Finanțat de Uniunea Europeană NextGenerationEU
Planul Național de Redresare și Reziliență

Experiences with digitalization

Krisztina Demeter[a,b]
Contributors: Dávid Losonci[b], Kolos Ágoston[b], Ottó Csiki[a], Botond Benedek[a], Máté Baksa[b], Yang Cheng[c]

[a]Faculty of Economics and Business Administration, Babeş–Bolyai University, Cluj-Napoca, Romania
krisztina.demeter@ubbcluj.ro, otto.csiki@ubbcluj.ro, botond.benedek@ubbcluj.ro

[b]Institute of Operations and Decision Sciences, Corvinus University of Budapest, Budapest, Hungary
krisztina.demeter@uni-corvinus.hu, david.losonci@uni-corvinus.hu, kolos.agoston@uni-corvinus

[c]Department of Materials and Production, Aalborg University, Aalborg, Denmark
cy@mp.aau.dk

Sopron, International Scientific Conference, 06.11.2025

Agenda

1. Introduction

2. Literature review

3. Review approach methodology

4. Results

5. Illustration

6. Discussion

Agenda

1. Introduction

2. Literature review

3. Review approach methodology

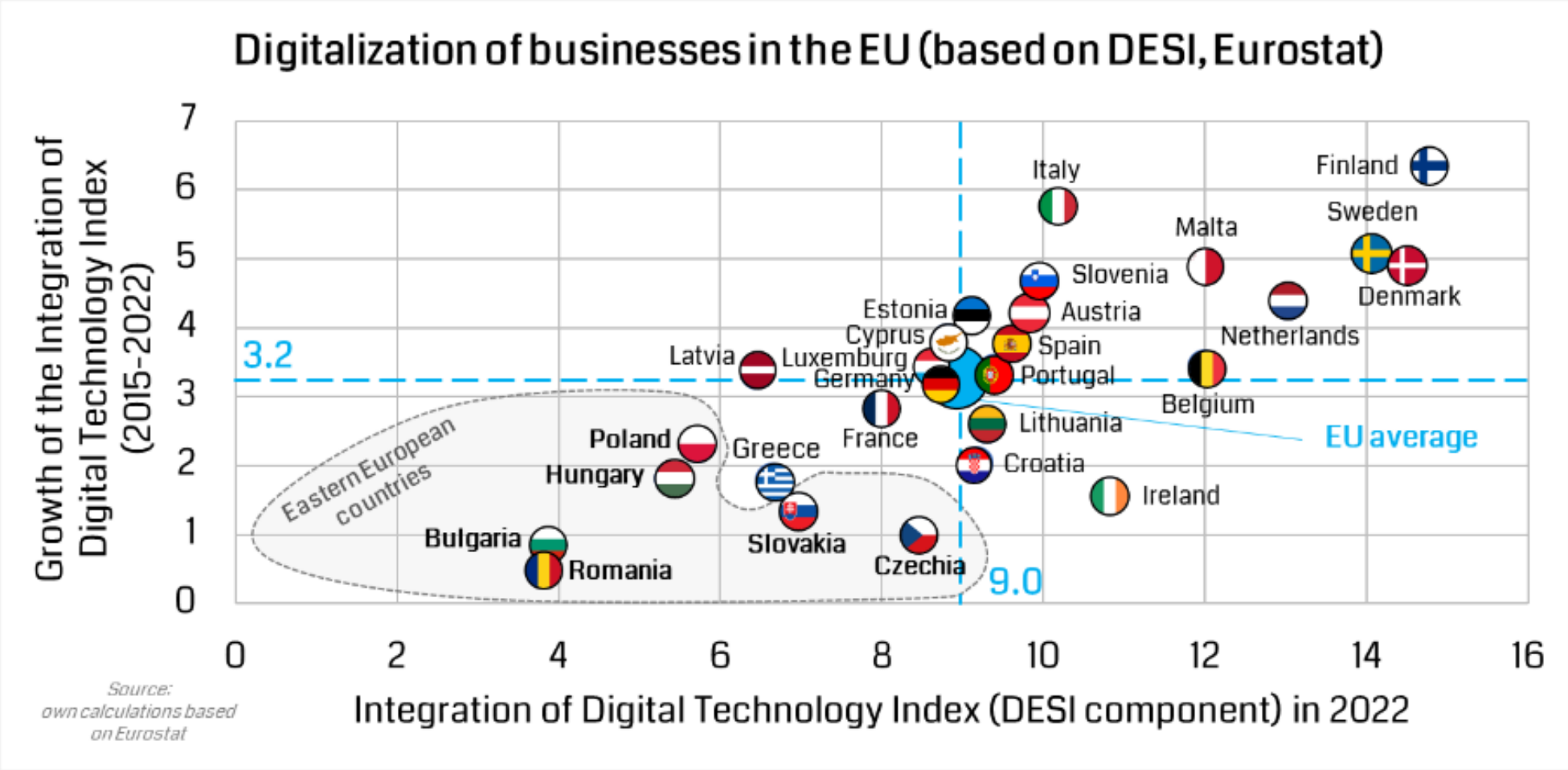
4. Results

5. Illustration

6. Discussion

Introduction – the project

- Motivation: CEE - low DESI values for business digitalization
- Approach: ***Micro level*** – case studies; ***Macro level*** – country-level company-based databases



Introduction – lecture topics

Literature review	RQ1: What are the most frequent barrier topics to digital transformation? RQ2: What are the differences in digital transformation barriers between countries with higher or lower digital competitiveness?
Illustration	Downstream automotive industry – context, value chain, and digitalization consequences

Agenda

1. Introduction

2. **Literature review**

3. Review approach methodology

4. Results

5. Illustration

6. Discussion

Literature review - concept

Multi-level models

Main theoretical basis: the multi-level theory.

