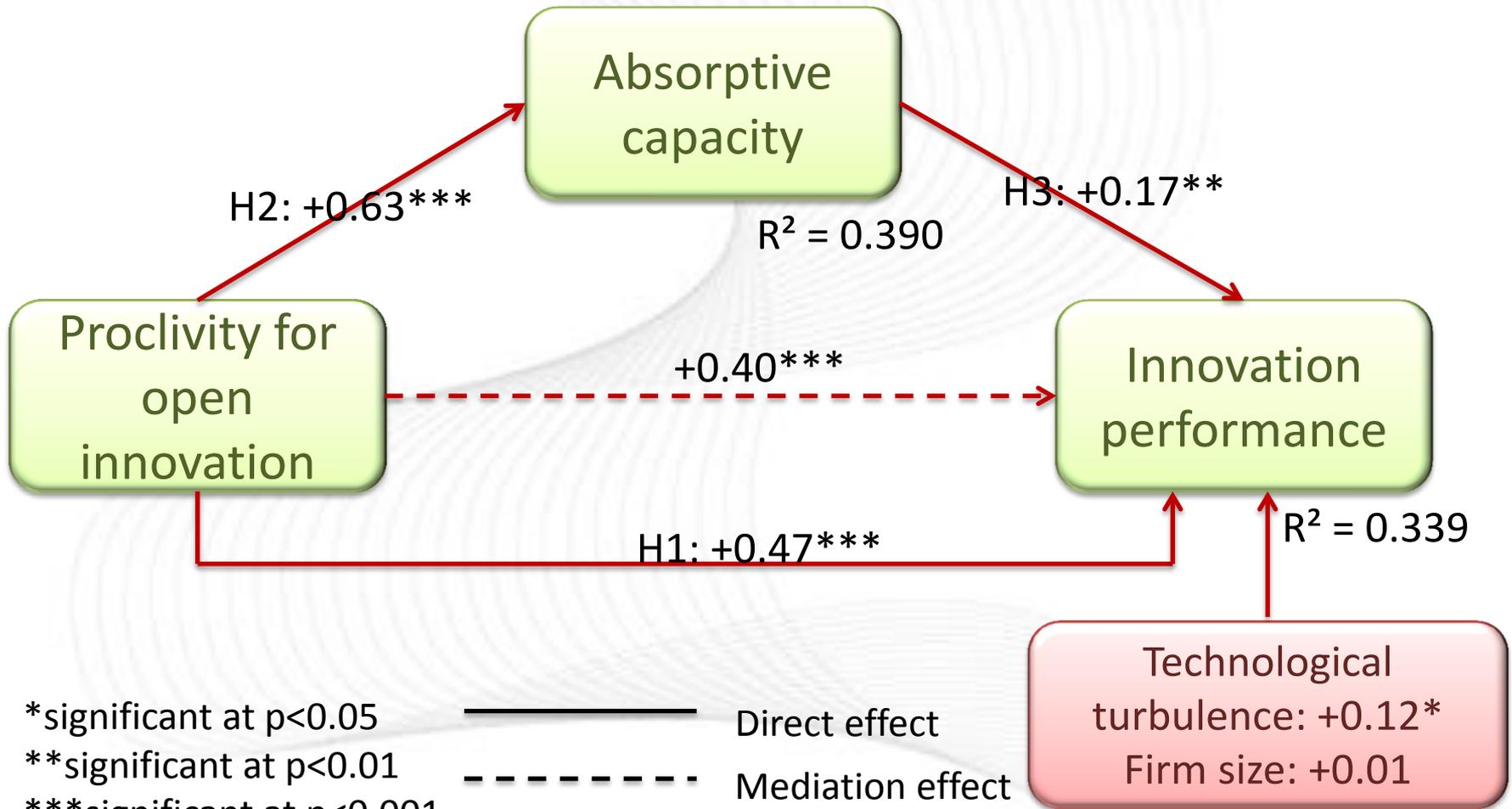
1. step-by-step inclusion of the paths to assess the best fitting model
2. the Sobel, Aroian and Goodman tests
3. steps recommended by Baron and Kenny (1986)

