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The Linkage Between Digital Transformation and Organizational Culture: Novel Machine Learning Literature Review Based on Latent Dirichlet Allocation

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Abstract
Organizational culture is a crucial component of innovation in company success, particularly in the setting of the information economy. The purpose of this research is to conduct a bibliometric analysis in order to identify dominant research topics, their potential shifts, and recent developments in the fields of organizational culture and digital transformation. It demonstrates a machine learning–supported method for identifying and segmenting the current state of this research field. The literature was identified from the Scopus database through a search query. The analyzed amount of papers (3065) was published in 1619 sources (journals, proceedings, books, etc.) with various research impacts. Identifying the dominant research topics resulted in eight topics: Social Media Connectivity; Digital Innovation Ecosystems; Socio-economic Sustainability; Digital Workforce Transformation; Digital Competence and Cultural Transformation; Knowledge, Culture, and Innovation; Data and Resource Management; and Digital Transformation Maturity. The results showed a shift in the research field on organizational culture related to digital transformation towards the subject area of business, management, and accounting, with increasing research interest and impact for the Digital Workforce Transformation as well as for the Knowledge, Culture, and Innovation topics.

Keywords Organizational culture · Digital transformation · Industry 4.0 · Machine learning · Latent Dirichlet allocation · Literature review

Introduction

In recent years, the world has gone through many events that have changed how we live, relax, work, or communicate. These changes are still resonating in the business environment, for example, in the transition to partial or complete work from home and bring several challenges that organizations have to deal with

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(Yang et al., 2023). One of the crucial areas is the socialization of employees and the formation and maintenance of organizational values expressed by the organizational culture (Noto et al., 2023).

Organizational culture has been well-researched since the early 1980s (O'Reilly et al., 1991; Schein, 1985). The focus originated in American-based qualitative studies and shifted over time towards a more international perspective (Cameron & Quinn, 1999; Denison & Mishra, 1995; Hofstede, 1998), as well as adopting a more quantitative viewpoint with many published papers (O'Reilly et al., 2014). Several different areas of organizational culture have already been analyzed, including performance, motivation, leadership, and innovation, among many others (Affes & Affes, 2022; Aasi & Rusu, 2017; Abu Bakar et al., 2021). One of the up-to-date research areas is the topic of digitalization.

The advent of automation and digitalization and the resulting digital transformation in recent history have significantly impacted many markets and organizations and influenced the behaviors and expectations of customers. Digital transformation is driven by several external factors, including the rapid growth and adoption of new technologies that foster e-commerce, big data, a changing competitive landscape, and altered consumption behavior, driven by better-informed, connected, and more empowered customers (Verhoef et al., 2021). It provides many challenges and opportunities, including relevant impacts on organizational culture (Alloghani et al., 2022). In recent years, the impact of the COVID-19 pandemic has had a significant influence on organizational culture (Daum & Maraist, 2021; Spicer, 2020).

Even before the pandemic, the fast development of digital technologies, including automation, smart technology, artificial intelligence (AI), and robots, cloud computing, and the Internet of Things (IoT) is radically altering the nature of work and of organizations (Nimawat & Gidwani, 2021). The combination of technological advancements was coined as the Fourth Industrial Revolution or Industry 4.0 by Klaus Schwab in late 2015 (Schwab, 2015). The speed and scope of current technological changes are prompting concerns about the extent to which new technologies will fundamentally alter organizational cultures, workplaces, or completely replace workers (Acemoglu & Autor, 2011; Brynjolfsson & McAfee, 2014; Frey & Osborne, 2017).

These Industry 4.0 developments and an agile workforce are all components of a global digital transformation that changed the workplace dynamics and led to significant changes in organizations and employee behavior. Due to the unexpected interruption brought on by the coronavirus pandemic, working from anywhere has become the new standard for millions of people worldwide (Özkazanç-Pan & Pullen, 2020).

The combination of these two driving forces will have a lasting effect on the formation and effectiveness of organizational culture in the future (Kniffin et al., 2021; Trenerry et al., 2021). However, the number and range of publications in recent years on organizational culture, digital transformation, Industry 4.0, and COVID-19 make it necessary to provide a structured overview of the published literature.