Kozlowski & Klein (2000), *„fundamental to the levels perspective is the recognition that **micro phenomena are embedded in macro contexts** and that **macro phenomena often emerge through the interaction and dynamics of lower-level elements**."* (p.5.)

Discovering both micro and macro levels and their relationship is critical to understanding systems and processes.

Multi-topic approach

Existing literature reviews have comprehensively analysed the impact of digitalisation in terms of management challenges, organisational structure, supply chain performance, human resource management, and strategic considerations.

Process view with inputs, transformation process and output, considering the result of digital transformation as the output.

Multi-level and multi-topic framework

Our two-dimensional classification, starting at the item level, enables quantified meta-analysis of DT's barriers.

Other literature reviews

Authors	Level[1]	Individual	Firm	Group of companies	Country
Ghobakhloo et al., 2022	IFGC		●	●	●
Nayernia et al., 2022	IFGC	●	●	●	●
Schneider, 2018	IFGC	●	●	●	
Matt et al., 2023	IFGC	●	●	●	●
Rad et al., 2022	IFGC		●	●	
Ammirato et al., 2023	IFGC	●	●		
Vial, 2021	IFGC	●	●		
Rêgo et al., 2021	IFGC		●	●	
Jones et al., 2021	IFGC	●	●	●	
Zamani, 2022	IFGC	●	●	●	

Legend: (1) Levels: individual, firm, group of companies, country

The multi-level, multi-topic framework

Topics

Levels

Barriers (topics) / Levels	Direction	Resources					Coop. between resources	Perspectives				Other
		Technological resource		Human resources				Financial	Legal	Material	Information	
	Strategy	Technology	Integration and infrastructure	Leadership	Human resources	Culture	Cooperation	Economic / financial	Legal	Process / project execution	Data management / security	Other
Individual												
Company												
Group of companies												
Country												

