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- Project: Human Capital in the Age of Open Innovation

# Innovation culture in the age of openness: operationalization and empirical validation of the concept



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# Overview

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- **Research question:** *Innovation culture* in the age of open innovation — a useful concept or a cumbersome metaphor
  - Is *openness* enough to describe the in-house factors that determine the efficiency of firm's innovation effort?
- **Step 1:** Operationalization of the innovation culture concept in the age of open innovation and before
  - What is behind the broadly used “innovation culture” concept?
  - What happens with the scope of this concept over time?
- **Step 2:** Who had dared to measure innovation culture and how did they do it?
  - Approaches used in the empirical studies of innovation culture
- **Step 3:** Innovation culture components combined: what data tells us?
  - Operationalization of the theoretical innovation culture components using the survey data
  - Estimates based on the data on the Russian high-tech manufacturing

# STEP 1

Operationalization

of the innovation culture concept  
in the age of open innovation  
and before



## **Systematic discourse analysis of the conceptual publications**

What is behind the broadly used  
“innovation culture” concept?

What happens with the scope of  
this concept over time?

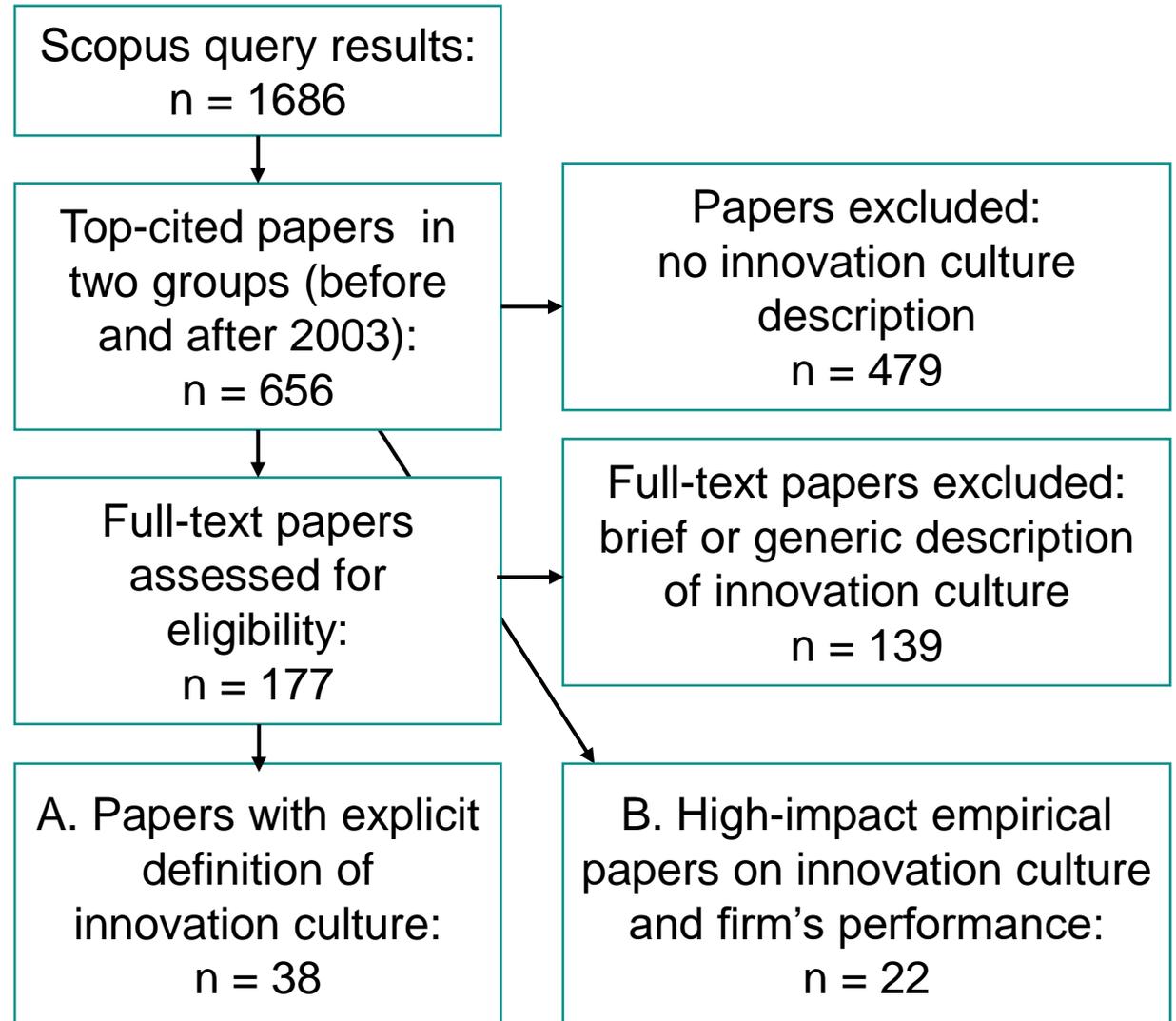
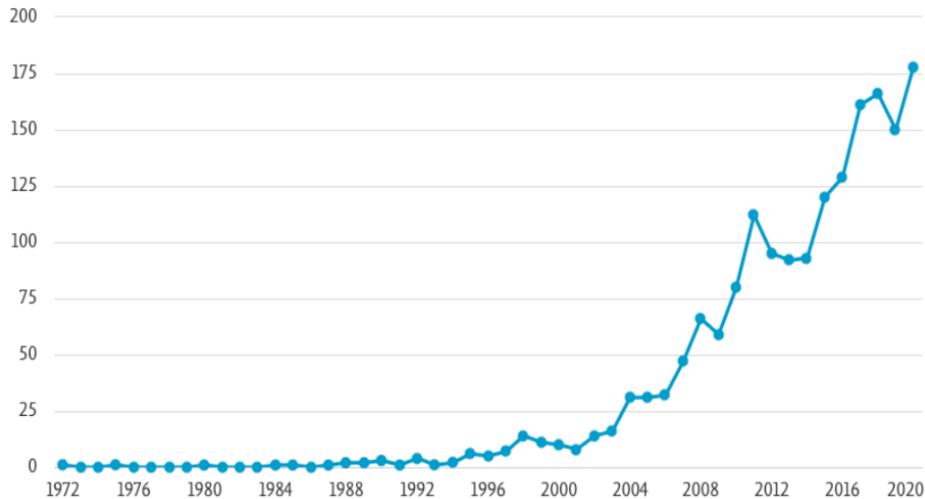
# Search and selection



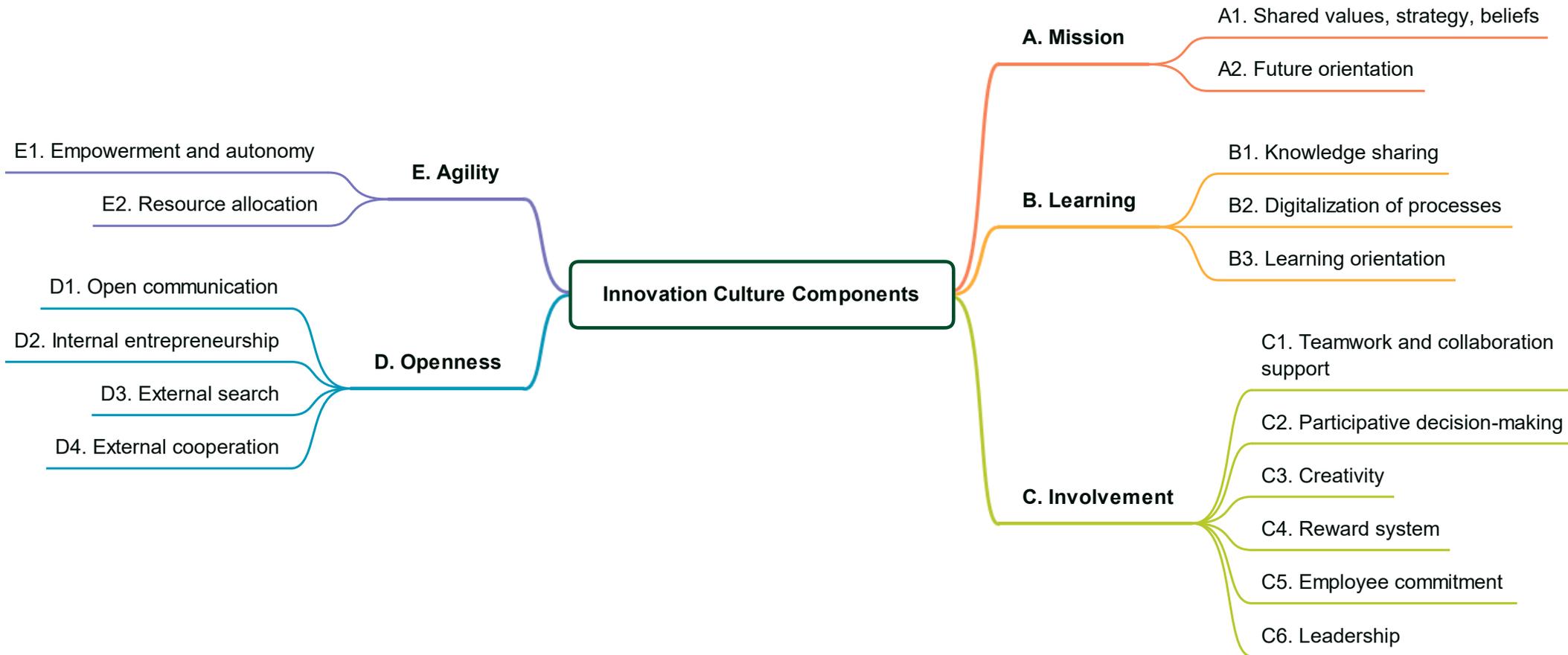
## Search query in SCOPUS:

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TITLE-ABS-KEY( ( "innovat* culture" OR "culture of innovat*" OR "innovation oriented culture" ) OR ( ( "corporate culture" OR "organization culture" OR "organizational culture" OR "company culture" OR "firm culture" OR "enterprise culture" OR "culture of organization" OR "culture of company" OR "culture of firm" OR "culture of enterprise" ) w/2 innovat* ) )
```

## Papers per year:



# Scope of innovation culture concept (derived from discourse analysis)



# Discourse analysis results: innovation culture before and after the exposure of the open innovation idea



Components of innovation culture	Total (N=38)	Before 2003 (N=19)	Frequency, %	After 2003 (N=19)	Frequency, %	Frequency change, %