	Model 0	Model 1	Model 2
$\chi^2$	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

**$\beta = 0.11, p < 0.01$ :**  
**Sobel test = 2.603**  
**Aroian test = 2.594**  
**Goodman test = 2.613**

	Total	Direct	Indirect
<b>No mediation</b>			
Proclivity for open innovation → Innovation	0.47***	0.47***	-
Technological turbulence → Innovation	0.15**	0.15**	
Firm size → Innovation	-0.03	-0.03	
<b>Mediation</b>			
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	

**H4: Proclivity for open innovation → Absorptive capacity → Innovation +0.11\*\* (Sobel test = 2.603, Aroian test = 2.594, Goodman test = 2.613)**



# Contributions

- To the theory of absorptive capacity by providing the evidence on the antecedents of this capability which can be triggered with firm's proclivity for open innovation.
- To the work on open innovation, taking into consideration the multidimensional nature of the concept. → We provide the evidence on the chain of effects of the organizational correlates in impacting firm's innovation performance.
- 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.
- To the dynamic capabilities framework: Most prior studies on dynamic capabilities used longitudinal and qualitative research with an aim of theory building that do not reveal under what circumstances and how firms should direct their resources and capabilities. Our study set dynamic capabilities in a nomological network and showed how they jointly effect firm's innovation performance.

# Limitations and future research

- The use of cross-sectional data → Future research will profit from **longitudinal designs** that provides additional insights about the hypothesized relationships in the model.
- The survey was conducted in one national context → **the replication of the model** in other countries could deliver further insights and support the generalizability of the results.
- **Other potential moderation and mediation effects** may be present in the relationship between proclivity for open innovation and firm's innovation performance.
- Future studies should also include **the role of individuals** (top management as well as employees) in the model (using a multilevel approach with cross-level interactions).