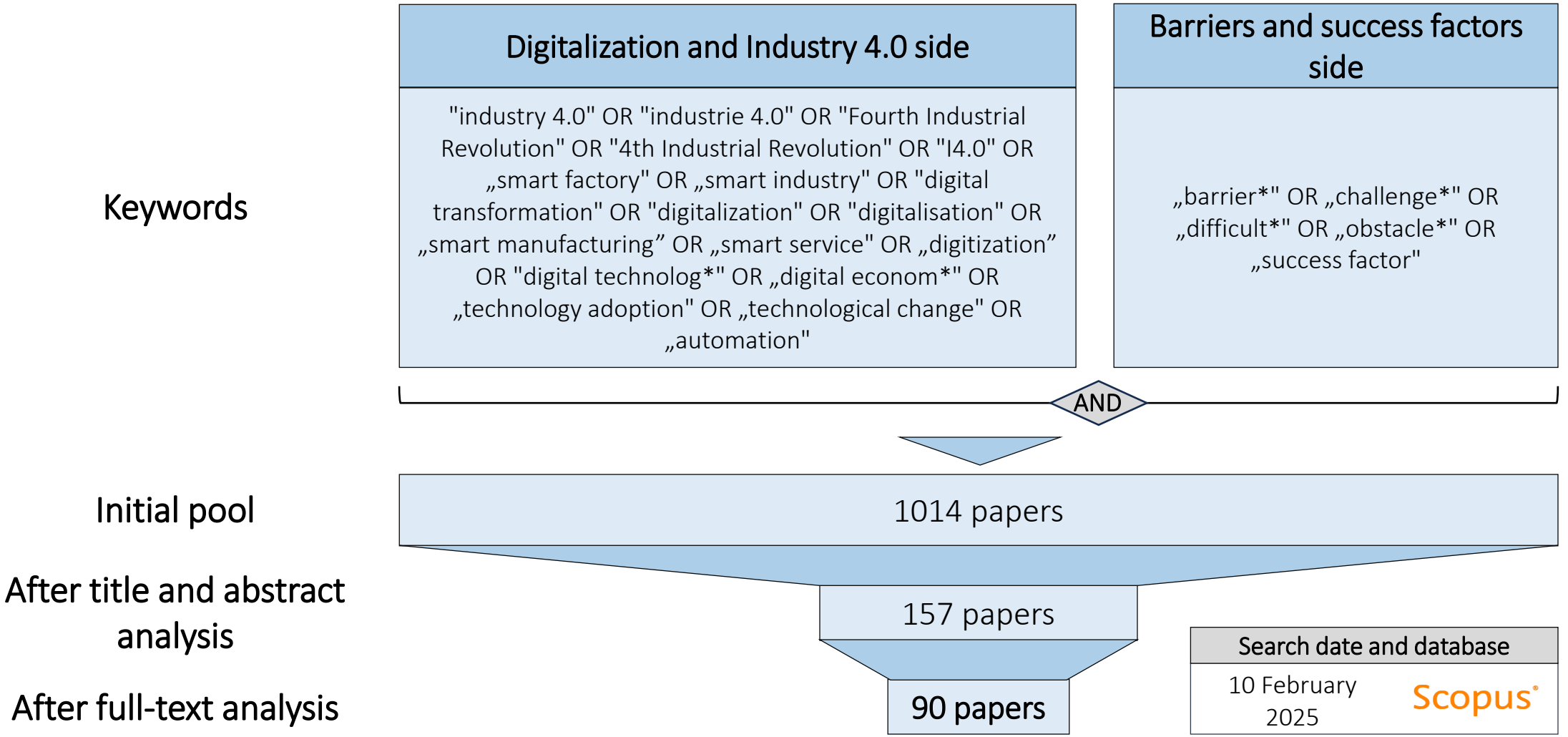
Agenda

1. Introduction
2. Literature review
3. **Review approach methodology**
4. Results
5. Illustration
6. Discussion

Inclusion criteria

	Inclusion criteria	Detailed argument
	(a) Papers written in English.	English is the dominant research language in business and economics research; the use of English ensures the accessibility and comparability of our results.
	(b) Papers published in or after 2012	The concept of I4.0 appeared in 2012 (Kagermann et al., 2013; Liao et al., 2017). Although some constituent technologies appeared earlier, 2012 can be considered as the seminal point of the I4.0 literature stream.
	(c) Type of publication: scientific article	We focus only on high quality, peer-reviewed scientific papers, where a rigorous review process ensures the reliability of the results. Other publication types, such as conference papers or book chapters are excluded. Literature reviews and conceptual papers were also excluded, only the empirical papers were analysed.
	(d) Based on its topic, the journal is included in at least one of the Social Sciences, Business, Economics, Decision Sciences and Psychology domains in Scopus	This review exclusively addresses economic-related barriers to digital transformation, focusing solely on topics related to the economy. However, as barriers related to individuals can be numerous within the psychology topic, we have also included this topic in our analysis.
	(e) The journal is listed on the ABS list	With the use of the ABS list, this research aims to focus on papers of genuine quality.
	(f) The paper applies an empirical approach	However, during the search, literature review papers were excluded, even though some of them also comprised the list. Consequently, we excluded all types of literature reviews and purely conceptual papers, relying on empirically proven results.
	(g) The paper is relevant	The relevance of the papers was operationalized using keywords, but researchers manually evaluated each paper to obtain a fully relevant sample. For example, a relevant paper addresses barriers while ensuring that its focus on technology is not overly narrow. In numerous cases, the papers either touched on the topic of barriers lightly or were excessively technology focused.

Keyword selection

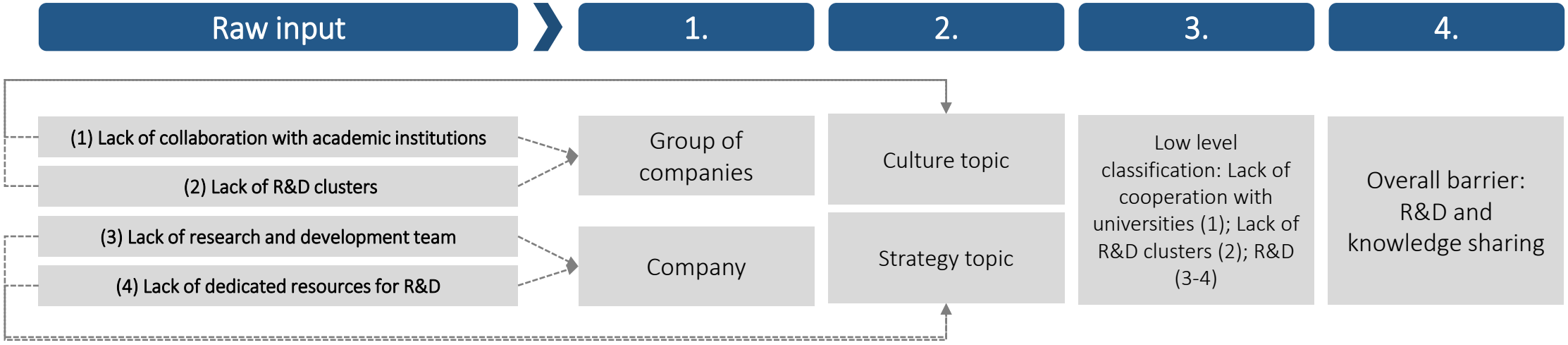


Coding and categorization

During this identification, each barrier was also linked to a particular level. Subsequently, we classified the barriers. This thematic classification resulted in many meaningful clusters.

1. Each barrier item was linked to a particular level.
2. Each barrier item was linked to a particular topic.
3. Low-level classification: resulted in 353 clusters.
4. From low-level clusters, we derived 54 overall barriers.