<b>A. Mission</b>						
A1. Shared values, strategy, beliefs	19	9	47.4	10	52.6	5.3
A2. Future orientation	7	4	21.1	3	15.8	-5.3
<b>B. Learning</b>						
B1. Knowledge sharing	22	11	57.9	11	57.9	0.0
B2. Digitalization of processes	5	2	10.5	3	15.8	5.3
B3. Learning orientation	15	7	36.8	8	42.1	5.3
<b>C. Involvement</b>						
C1. Teamwork and collaboration support	19	11	57.9	8	42.1	-15.8
C2. Participative decision-making	8	3	15.8	5	26.3	10.5
C3. Creativity	22	10	52.6	12	63.2	10.5
C4. Reward system	16	8	42.1	8	42.1	0.0
C5. Employee commitment	7	3	15.8	4	21.1	5.3
C6. Leadership	9	3	15.8	6	31.6	15.8
<b>D. Openness</b>						
D1. Open communication	16	6	31.6	10	52.6	21.1
D2. Internal entrepreneurship	5	1	5.3	4	21.1	15.8
D3. External search	20	9	47.4	11	57.9	10.5
D4. External cooperation	10	1	5.3	9	47.4	42.1
<b>E. Agility</b>						
E1. Empowerment and autonomy	16	6	31.6	10	52.6	21.1
E2. Resource allocation	10	4	21.1	6	31.6	10.5

Decline in popularity after 2003



Increase in popularity after 2003



Growing complexity of the innovation culture concept



Openness agenda has considerable impact on the innovation culture discourse



# STEP 2

Who dared to measure  
innovation culture  
and how did they do it?