## Different modes of openness and their influence on 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.

Kaja Rangus

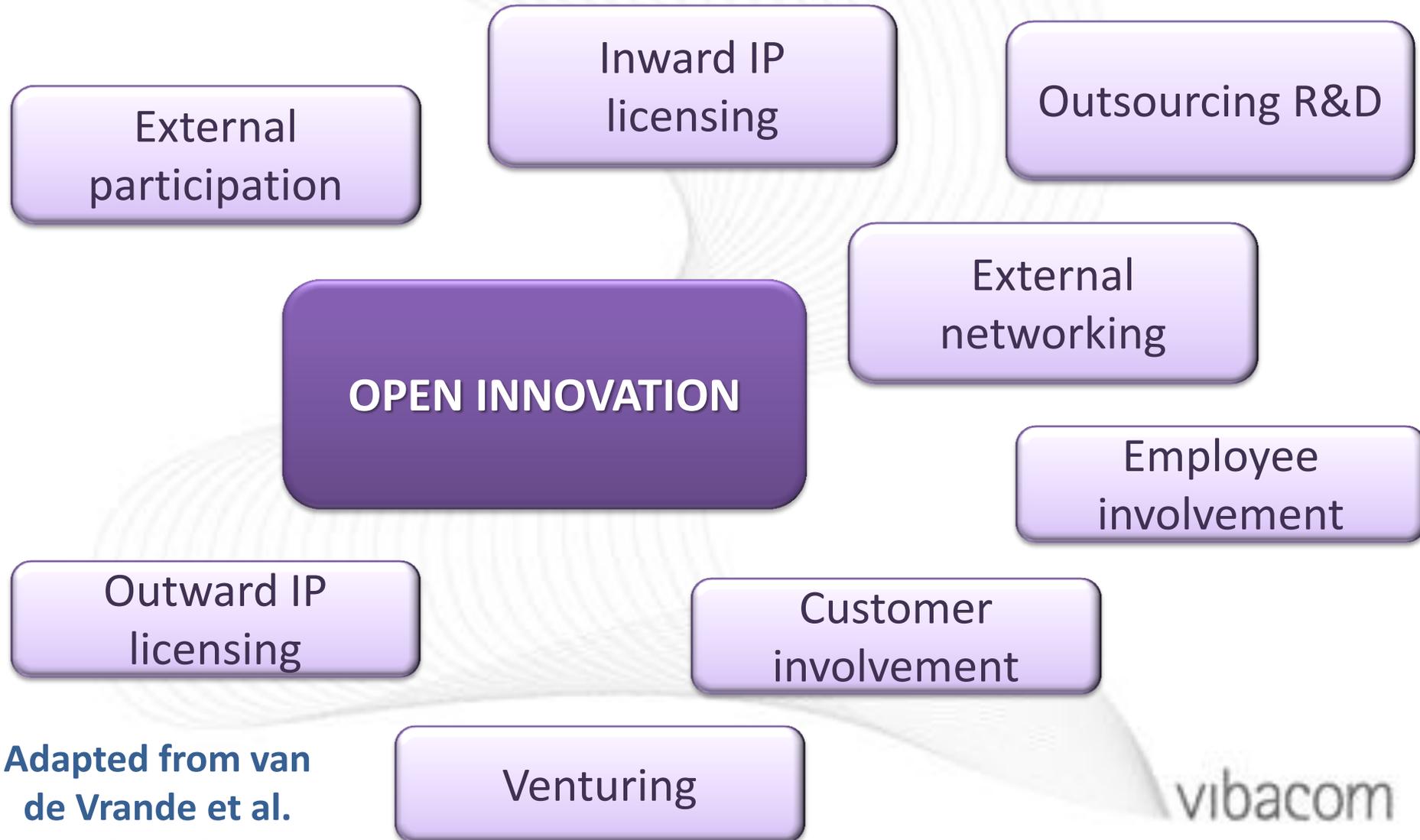
dr. Mateja Drnovšek

dr. Alberto Di Minin

# Introduction

- Existing research mostly has focused on only one of open innovation dimensions.
- This narrow view hinders the understanding of the complexity of open innovation phenomenon and its activities.
- How can different open innovation dimensions be implemented?
- How do different dimensions of open innovation influence innovation performance?
- Do different modes of open innovation exist?
- Are companies that are highly intense on all open innovation dimensions superior innovators?

# Dimensions of open innovation



Adapted from van  
de Vrande et al.  
(2009)

## Sampling and data analysis

693 companies from three countries:

99 companies from Italy (Amdeus database; October 2012)

421 companies from Slovenia (PIRS; May/June 2013)

173 companies from Belgium (BELFirst database; June 2013)

## Measures

- Proclivity for open innovation (Rangus, Drnovšek and Di Minin, 2013)
  - Innovation (Jiménez-Jiménez & Sanz-Valle, 2011)
    - Firm size (number of employees)
- Firm industry (manufacturing, service, construction and public sector)