Firstly, this paper shall give an overview of the research being conducted on organizational culture and digital transformation and identify the main research

areas, authors and journals. The methods utilized are outlined, along with the applied bibliometric tools. Secondly, this paper aims to provide an overview of the status quo of research by identifying the different research clusters with its critical analysis.

Literature Review

Research on Organizational Culture and Digital Transformation

Over time, the concept of organizational culture has been the center of attention for many researchers. It has been the main focus of study of several scientific works, especially in management and business (Mohelska & Sokolova, 2018; Streimikiene et al., 2021; Vallejo, 2011).

The concept of organizational culture has been studied from different angles, with researchers exploring the role that organizational culture can play and which factors impact organizational culture (Guzal-Dec, 2016; Polyanska et al., 2019; Zeng & Luo, 2013).

A high number of researchers agree with Schein's (1985) model, which asserts that there are three levels at which an organizational culture may be conceptualized: fundamental presumptions and beliefs, norms and values, and cultural artifacts (Chatman & O'Reilly, 2016). From the perspective of the organization and its working environment, organizational culture emerges from behavior in which basic assumptions and beliefs are shared and seen as given by organizational members (Schein, 1985).

Academics primarily focused on organizational culture's definition, connotation, structural components and type categorization in the 1980s; most of this research was qualitative (Cui et al., 2018). Even though there was no universal agreement on the meanings of organizational culture at the time, Schein's framework (Schein, 1992) was somewhat representational in the academic world. Research on organizational culture then evolved from mainly qualitative research to quantitative studies in the 1990s (Cameron & Quinn, 1999; Denison & Mishra, 1995; Hofstede, 1998, 2001; O'Reilly et al., 2014). According to Cui et al. (2018), contemporary views of organizational culture are seen as a key factor for success, promoting organizational effectiveness and performance (Gregory et al., 2009), organizational innovation (Hogan & Coote, 2014), and organizational identity (Ravasi & Schultz, 2006). Organizational culture is now considered a key component of innovation in company success, particularly in the setting of the information economy (Büschgens et al., 2013). Cartwright identifies nine relevant factors that drive the cultural transformation in organizations that enable successful business practices (Cartwright, 1999).

Organizational culture has two basic academic foundations: sociology (organizations have culture) and anthropology (organizations are cultures). The sociological position has become dominant in recent years (Cameron & Quinn, 1999). Based on this, there are two opposing viewpoints regarding the possibility of managing organizational culture — the functionalist and symbolist view (Schueber, 2009). The functionalist perspective regards culture as an organizational variable (Alvesson,

1993), and it can be determined by management (Meek, 1988; Silverzweig & Allen, 1976). According to the functionalist perspective, culture is seen as something that the organization possesses and can be controlled (Barley et al., 1988; Smircich, 1983). The symbolist viewpoint regards culture as a representation of what an organization *is* rather than anything it *has*. This implies major challenges in controlling or managing organizational culture (Morgan, 1986; Smircich, 1983). Functionalists would argue that the culture should be changed to fit the strategy, whereas symbolists would propose that the strategy should be adjusted to the organization's culture (Ogbonna, 1992; Senior, 1997). In this paper, the functionalist view is supported by implications of the results.

Digitalization is defined as "the transformation of business models as a result of fundamental changes to core internal processes, customer interfaces, products and services, as well as the use of information and communications technologies" (Isensee et al., 2020). However, digitalization and digital transformation are quite different. A company may embark on several digitalization initiatives, from automating procedures to retraining staff members to utilize computers. On the other hand, businesses cannot conduct digital transformation as projects. Instead, this more general phrase refers to a client-centered strategic business transformation that calls for adopting digital technology and organizational changes across all departments (Verhoef et al., 2021).

An executive's view that does not distinguish between digitalization and digital transformation could lead to an insufficient strategic focus (Li & Shao, 2023). Digital transformation efforts will often involve several digitalization projects, which require management sponsorship and the willingness to change existing structures and practices. Various papers have studied the challenges that may arise from organizational culture when adopting new technologies and structures, e.g., agile practices (Anwar et al., 2016; Ghimire et al., 2020; Raharjo & Purwandari, 2020), technology adoption (Melitski et al., 2010), or even Green Supply Chain Management (El Baz & Iddik, 2021). As the business becomes primarily customer-driven, digital transformation necessitates improving how well the organization manages change (Anghel, 2019).