Example



Source: own construction

Agenda

1. Introduction

2. Literature review

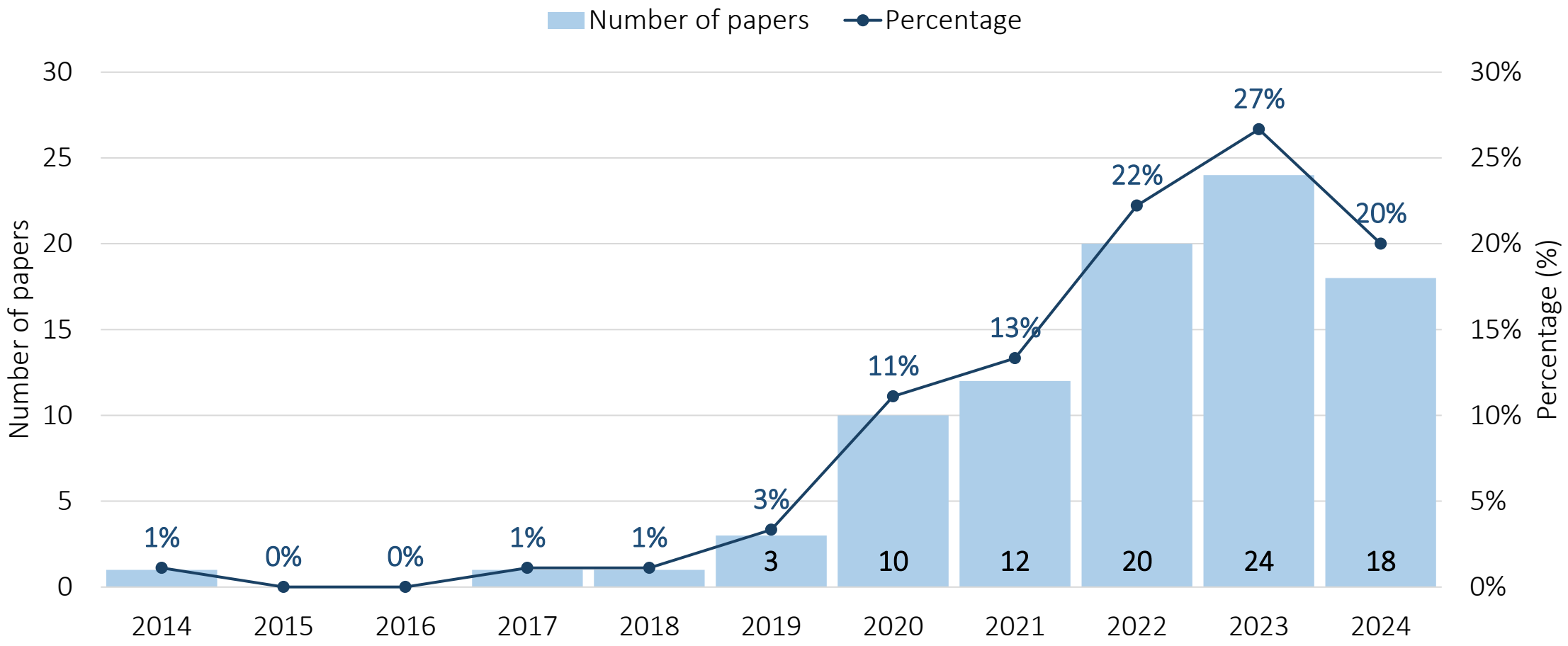
3. Review approach methodology

4. Results

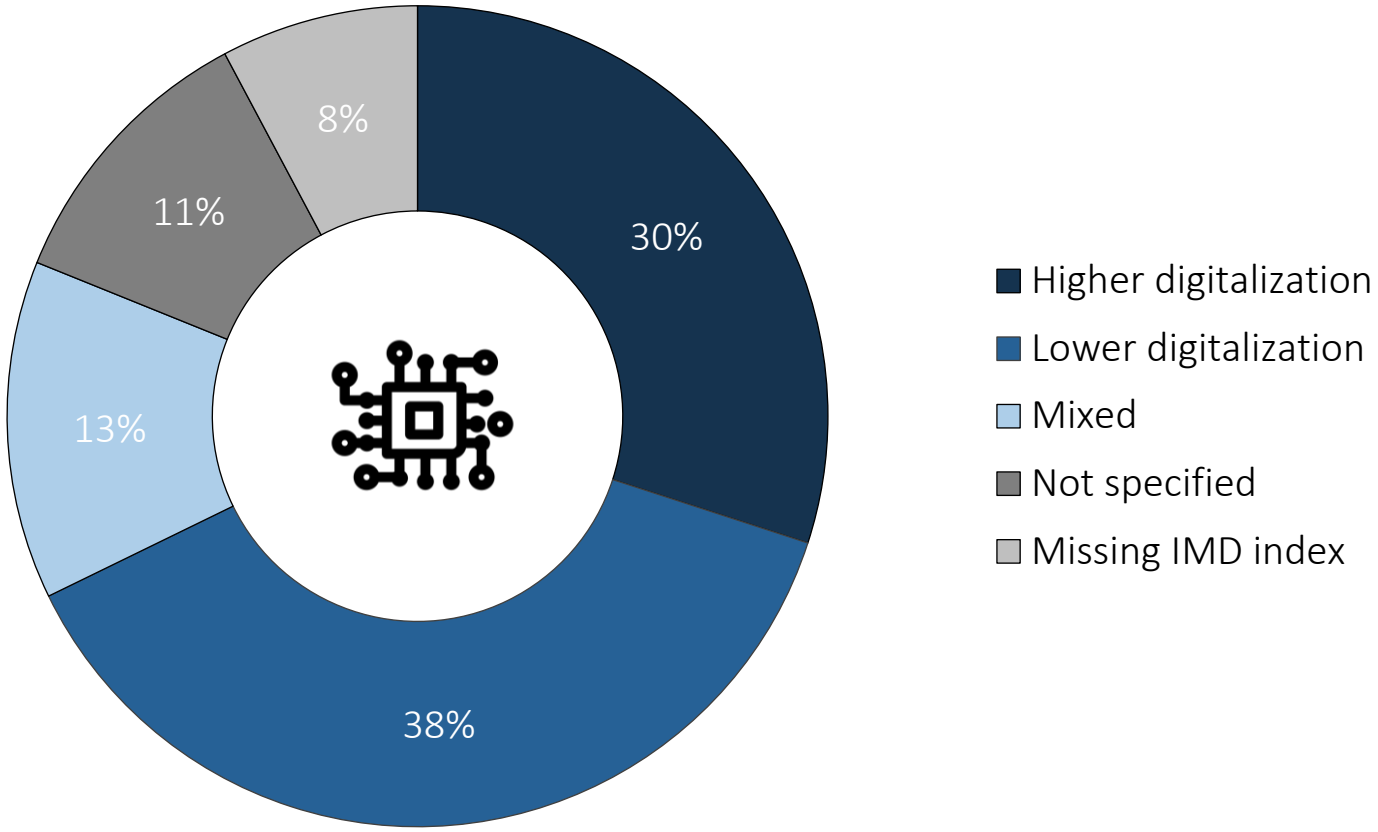
5. Illustration

6. Discussion

The demographic characteristics of the sample



The demographic characteristics of the sample



Barriers to digital transformation – paper-based

RQ1: What are the most frequent barrier topics to digital transformation?