## Data analyses

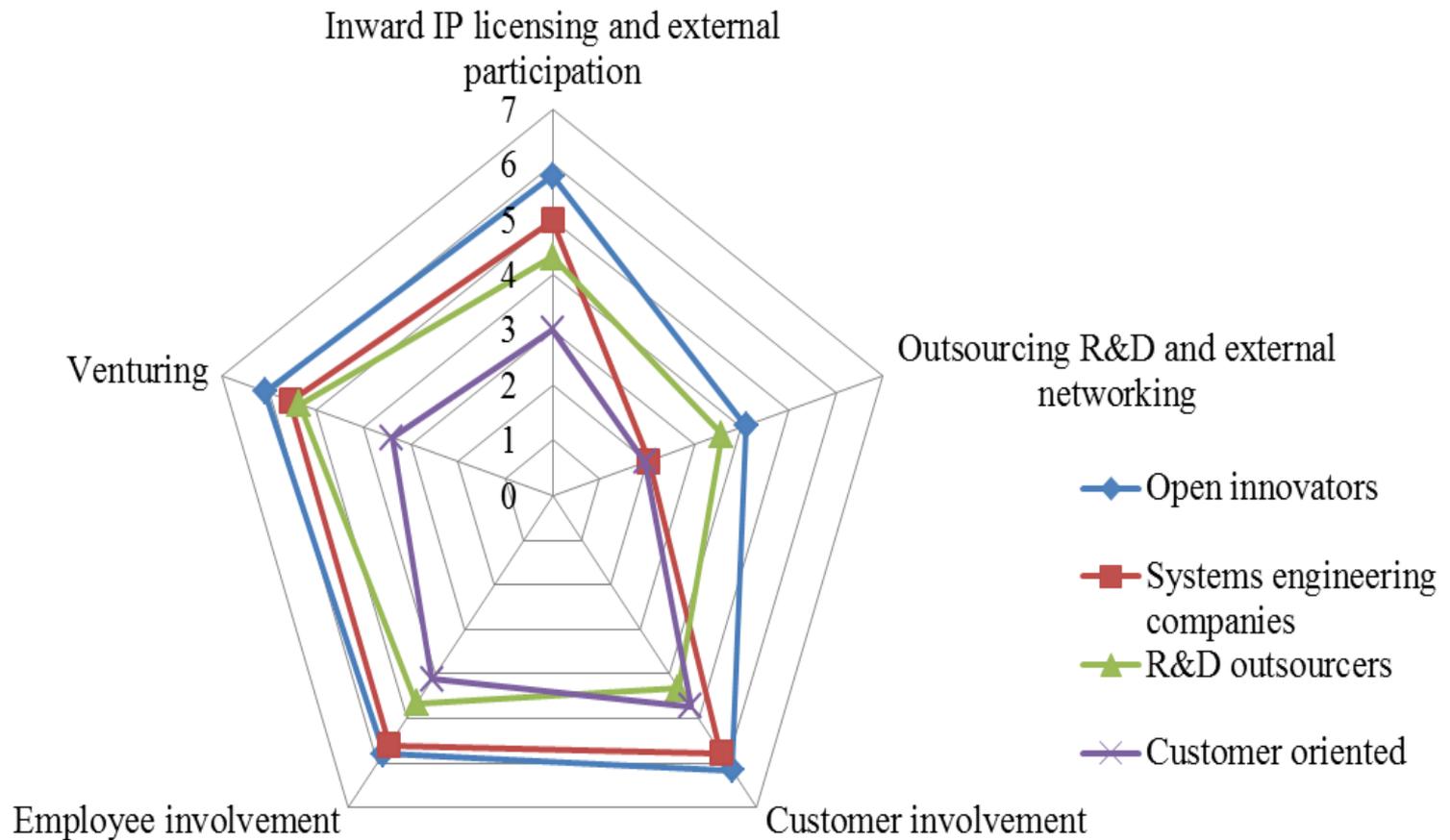
- IBM SPSS Statistics 20

- Linear regression analysis
- Cluster analysis: Hierarchical technique (Ward's method and squared Euclidian distances) + K-means