Industry 4.0 began in the twenty-first century with the development of cyber-physical systems (CPS), the Internet of Things (IoT), the Internet of Services, smart factories, and cloud computing. It continues today (Hermann et al., 2016; Kagermann et al., 2013; Liao et al., 2017; Xu et al., 2018). It is characterized as a combination of CPS and IoT in the manufacturing industry, which can have repercussions for value creation, company growth, work organization, and downstream businesses (Kagermann et al., 2013; Kiel et al., 2017). The advent of Industry 4.0 involves significant changes for organizations and societies and has various effects on nations, businesses, industries, and society (Schwab, 2015). Industry 4.0 implementation is a complicated process involving horizontal, vertical and seamless integration and will rely on the synergies between the business and stakeholders from many functional domains (Müller, 2019a, 2019b; Wang et al., 2016). In particular, many organizations fail to capture their Industry 4.0 vision and strategy throughout the change process (Schumacher et al., 2016a). Other important factors that hinder the application of a successful digital transformation

towards a functional Industry 4.0 concept are fear of uncertainty and wrong expectation of requirements (Balasingham, 2016). Willingness to adopt this technology is another reason to fail (Adebanjo et al., 2021). Organizations aiming to incorporate and adopt digital transformation into their operational procedures must recognize and assess important critical factors (Nimawat & Gidwani, 2021).

Organizational communication and collaboration styles have changed due to globalization, advancements in information and communication technologies (ICTs), an increase in hybrid work models and the rise of computer-mediated groups (Sharma et al., 2022). With the knowledge economy, digital culture, and recent technological innovations, new working styles have quietly emerged in organizations (Powell et al., 2004). Then, the spreading of the coronavirus and the required shift in transition to remote working acted as a catalyst for how organizations operate and employees engage. The drastic changes in the workplace naturally affected employees and spurred changes in their behavior and attitudes (Caligiuri et al., 2020). The corresponding research topic of COVID-19-related impacts and the implications on digital transformation in the context of organizational culture is relatively new. Many partial aspects that have gained new relevance during the corona pandemic have already received attention in the research community over the past 20 years.

Therefore, this study aims to conduct a bibliometric analysis in order to identify dominant research topics, their potential shifts, and recent developments in the fields of organizational culture and digital transformation. The most significant research articles or authors and their related relationships can be found using the scientific computer-aided review process known as bibliometric analysis. It can help to forecast the possible direction of such identified fields and is widely applied in academic research (Diem & Wolter, 2013). This method aids in providing a thorough overview of the subject as well as visually summarizing its patterns and trends (Baker et al., 2020; Zhou et al., 2020).

Overview of Bibliometric Reviews

The topic of organizational culture has had a large number of contributors in the past decades. Several articles were published on organizational culture as bibliometric studies (Cicea et al., 2022). Only a few reviews were conducted on digital transformation in organizations related to organizational culture (e.g., as digitalization). Table 1 lists a few publications on these topics.

Overview of Systematic Reviews

Apart from bibliometric literature reviews, many authors have conducted systematic literature reviews on various research areas relating to organizational culture and digital transformation. As seen in the following non-conclusive overview in Table 2 and Table 3, researchers have focused their attention on heterogeneous study fields like performance-orientation, entrepreneurship, Industry 4.0, agile practices,

Table 1 Overview of selected bibliometric reviews on organizational culture and digital transformation