Barriers / Levels	Direction	Resources					Cooperation between resources	Perspectives				Other	Total
		Technological resource		Human resources				Financial perspective	Legal perspective	Material perspective	Information perspective		
	Strategy (policies, directions, goals, measures)	**Technology** (current level of technology, individual technologies)	**Integration and infrastructure**	**Leadership** (knowledge and skills of the leaders, leadership style)	**Human resources** (knowledge and skills)	**Culture** (behaviour, attitude)	**Cooperation** (vendors or customers, between people)	**Economic / financial**	**Legal** (laws, regulations)	**Process / project execution**	**Data management / security**	**Other**	
Individual	3	0	0	15	17	33	1	0	0	0	0	0	**48**
Company / department	61	32	43	38	57	44	12	71	9	23	45	1	**86**
Group of companies	10	7	16	2	8	15	33	10	3	2	11	6	**53**
Country / region / international	19	3	18	0	22	2	2	15	24	0	3	2	**50**
Total	**68**	**37**	**60**	**46**	**73**	**65**	**43**	**78**	**30**	**24**	**53**	**9**	**90**

Number of papers

Barriers to digital transformation – item-based

RQ1: What are the most frequent barrier topics to digital transformation?

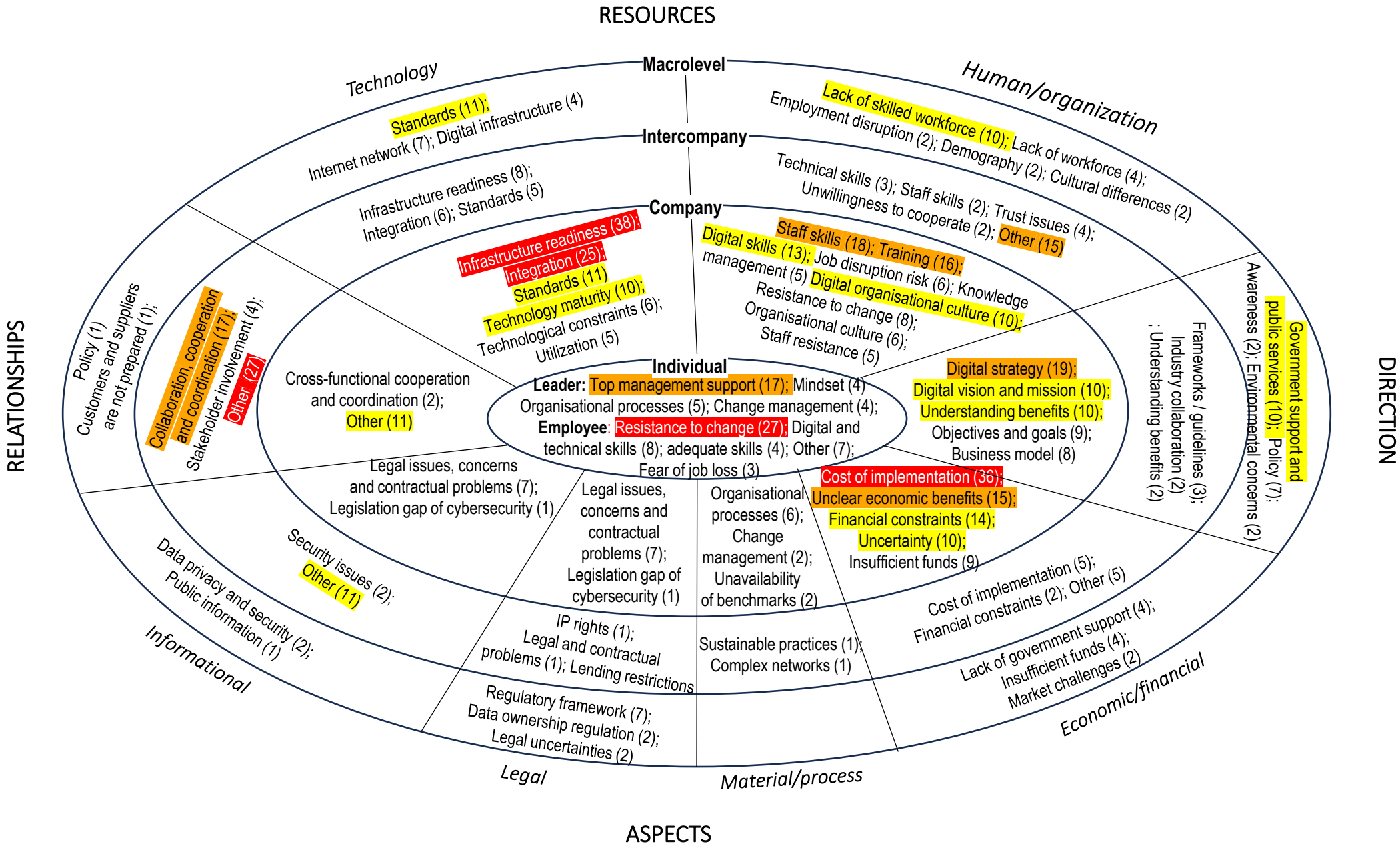
Barriers / Levels	Direction	Resources					Cooperation between resources	Perspectives				Other	Total
		Technological resource		Human resources				Financial perspective	Legal perspective	Material perspective	Information perspective		
	Strategy (policies, directions, goals, measures)	Technology (current level of technology, individual technologies)	Integration and infrastructure	Leadership (knowledge and skills of the leaders, leadership style)	Human resources (knowledge and skills)	Culture (behaviour, attitude)	Cooperation (vendors or customers, between people)	Economic/financial	Legal (laws, regulations)	Process / project execution	Data management / security	Other	
Individual	4	0	0	27	19	50	1	0	0	0	0	0	**101**
Company / department	120	49	77	56	92	58	13	128	10	26	70	1	**700**
Group of companies	13	9	20	2	9	17	48	12	3	2	14	9	**158**
Country / region / international	25	4	25	0	25	2	2	18	27	0	3	2	**133**
Total	**162**	**62**	**122**	**85**	**145**	**127**	**64**	**158**	**40**	**28**	**87**	**12**	**1092**