## **Structured review of the empirical papers on innovation culture**

**22 empirical papers derived from the top-20% highly-cited papers of the original search results**

**No empirical papers before 2000**

**Major focus: relations of various innovation culture components to the firms' innovation performance**

# Mapping the components addressed in the high-impact empirical studies of innovation culture



Empirical study	Innovation culture components addressed																
	Mission		Learning			Involvement						Openness				Agility	
	A1	A2	B1	B2	B3	C1	C2	C3	C4	C5	C6	D1	D2	D3	D4	E1	E2
Amara and Chen (2021)																	
Freixanet et al. (2021)																	
Su et al. (2021)																	
Santoro et al. (2020)																	
Papa et al. (2018)																	
Popa et al. (2017)																	
Olmos-Peñuela and García-Granero (2017)																	
Naranjo-Valencia and Jiménez-Jiménez (2016)																	
Wang and Rafiq (2014)																	
Hogan and Coote (2014)																	
Büschgens and Bausch (2013)																	
Martín-de Castro and Delgado-Verde (2013)																	
Bock et al. (2012)																	
Kmieciak et al. (2012)																	
Naranjo-Valencia and Jiménez-Jiménez (2011)																	
Çakar and Ertürk (2010)																	
Tellis et al. (2009)																	
Dobni (2008)																	
Sarros et al. (2008)																	
Khazanchi et al. (2007)																	
Lau and Ngo (2004)																	
Chandler and Keller (2000)																	
Target for this study																	

*Temptation to simplify:  
innovation culture =  
openness + agility*

Generally, most components are positively related to higher innovation output or other innovation capabilities metrics

However, few papers explored the effects of many innovation culture components *ceteris paribus*

# STEP 3

Innovation culture components  
combined: what data tells us?



**Capturing the diversity of  
innovation culture and the  
relationship to the firm's  
innovation capabilities**

Operationalization of the theoretical  
innovation culture components  
using the available survey  
indicators

Estimates based on the data on the  
Russian high-tech manufacturing

# Data

## HSE Monitoring of innovation behavior of enterprises (2018)

Stratified sample of 545 high-tech and medium high-tech enterprises (NACE rev 2., Eurostat), based on RUSLANA enterprise registry

Questionnaire design: follows Oslo Manual 2018

### Sections:

- I. General information – business model, markets, position in supply chain, competition
- II. **Innovation activities**