Paper	Authors	No. of papers	Time frame
A bibliometric study of the cultural models in international business research	Reis et al. (2013)	3639	1976–2011
Positioning Organizational Culture Studies Between the Construction Industry and Other Industries	Teravainen et al. (2017)	6743	1986–2016
Bibliometric analysis of organisational culture using CiteSpace	Cui et al. (2018)	1479	2005–2016
Bibliometric analysis of safety culture research	van Nunen et al. (2018)	1789	1990–2015
Bibliometric analysis of Organizational culture in Business economics of Web of Science, 1980–2018	Leyva-Duarte et al. (2019)	1936	1980–2018
Organizational culture in the hospitality industry a bibliometric analysis and systematic literature review	Leyva-Duarte et al. (2020)	43	1980–2019
Corporate sustainability strategies and decision support methods: a bibliometric analysis	Kitsios et al. (2020)	72	1998–2019
Evaluation of the relationship between Lean Philosophy and Organizational Culture: a bibliometric review	Montini et al. (2020)	3676	2009–2019
Green supply chain management and organizational culture: a bibliometric analysis based on Scopus data (2001–2020)	El Baz and Iddik (2021)	46	2001–2020
Impact of organisational culture on work-life balance a bibliometric analysis and growth in research	Nidhi and Arti (2020)	444	2001–2020
Organizational Culture: A Concept Captive between Determinants and Its Own Power of Influence	Cicea et al. (2022)	352	1977–2020
Working in Virtual Teams: A Systematic Literature Review and a Bibliometric Analysis	Garro Abarca et al. (2020)	2354	2015–2019
Toward a sustainability organizational culture model	Assoratgoon and Kantabutra (2023)	935	1995–2021

Table 2 Overview of selected systematic reviews on organizational culture

Paper	Authors
Organizational culture now and going forward	Baek et al. (2019)
The relationship between organizational culture, sustainability, and digitalization in SMEs: a systematic review	Isensee et al. (2020)
Exploring BIM-triggered organisational and professional culture change: a systematic literature review	Alankarage et al. (2021)
Organisational Culture Attributes Influencing the Adoption of Agile Practices: A Systematic Literature Review	Mkoba and Marnewick (2022)
Entrepreneurial strategies and family firm culture in the Arab world: a systematic literature review	Sindakis et al. (2022)
Inclusive organizational behaviour—the dynamic rules of building new workplaces	Kar et al. (2023)

work-from-anywhere, SMEs, and many others. This broad overview indicates that the topic of organizational culture plays a very relevant role in recent research, especially in the context of digital transformation.

The provided overview on digital transformation research mainly focuses on functional areas and its application. The center of research is the implementation, readiness, adoption, as well as barriers, opportunities, and challenges. Additionally, research fields like *examining potential directions* (Belinski et al., 2020; Kamble et al., 2018; Pagliosa et al., 2019; Piccarozzi et al., 2018; Schneider, 2018; Sony & Naik, 2020); *implementation, readiness and adoption* (Çınar et al., 2021; Pacchini et al., 2019; Sung & Kim, 2021); *barriers, opportunities, and challenges to the adoption and implementation of Industry 4.0* (Bajic et al., 2021; Raj et al., 2020); and *sustainability* (de Sousa Jabbour et al., 2018; Luthra & Mangla, 2018) are analyzed.

The main focus areas, among many others, which are influenced by digital transformation are *agile and collaborative teamwork and management* (Kerber & Buono, 2004; Huang et al., 2003; Sheppard, 2020; Parry & Battista, 2019;

Table 3 Overview of selected systematic reviews on digitalization and digital transformation

Paper	Authors
Industry 4.0 integration with socio-technical systems theory: A systematic review and proposed theoretical model	Sony and Naik (2020)
Preparing Workplaces for Digital Transformation: An Integrative Review and Framework of Multi-Level Factors	Trenerry et al. (2021)
Identification of critical success factors for leveraging Industry 4.0 technology and research agenda: a systematic literature review using PRISMA protocol	Sahoo et al. (2022)
The Evolution of Balanced Scorecard in Healthcare: A Systematic Review of Its Design, Implementation, Use, and Review	Betto et al. (2022)
Microfoundations of dynamic capabilities: a systematic review and a multilevel framework	Chen et al. (2023)

Singer-Velush et al. 2020; Hamouche, 2020), *adaptive business culture in dynamic*, *supportive*, *environments*, *with focus on employee well-being*, *work design*, *open innovation*, *workforce effectiveness* (Am et al., 2020; Ngoc Su et al., 2021; Baker et al., 2006; Žižek et al., 2021; Parry & Battista, 2019; Bélanger et al., 2013; Carnevale & Hatak, 2020), and recent *technological developments* (Ågerfalk et al., 2020; Bloom et al., 2015; Bondarouk & Ruël, 2009; Johnson et al., 2020; Spreitzer et al., 2017; Wiggins et al., 2020).