Number of barriers

184

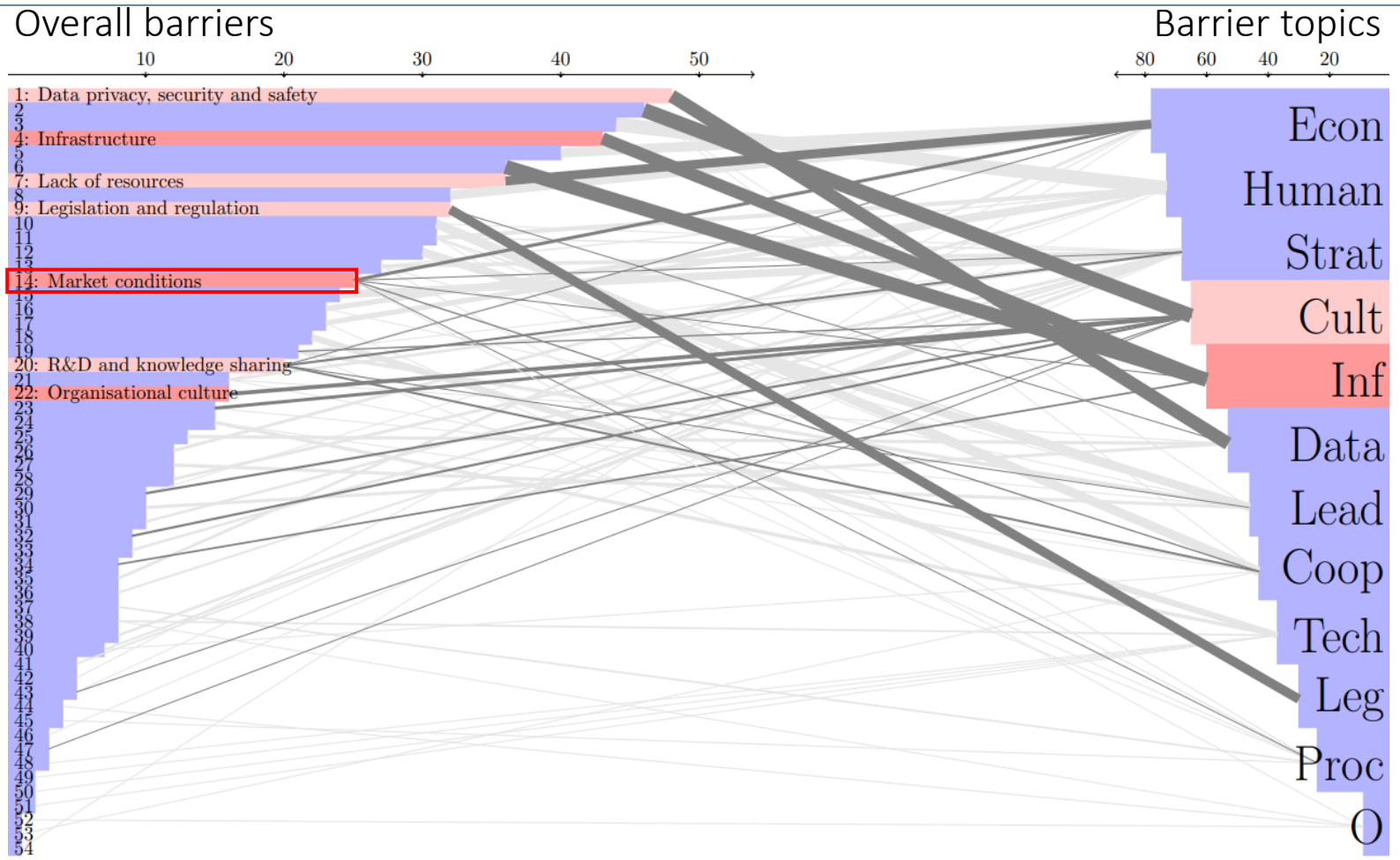
272

Barriers (low-level) to digital transformation – An overall map



Differences between countries with higher and lower digital competitiveness

RQ1: What are the differences in DT barriers between countries with higher or lower digital competitiveness?



Only 'Integration and infrastructure' shows a **significant difference** at 0.05 p-level (low-digi: 0.79 and high-digi: 0.48), and **'Culture'** (0.85, 0.63) differs at the 0.1 p-level.

Legend: red bar: significant difference at the 0.05 p-level (test of independence); orange bar: at the 0.1 p-level, blue: no difference; link thickness: number of items linking overall barriers to barrier topics