- III. Cooperation for innovation
- IV. **State support for innovation**
- V. **Advanced technologies and organizational concepts (New production processes, Digitalization, Lean, Agile)**

Industry	Size	Sample	Population	Pweight
Pharma	small	26	548	
	medium	28	148	
	large	8	105	
Precision instruments and ICT	small	35	1815	
	medium	13	490	
	large	17	300	
Chemical products	small	36	2615	
	medium	32	439	
	large	21	246	
Electric machinery and equipment	small	57	2458	
	medium	31	506	
	large	13	314	
Transport (w/o aerospace)	small	10	866	
	medium	11	304	
	large	24	194	
Aircraft and spacecraft	small	9	551	
	medium	9	126	
	large	21	198	
Other machinery and equipment	small	45	4659	
	medium	46	820	
	large	53	476	

<https://www.hse.ru/en/monitoring/innofirms/>

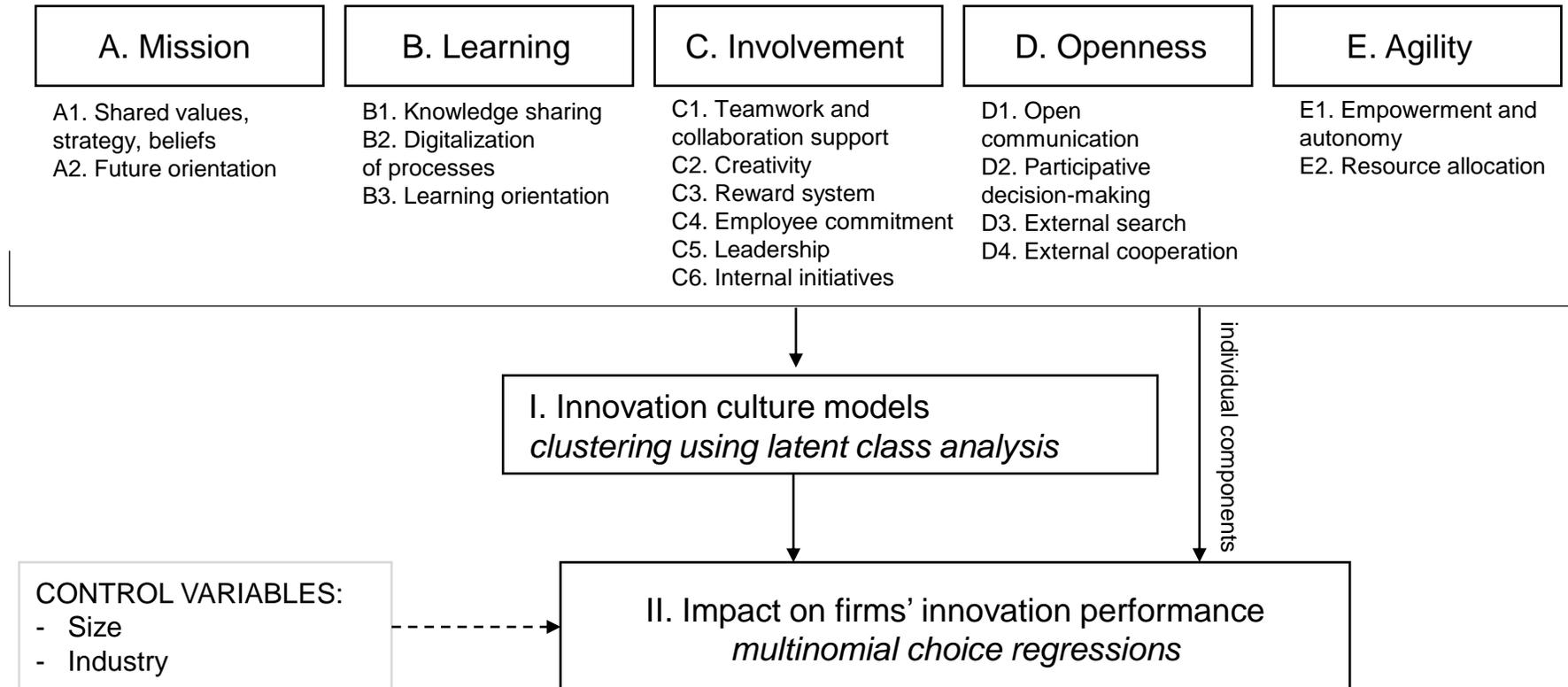
# Operationalization based on the available proxies from the questionnaire



Components of innovation culture		Proposed metrics from the questionnaire	N of firms	Frequency, %
<b>A. Mission</b>	A1. Shared values, strategy, beliefs	A1. Innovation as an integral part of the firm's strategy	266	48.9
	A2. Future orientation	A2_1. Reaching new client groups as an integral part of the firm's strategy	166	30.5
		A2_2. Considering technological and market trends in determining the firm's strategy	160	29.4
<b>B. Learning</b>	B1. Knowledge sharing	B1. Senior experience retention and transfer programs	345	63.4
	B2. Digitalization of processes	B2. Resource planning software or automated warehouse management systems	240	44.1
	B3. Learning orientation	B3. Talent development programs	326	59.9
<b>C. Involvement</b>	C1. Teamwork and collaboration support	C1. Project-team organization of production	205	37.7
	C2. Participative decision-making	C2. Formal meetings of employees at various levels to develop new ideas	317	58.3
	C3. Creativity	C3. Providing resources for employees' innovation and creative projects	176	32.4
	C4. Reward system	C4. Rewarding programs for successful ideas to improve products, increase production efficiency	302	55.5
	C5. Employee commitment	C5. Tools to increase employee loyalty (free meals, health insurance, childcare arrangements)	274	50.4
	C6. Leadership	C6. Top-management's contribution to innovation development	296	54.4
<b>D. Openness</b>	D1. Open communication	D1_1. Participation in scientific events to bring business issues to the scientific community	244	44.9
		D1_2. Conducting open competitions related to the selection of R&D and innovation partners	119	21.9
	D2. Internal entrepreneurship	D2. Involvement in the innovation process of at least two subdivisions of the company	170	31.3