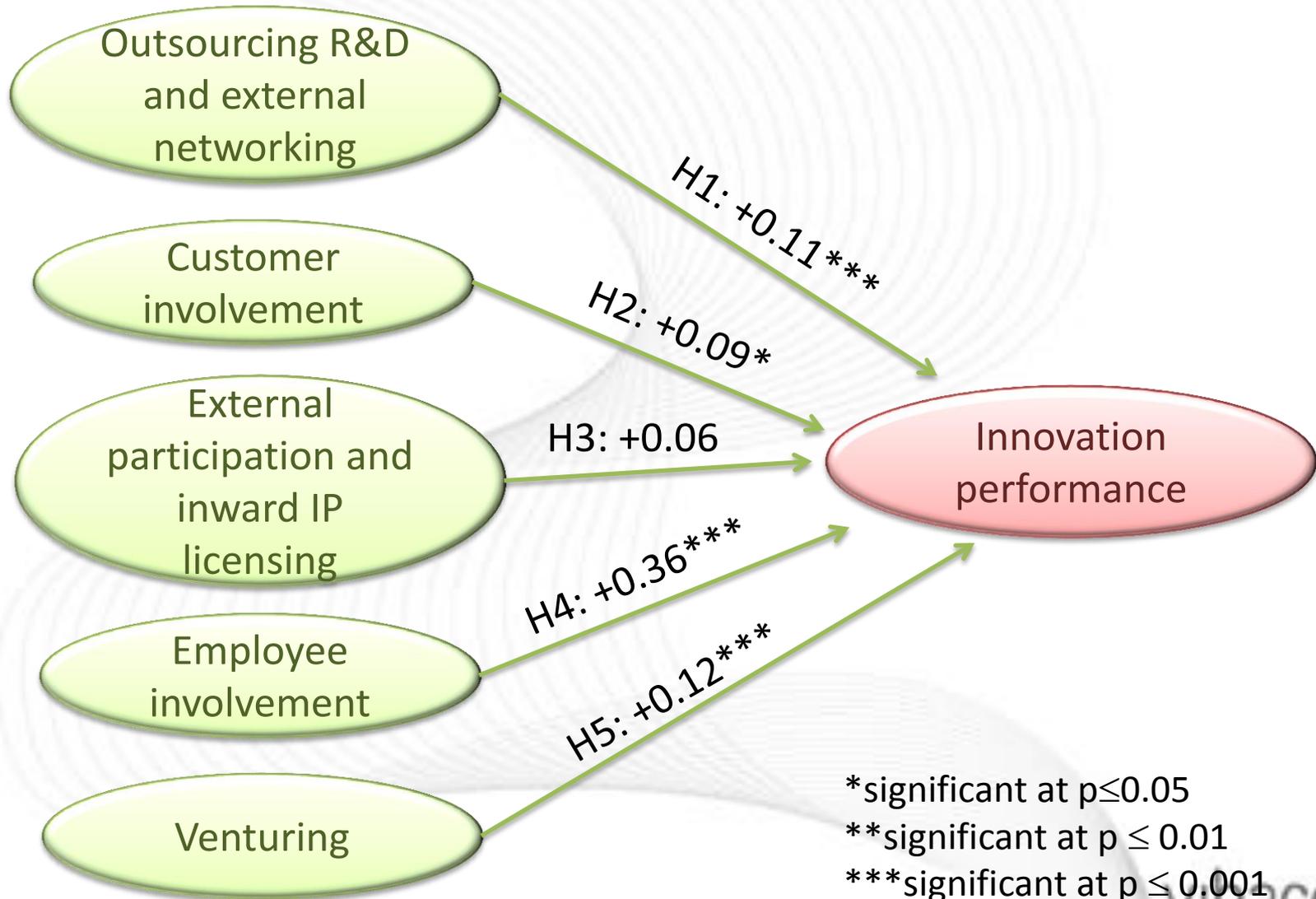
## 4-cluster solution

- ANOVA test ( $p < 0.001$ )
- firm size (Kruskal–Wallis test=31.59;  $p < 0.001$ )
- firm industry (Chi-Square=18.63;  $p = 0.116$ )