Agenda

1. Introduction

2. Literature review

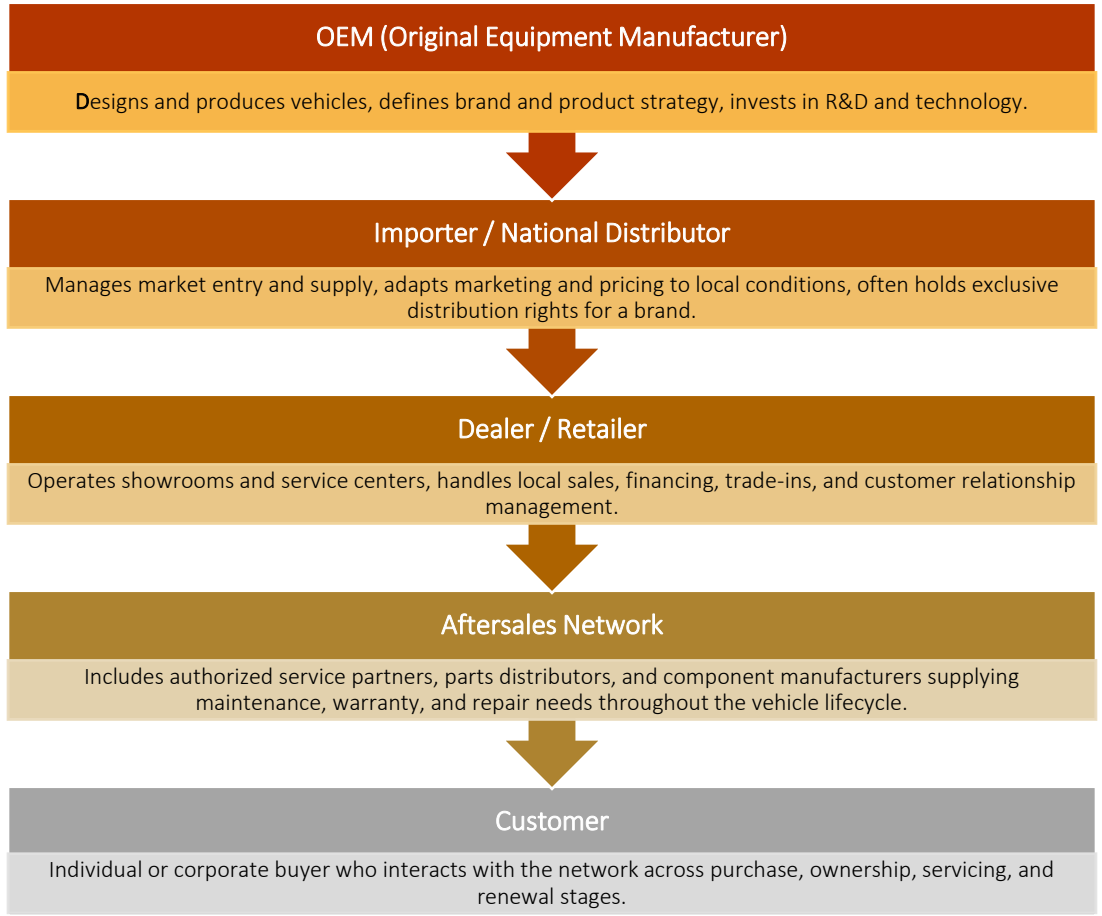
3. Review approach methodology

4. Results

5. Illustration – downstream automotive

6. Discussion

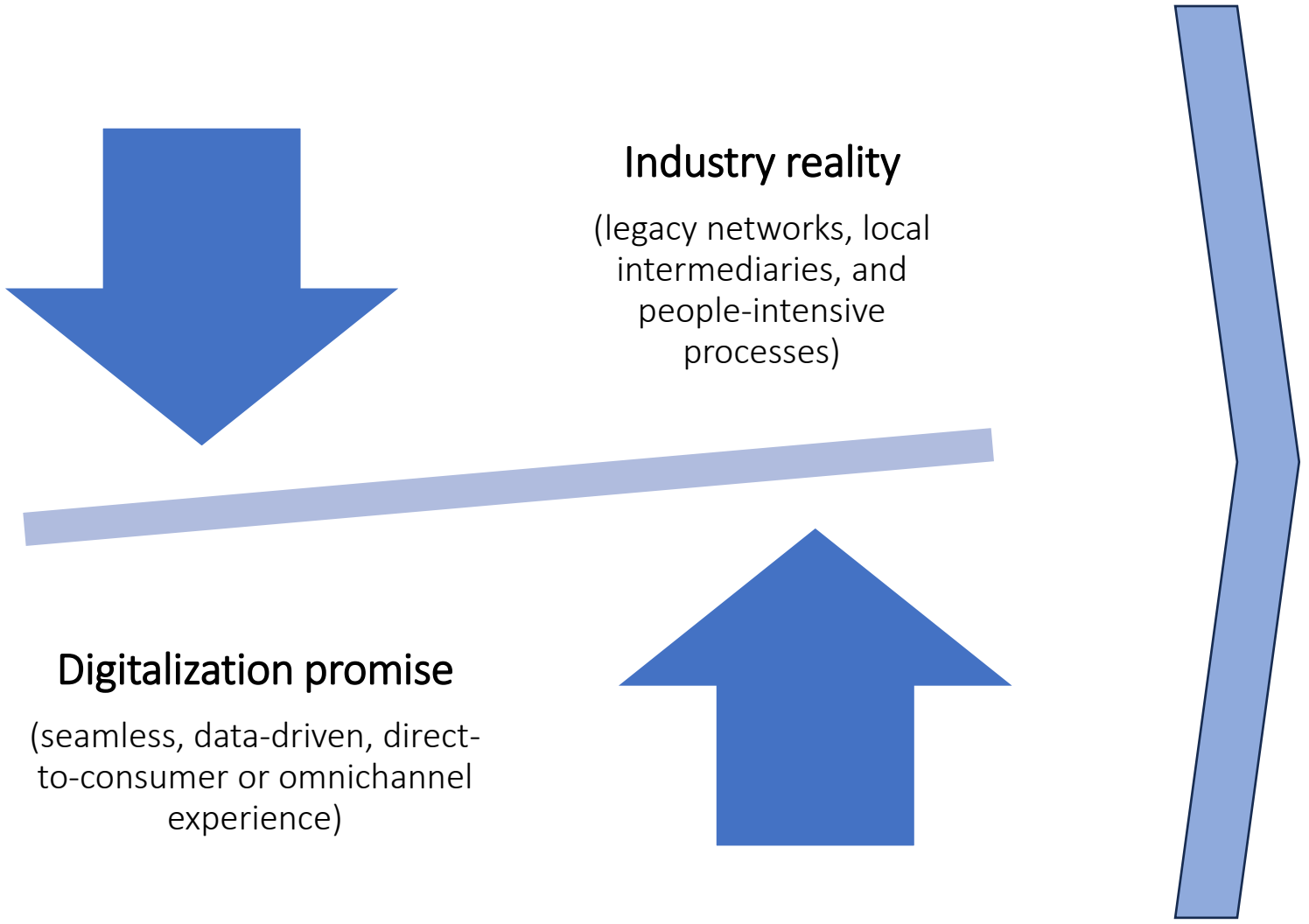
Automotive distribution value chain and customer journey