	D3. External search	D3. Intensive use of various external sources and methods of obtaining information for innovation	238	43.8
	D4. External cooperation	D4_1. Integration of users in the development and production of products and services	111	20.4
D4_2. Extensive external networking (with at least three different types of cooperation partners)		258	47.4	
<b>E. Agility</b>	E1. Empowerment and autonomy	E1_1. Combination of planning, management, control functions at the level of workshop/operators	116	21.3
		E1_2. Continuous quality improvement techniques	183	33.6
	E2. Resource allocation	E2. Reserving funding for risky innovation projects with a high degree of uncertainty	115	21.1

A combination of concepts from CIS-style innovation surveys, *Lean* and *Agile* provides comprehensive indicators for innovation culture components

# Empirical strategy: heterogeneity of innovation culture profiles and impact on innovation performance



# Innovation culture models derived using latent class analysis



	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Cluster size (share of all enterprises)	28.3%	10.8%	26.3%	11.4%	23.2%
<b>Components of innovation culture</b>					
<i>A - Mission:</i>					
A1. strategy_innovation	69.5	50.8	60.1	4.8	31.7
A2_1. strategy_new_clients_groups	29.2	39.0	32.9	21.0	30.2
A2_2. strategy_considering_trends	64.9	40.7	13.3	25.8	0.8
<i>B - Learning:</i>					
B1. experience_retention_programs	94.8	30.5	77.6	67.7	22.2
B2. digitalization_of_processes	68.8	62.7	44.1	37.1	8.7
B3. talent_development_programs	98.7	3.4	76.2	79.0	11.1
<i>C - Involvement:</i>					
C1. project_team_organization	72.7	54.2	19.6	40.3	6.3
C2. internal_networking	43.5	40.7	42.0	0.0	15.1
C3. creativity	51.9	55.9	18.9	58.1	0.0
C4. reward_programs	90.3	71.2	51.0	71.0	3.2
C6. employee_loyalty	87.7	32.2	55.9	48.4	7.9
C6. top_management_innosource	67.5	52.5	79.7	0.0	37.3
<i>D - Openness:</i>					
D1_1. participation_sci_events	78.6	55.9	34.3	48.4	8.7
D1_2. open_competitions	48.7	25.4	7.0	27.4	1.6
D2. formal_meetings	92.9	93.2	35.0	88.7	11.1
D3. external_innosources	75.3	62.7	43.4	4.8	15.9
D4_1. deep_user_integration	34.4	40.7	15.4	0.0	9.5
D4_2. external_networking	62.3	44.1	21.7	59.7	54.0
<i>E - Agility:</i>					
E1_1. functions_combination	51.9	27.1	8.4	9.7	1.6
E1_2. continuous_quality_improvement	73.4	45.8	23.8	12.9	0.8
E2. funding_for_risky_projects	38.3	32.2	11.9	32.3	0.0

## Identified 5 degrees of innovation culture sophistication

- Model 1: multifaceted organizational practices, focus on learning, talent development, experience retention, creativity rewards.