Research Gap

The research mentioned in the aforementioned literature review sought to examine several factors of organizational culture and digital transformation. However, reviews of literature based solely on a systematic or bibliometric methodology have significant drawbacks. Studies of systematic literature reviews are frequently in-depth and typically handle only a small number of documents. As a result, the findings are more constrained (Moher et al., 2015; Page et al., 2021). Contrarily, bibliometric reviews are concentrated on a wider range of the studied areas. They mostly reveal major trends as an outcome (Cobo et al., 2011; van Eck & Waltman, 2010). Using machine learning to find latent patterns in textual data is one of the most popular study methods in the field of bibliometric review (Han, 2020; Mariani & Baggio, 2022). Automated processing is used to analyze the scientific publications for our study. It employs an advanced machine learning–based methodology to extract topics from the scientific literature. This paper contributes to the existing literature by answering the following research questions:

Research Question 1 *(RQ1)*. How has the organizational culture — digital transformation relationship evolved over time?

The number of publications on digital transformation is growing, and organizational culture is a well-established research area with years of academic work. Consequently, a bibliometric analysis of the growth of the top journals, articles, and most cited publications may be able to provide relevant insights.

Research Question 2 *(RQ2)*. What are the dominant research topics on organizational culture and digital transformation?

The total number of publications on the subject of this study is rapidly increasing. Therefore, we may apply machine learning to extract particular study ideas from a large body of published scientific literature.

Research Methodology

Data

This paper aims to establish the trends of research papers in the field of organizational culture research with a focus on digital transformation. The authors conducted the review of the literature using bibliometric analysis and a machine learning method.

Researchers often undertake bibliometric analysis with the main goal to determine the body of knowledge on a certain subject, to provide an assessment of the research already conducted, and to develop networking structures for the scientific community. Five steps (*study design*, *data collection*, *data analysis*, *data visualization*, and *interpretation of results*) represent the workflow of science mapping and were used to apply the bibliometric approach and network analysis (Aria & Cuccurullo, 2017).

The review usually starts by determining the database that contains the input data. The only source for this paper are the bibliographic records from the Scopus database as data collection input. This source has been considered reliable in prior works. Scopus, developed by Elsevier B.V., is the largest database of scientific peer-review literature hosting more than 27,950 journal published articles (Elsevier, 2023). It was chosen for this study as it is the largest and most relevant scientific database in the world, covering most of the publications available. This includes consistent repositories of documents as well as additional information such as country of all the authors, citations per document, and further information that is relevant in terms of quality and quantity for the study.

The search query was developed after identifying the research area. This was done by splitting the topic into three fields of research. The first set was *organization* with the corresponding synonyms followed by *culture* (second set). The third was *digital transformation* and its phases *digitization* and *digitalization* following Verhoef et al. (2021) and its synonyms including *Industry 4.0*. The database was queried using additional synonyms and alternative spellings to increase the study's coverage.

To collect these articles, the combination of the following keywords was selected:

Digital transformation, *digitalization*, *digitalisation*, *digitization*, *digitisation* combined with Industry 4.0 search terms *fourth industrial revolution*, *4IR*, *4-IR*, *industry 4.0* and the organizational culture related keyword *organisation**, *organization**, *firm*, *company*, *corporate*, *enterprise*, *business* and *culture*.

The search criteria were then determined. The authors used the *title*, *abstract* and *keywords* from the articles provided by the Scopus database (TITLE-ABS-KEY). This resulted in 3077 identified papers. The search query and result are shown in Table 4. The search was conducted on March 30, 2023.

After collecting the data, all documents with no abstracts were removed. The authors also removed all documents with abstracts defined as: "[No abstract available]". After this removal, the dataset consisted of 3065 documents. The applied

Table 4 Search query and resulting number of papers

Search keywords	No. of papers
TITLE-ABS-KEY (("*organisation**" OR "*organization**" OR "*firm*" OR "*company*" OR "*corporate*" OR "*enterprise*" OR "*business*") AND ("*culture*")) AND ("*industry 4.0*" OR "*digitalization*" OR "*digitalisation*" OR "*digitization*" OR "*digitisation*" OR "*digital transformation*" OR "*fourth industrial revolution*" OR "*4IR*" OR "*4-IR*")	3077

dataset was made up of the following eight variables: authors, title, year, source, cited by, abstract, authors keywords, index keywords. A total of 139 documents were tagged as *Review*. In addition, to answer the research question RQ1, we joined our dataset with a dataset that defined individual subject areas for each journal. Thanks to such an expanded dataset, we were able to better structure the results.