Digitalization challenges

Challenge Area	Description
Structural Complexity	Fragmented chain (OEM–importer–dealer) makes unified digital systems difficult.
Legacy IT and Data Silos	Multiple brands and outdated dealer systems prevent data integration.
Ownership & Capital Limits	Many small, undercapitalized dealer groups (especially in CEE) lack digital investment capacity.
Dealer Dependence	Dealers remain key to customer trust and deliver, so digitalization can’t bypass them fully.
Product & Regulatory Complexity	Financing, insurance, and safety regulations slow process automation.
Customer Expectations	Consumers expect Amazon-like ease but still want physical reassurance for a high-value purchase.
Competitive Pressure	New entrants (Tesla, Chinese EV brands) set new digital benchmarks, forcing legacy players to adapt.

The core tension



Industry reality

(legacy networks, local intermediaries, and people-intensive processes)

Digitalization promise

(seamless, data-driven, direct-to-consumer or omnichannel experience)

Result

Gradual evolution, not disruption, digitalization as a *negotiation* among OEMs, importers, and dealers.

Summary of the interviews

Company	Position	Digital project presented	Topic	Barriers/challenges
Spare parts	CIO - Group	Standardization of background data structure for countries, creation of dashboards.	Corporate data system	Non-standardized **data**, too much data, knowledge sharing, adaptation to changes, perfectionism, **cultural** differences.
Spare parts	Business Development Director - Romania	"Marketing ERP", offers promotions, provides gifts for service providers, and enables them to receive exclusive offers.	CRM	Coordination of **different technologies**, **vision - planning**, GDPR.
Spare parts	CEO - Central Europe	D365: ERP system integration.	ERP	**Unstable internet**, other **technical** problems, **human** errors.
Spare parts	COO - Hungary	Connect: Web store development (replacing background, changing user interface).	CRM	"**Why do we need** a new system?", maintaining normal business operations.
Distributor & retailer	CIO - Group	BI project (system development and follow-up integration projects)	Corporate data system	**Lack of resources** (BI developers), conflicts of interest between business units and headquarters
Distributor & retailer	Digital Project Delivery Lead - Group	Importer management system replacement	ERP	Current **vendor-related constraints**, immature PM organizational **culture**, difficult to formulate **business specifications**, slow **management** delegation/decision-making
Distributor & retailer	Senior Project Manager - Group	CRM project	CRM	Different needs, interests, **cultures**, **decision-making** aspects, and underdeveloped **project governance** systems between organizational units
Distributor & retailer	IT manager - Mobility BU	IT system replacement and migration following an organizational merger	ERP	**Cultural** differences between organizations, complex internal **architecture**, missing documentation
Distributor & retailer	Head of PMO - Distribution BU	Finance & accounting system replacement	ERP	Lack of **project management approach/culture**, inadequate **planning**, **process**, few dedicated **resources**, lack of coordination with business

Agenda

1. Introduction

2. Literature review

3. Review approach methodology

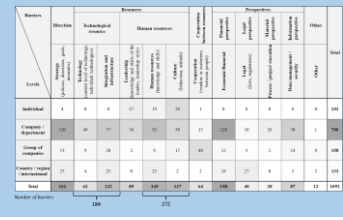
4. Results

5. Illustration

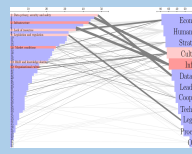
6. Summary

Summary

The **most frequent barrier topics are economic, strategic, and skills-related, closely followed by integration/infrastructure and culture**.
These barriers are neither new nor surprising. However, relying on a Meta-analysis, using the results of 90 papers, increases their power.



Minor differences between the countries with higher and lower digital competitiveness, which goes against previous findings. The **most influential difference is integration and infrastructure**, which was not emphasized in the literature.



Specific context and **industry characteristics** can have a direct impact on the **extent** and **direction** (type of technologies) of digitalization, but the barriers are the same.

Funding

This work was supported by the project entitled

"Strengthening the digitalization of businesses in Eastern Europe – a micro and macro-level approach"

funded by the **European Union – NextGenerationEU** project and the **Romanian Government**,

under the National Recovery and Resilience Plan for Romania,

contract no. 760036/23.05.2023, cod PNRR-C9-I8-CF 198/28.11.2022,

through the Romanian Ministry of Research, Innovation and Digitalization, within Component 9, Investment I8.

Finanțat de Uniunea Europeană NextGenerationEU
Planul Național de Redresare și Reziliență

Thank you for your attention!

Experiences with digitalization

Krisztina Demeter[a,b]
Contributors: Dávid Losonci[b], Kolos Ágoston[b], Ottó Csiki[a], Botond Benedek[a], Máté Baksa[b], Yang Cheng[c]

[a]Faculty of Economics and Business Administration, Babeş–Bolyai University, Cluj-Napoca, Romania
krisztina.demeter@ubbcluj.ro, otto.csiki@ubbcluj.ro, botond.benedek@ubbcluj.ro

[b]Institute of Operations and Decision Sciences, Corvinus University of Budapest, Budapest, Hungary
krisztina.demeter@uni-corvinus.hu, david.losonci@uni-corvinus.hu, kolos.agoston@uni-corvinus

[c]Department of Materials and Production, Aalborg University, Aalborg, Denmark
cy@mp.aau.dk

Sopron, International Scientific Conference, 06.11.2025