- Model 2: comprehensive and involving, but weaker learning orientation and agility
- Model 3: lower openness and agility, limited future orientation
- Model 4: lack of innovation-related mission/values, limited agility and less open to cooperating with clients
- Model 5: limited innovation culture, top-down processes, outsourcing of innovation capabilities

# Regression 1: innovation cluster models vs. innovation capabilities



Factors	Firms by innovation status and export activity (margins after mlogit)				
	Non-innovators	New to firm, Non-exporters	New to market Non-exporters	New to firm, Exporters	New to market, Exporters
Cluster 1	<b>-0.360***</b> (0.0629)	-0.0503 (0.0572)	<b>0.139**</b> (0.0575)	<b>0.111***</b> (0.0416)	<b>0.160***</b> (0.0583)
Cluster 2	<b>-0.347***</b> (0.0857)	0.0216 (0.0680)	<b>0.177***</b> (0.0682)	-0.0421 (0.0731)	<b>0.191***</b> (0.0690)
Cluster 3	<b>-0.243***</b> (0.0562)	0.0636 (0.0501)	0.0315 (0.0586)	<b>0.113***</b> (0.0402)	0.0346 (0.0611)
Cluster 4	<b>0.157**</b> (0.0710)	-0.0322 (0.0766)	-0.0603 (0.0884)	-0.0774 (0.0926)	0.0128 (0.0912)
Number of employees (log)	<b>-0.0304*</b> (0.0162)	-0.00976 (0.0134)	-0.0146 (0.0141)	<b>0.0296***</b> (0.0084)	<b>0.0251*</b> (0.0130)
NACE 21	0.0836 (0.0724)	-0.0181 (0.0689)	0.00391 (0.0672)	0.0131 (0.0429)	-0.0825 (0.0740)
NACE 26	-0.00962 (0.0769)	0.0806 (0.0600)	-0.0383 (0.0676)	-0.0006 (0.0426)	-0.0322 (0.0656)
NACE 20	<b>0.144**</b> (0.0662)	-0.00927 (0.0604)	<b>-0.110*</b> (0.0640)	0.0211 (0.0345)	-0.0453 (0.0582)
NACE 27	-0.0224 (0.0703)	0.0395 (0.0572)	0.0479 (0.0557)	0.00358 (0.0392)	-0.0685 (0.0602)
NACE 29	0.0885 (0.0890)	0.0101 (0.0758)	-0.0045 (0.0726)	-0.0256 (0.0459)	-0.0684 (0.0724)
NACE 28	<b>0.228**</b> (0.0900)	0.116 (0.0738)	<b>-0.225**</b> (0.1100)	<b>-0.106*</b> (0.0598)	-0.0144 (0.0759)
Observations	544				
LogL	-763.5597				
Pseudo R2	0.1070				

- Strong impact of the innovation culture sophistication degree on the innovation capabilities
- Modes 1 and 2 are more typical for firms that deliver new-to-market innovations
- Mode 3 empowers the exporters of new-to-firm innovations
- Non-innovation firms are associated with limited innovation culture (Mode 4)

# Regression 2: effects of all innovation culture components *ceteris paribus*



- Compared to high impact of composite innovation culture models, the significance of individual components is very low and hardly interpretable
- Innovation-related practices are not that significant if taken individually compared to the synergetic effects that correspond to the elaborate innovation culture
- Limitations: sample size and discrete metrics for innovation capabilities

Factors	Firms by innovation status and export activity				
	Non-innovators	New to firm,	New to market	New to firm,	New to market,
		Non-exporters	Non-exporters	Exporters	Exporters
A1. strategy_innovation	-0.056 (0.048)	-0.050 (0.042)	0.019 (0.044)	-0.006 (0.033)	<b>0.094**</b> (0.043)
A2_1. strategy_new_clients_groups	-0.028 (0.047)	<b>0.098**</b> (0.046)	-0.017 (0.044)	-0.031 (0.031)	-0.022 (0.041)
A2_2. strategy_considering_trends	0.036 (0.059)	-0.032 (0.049)	0.013 (0.051)	-0.009 (0.034)	-0.008 (0.046)
B1. experience_retention_programs	-0.062 (0.060)	<b>0.094***</b> (0.048)	0.014 (0.054)	0.006 (0.044)	-0.051 (0.055)
B2. digitalization_of_man_processes	-0.051 (0.051)	-0.039 (0.044)	-0.066 (0.046)	0.039 (0.034)	<b>0.117**</b> (0.046)