Topic Modelling

In order to be able to answer research question RQ2, we needed to perform an analysis of the scientific field. There are several ways to conduct a literature review. Instead of the standard literature review process, we decided to carry out the literature review based on machine learning. This way of analyzing the scientific field allowed us to assess a much larger number of documents and thus make the literature review more relevant. Our review based on machine learning analyzed 3065 document abstracts in total.

Before the actual process of identifying individual research topics in the selected area, it was necessary to perform text preprocessing and then divide the analyzed documents into individual topics. Data preprocessing included several steps which are common in text analytics. After removing some special characters, we removed punctuation, further removed numbers and stopwords defined in the tm package in R. In addition, we defined other custom stopwords that were removed from the corpus of abstracts. Then we then removed the extra spaces and stemmed the words in the document. The last step was to delete custom stopwords[1] specific to our area of

[1] cultur, digit, studi, research, technolog, busi, industri, organ, organiz, use, transform, practic, compani, paper, result, factor, perform, effect, find, implement, author, analysi, provid, differ, organis, approach, base, adopt, identifi, impact, improv, literatur, support, relat, increas, focus, success, level, structur, present, purpos, aim, relationship, influenc, understand, method, enterpris, signific, firm, articl, includ, limit, publish, framework, context, contribut, corpor, show, requir, sector, case, review, futur, within, creat, examin, key, explor, right, current, propos, institut, collect, main, howev, reserv, natur, analyz, implic, discuss, consid, concept, mani, construct, investig, achiev, conduct, among, becom, toward, exist, respons, applic, enabl, theori, affect, issu, survey, assess, opportun, three, interview, adapt, indic, appli, perspect, area, suggest, critic, determin, specif, high, aspect, field, build, form, order, evalu, direct, establish, relev, offer, object, various, methodolog, address, problem, enhanc, addit, part, empir, initi, scienc, associ, analyt, reveal, term, theoret, test, springer, possibl, generat, complex, big, open, continu, switzerland, particip, academ, state, mediat, originalityvalu, designmethodologyapproach, across, solut,advanc, content, regard, characterist, highlight, analys, therefor, higher, interest, access, allow, emerald, advantag, face, make, better, year, insight, goal, select, trend, function, small, element, due, must, conceptu, view, systemat, action, chapter, combin, play, accord, question, describ, questionnair, sever, valid, larg, general, thus, â€, major, recent, type, technic, mean, concern, moder, topic, facilit,sampl, gap, respond, way, attent, outcom, stage, scientif, final, expect, repres, creation, report, still, variabl, especi, techniqu, ensur, compar, number, carri, practition, necessari, exampl, defin, second, copyright, document, compon,

interest. In this case, these were words that were irrelevant to our field of research and, in our opinion, did not add value to the resulting analysis. We defined these words based on the frequency analysis of stemmed words from the corpus of analyzed abstracts. The mentioned procedures were performed in the R programming language using the tm and SnowballC packages. After removing the specific stopwords, we finally removed the extra spaces. Subsequently, a document-term matrix (dtm) was created, which contained the frequencies of all individual words in every document. Since the dtm itself also contained low-frequency words, we removed