# Results of the cluster analysis



# Results of the regression analysis



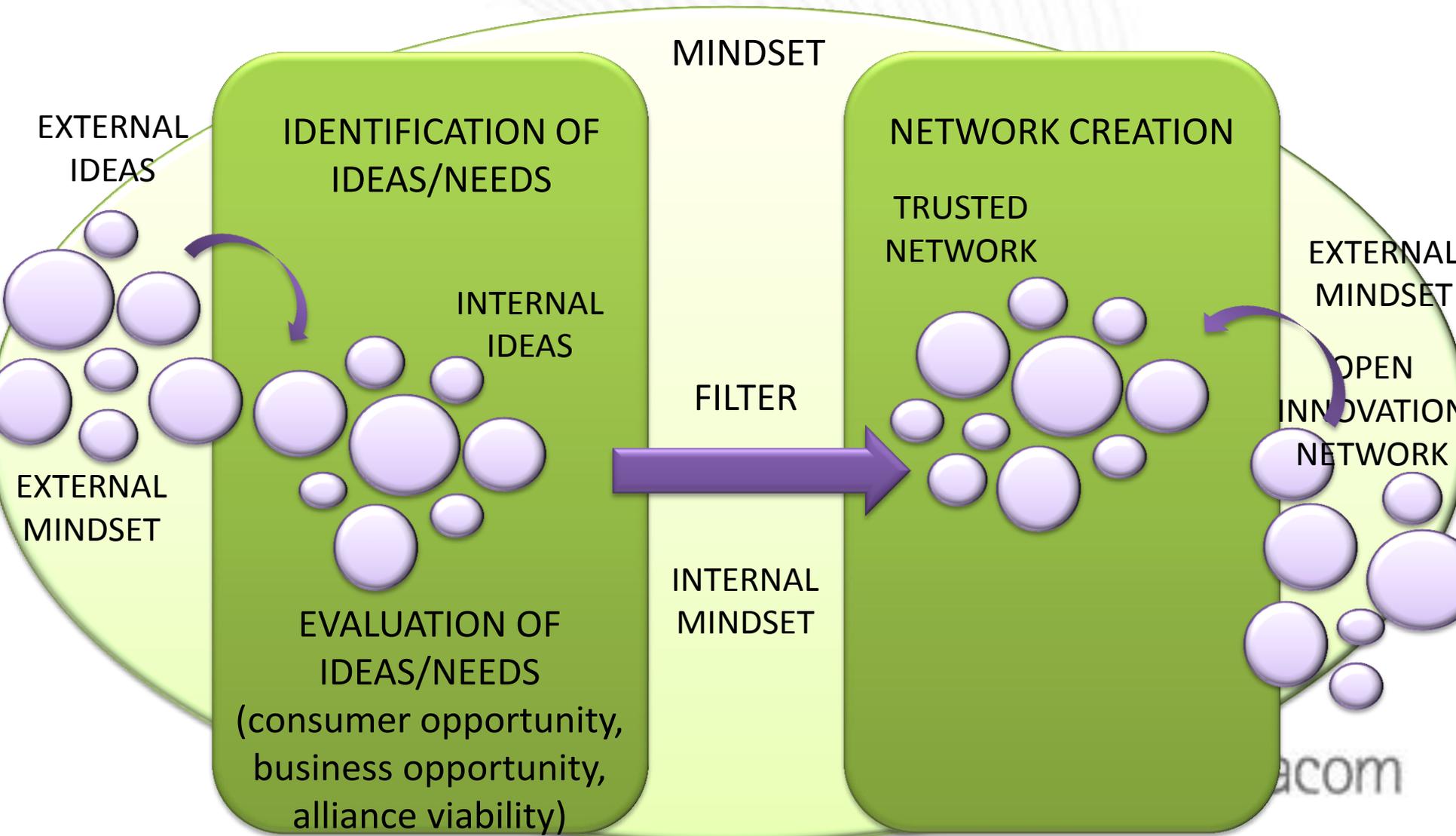
# Open innovation mode and innovation performance

	Mean (first 25%)	SD (first 25%)	Mean (last 25%)	SD (last 25%)	t-value (p<0.001)
Outsourcing R&D and external networking	3.34	1.37	2.70	1.22	4.61
Customer involvement	5.80	1.08	5.04	1.36	5.76
External participation and inward IP licensing	5.31	1.36	4.27	1.42	6.95
Employee involvement	5.93	0.82	4.64	1.29	11.13
Venturing	5.89	1.13	5.00	1.41	6.50

- Ranking the total sample according to the scores on innovation performance;
- Comparing the best-scoring 25% companies with the worst-scoring 25%.

	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

# Steps for successful implementation of open innovation



# Contributions, limitations and future research

- Systematic overview of open innovation dimensions → to help managers to recognize the rich and abundant opportunities of open innovation
- Regression analysis → underscoring the influence of the individual dimension of open innovation on a firm's innovation performance
- The importance of employee involvement
- Cluster analysis → presentation of different modes of open innovation (to ascertain different combinations of open innovation dimensions)
- Limitations and future research: cross-sectional data; joined samples; human centeredness of open innovation processes

vibacom



Thank you for your  
attention.

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

vibacom