B3. talent_development_programs	0.081 (0.057)	-0.054 (0.055)	-0.054 (0.057)	0.059 (0.042)	-0.033 (0.054)
C1. project_team_organization	-0.018 (0.058)	-0.001 (0.053)	0.044 (0.054)	-0.011 (0.036)	-0.013 (0.049)
C2. formal_meetings	-0.032 (0.059)	0.010 (0.051)	0.063 (0.055)	-0.024 (0.039)	-0.017 (0.052)
C3. creativity	0.003 (0.058)	-0.053 (0.047)	-0.007 (0.050)	<b>-0.056*</b> (0.031)	<b>0.114**</b> (0.052)
C4. reward_programs	0.059 (0.056)	<b>-0.090*</b> (0.052)	0.001 (0.054)	0.052 (0.038)	-0.023 (0.050)
C6. employee_loyalty	-0.015 (0.053)	0.033 (0.047)	-0.068 (0.050)	0.035 (0.038)	0.014 (0.047)
C6. top_management_innosource	<b>-0.247***</b> (0.053)	0.053 (0.043)	0.014 (0.057)	0.049 (0.034)	<b>0.131***</b> (0.044)
D1_1. participation_sci_events	<b>-0.142***</b> (0.051)	-0.039 (0.046)	0.067 (0.049)	-0.018 (0.034)	<b>0.133***</b> (0.046)
D1_2. open_competitions	-0.091 (0.057)	0.012 (0.059)	0.040 (0.059)	0.030 (0.043)	0.009 (0.052)
D2. internal_networking	-0.025 (0.056)	-0.043 (0.044)	0.024 (0.050)	0.000 (0.034)	0.044 (0.046)
D3. external_innosources	<b>-0.187***</b> (0.048)	0.029 (0.043)	0.050 (0.046)	0.049 (0.034)	0.059 (0.043)
D4_1. deep_user_integration	<b>-0.215***</b> (0.042)	0.039 (0.055)	<b>0.177***</b> (0.060)	-0.006 (0.035)	0.006 (0.046)
D4_2. external_networking	<b>0.228***</b> (0.049)	<b>-0.110***</b> (0.041)	<b>-0.105**</b> (0.043)	-0.026 (0.032)	0.013 (0.042)
E1_1. functions_combination	-0.074 (0.062)	<b>0.080*</b> (0.068)	-0.007 (0.058)	-0.035 (0.036)	0.036 (0.058)
E1_2. continuous_quality_improvement	0.062 (0.068)	-0.021 (0.053)	0.032 (0.057)	0.001 (0.037)	-0.075 (0.046)
E2. funding_for_risky_projects	0.024 (0.064)	-0.004 (0.055)	0.018 (0.055)	0.022 (0.042)	-0.060 (0.044)
Number of employees (log)	<b>-0.038**</b> (0.018)	-0.003 (0.016)	-0.007 (0.017)	<b>0.031***</b> (0.011)	0.016 (0.014)
Industry dummies	...	...	...	...	...

# Takeaway

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Innovation culture is rich and evolving concept that can be decomposed to rather robust components

The impact of innovation culture has synergetic nature — combinations of components bring statistically significant multiplicative effects on the innovation capabilities

Openness agenda has clearly influenced innovation culture discourse; *however, open innovation framework considers only a fraction of all the components to innovation culture*

Openness-related practices are distinctive feature of the most elaborate innovation culture models, while less sophisticated firms reduce openness to outsourcing of innovation capabilities; *however, controlled for other components of innovation culture, their individual effect is insignificant*

# Implications

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For the innovation culture studies:

- Continue beyond limited perspective on innovation culture as a combination of trendy aspects, such as *openness + agility*
- towards comprehensive theory-grounded multidimensional models and identification of optimal combinations of innovation-related organizational practices

For the open innovation research:

- it is important to address the complementarity of open innovation mechanisms with the broader scope of managerial practices within the firms that can influence the effects of openness (even changing them from positive to negative)



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