Footnote 1 (continued)
subject, common, obtain, demonstr, evid, drive, link, depend, exclus, principl, multipl, essenti, observ, quantit, format, revolut, effort, reflect, four, negat, recommend, made, idea, top, ltd, awar, five, regul, standard, rapid, previous, statist, take, strong, introduc, european, journal, foster, sinc, conclus, featur, basi, driver, equat, digitalis, special, best, comprehens, hand, help, forc, given, consist, align, uniqu, total, explain, overal, materi, refer, gain, furthermor, remain, taylor, whether, moreov, imag, conclud, origin, hypothes, consider, think, similar, russian, attribut, fundament, ieee, clear, bring, caus, around, encourag, period, live, shape, step, start, deploy, name, crisi, intent, contemporari, produc, particular, today, protect, satisfact, ident, accept, six, despit, progress, paradigm, theme, appropri, although, elsevi, argu, datadriven, attract, seek, complet, scholar, search, deal, china, maintain, act, respect, introduct, pattern, serv, less, acceler, indepth, predict, crucial, style, detail, procedur, extend, limitationsimpl, phase, emphas, togeth, greater, abl, central, via, confirm, novel, draw, correl, databas, rate, emot, primari, basic, wide, degre, give, machin, legal, domin, thing, map, basel, record, turn, interpret, south, transfer, cover, mdpi, along, leverag, pressur, move, hospit, decad, least, expand, evolv, fourth, holist, now, informa, rang, other, reliabl, solv, excel, site, uncertainti, henc, partial, littl, without, contain, balanc, prefer, real, cours, overcom, alreadi, india, prepar, sale, actor, instrument, valuabl, beyond, past, center, histori, fact, regress, prevent, preserv, assist, deliv, low, definit, mine, substanti, extens, answer, close, known, third, taken, contextu, popular, employeesâ€™, index, fit, deriv, locat, embrac, text, scenario, outlin, certain, ongo, desir, independ, transpar, avoid, proceed, realiz, illustr, visual, promis, inc, reach, usag, algorithm, identif, consult, feder, gather, whole, prioriti, russia, altern, constant, occur, shown, actual, proactiv, seem, europ, matter, resist, express, igi, appear, sociotechn, light, extent, germani, done, hybrid, upon, just, read, receiv, driven, german, cycl, suitabl, mainten, fulli, look, long, bodi, ground, attempt, broad, compris, varieti, indonesia, frame, african, rise, home, weak, proper, financ, keep, maker, dissemin, properti, senior, mitig, next, difficulti, captur, correspond, flow, begin, code, overview, stimul, squar, prove, volum, reduct, full, american, choic, malaysia, intend, llc, eight, tri, occup, diffus, vari, under, numer, extract, organizationâ€™, anoth, len, rule, indian, aid, know, joint, socioeconom, lower, summar, classifi, fast, experiment, exhibit, paramet, brought, widespread, understood, nowaday, mix, embed, africa, built, provis, sociolog, good, comparison, adjust, behind, quick, adequ, channel, instead, verifi, indirect, seven, primarili, soft, safe, companyâ€™, pose, handl, themat, routin, therebi, interconnect, reform, assumpt, either, constitut, utilis, believ, prior, john, separ, come, segment, item, assum, suffici, minim, whose, sem, plssem, outsid, seri, huge, restrict, wast, classif, updat, translat, obstacl, frequent, hold, version, interfac, discov, almost, represent, equal, wherea, hypothesi, presenc, simpl, robust, alway, categor, claim, score, like, print, interdisciplinari, ten, australia, note, italian, bibliometr, lie, america, underpin, synthesi, wiley, promin, alter, typic, stori, fuzzi, simultan, fulfil, estim, pursu, correct, return, manner, narrat, becam, besid, contrast, ration, inspir, replac, hinder, imper, detect, thought, son, faculti, convers, asia, profound, pilot, acknowledg, maxim, configur, urgent, argument, hard, sensit, gmbh, charact, larger, rich, wider, elabor, highest, shed, phenomena, deep, necess, mutual, mass, option, trigger, expans, poor, extant, domest, todayâ€™, concentr, demograph, reinforc, clarifi, anticip, eas, expos, deeper, most, editor, devot, middl, crosssect, usual, nine, ultim, manifest, scopus, calcul, vulner, andor, run, massiv, tension, ideal, old, retriev, first, singapor, ambigu, list, conscious, inher, insid, ministri, rethink, serious, compos, stay, modifi, per, encount, rare, attain, circumst, date, recognis, enter, near, spss, explicit, held, incent, unpreced, largest, stronger, insuffici, lack, nevertheless, word, longer, input, decreas, conting, accur, tendenc, preval, match, tackl, undertaken, sciencebusi, amongst, mention, easili, reader, chosen, prosper, elimin, coupl, hope, authorsâ€™, get, later, everyday, dedic, encompass, thrive, miss, acm, refin, interdepend, guarante, precis, except, random, accomplish, latest, easi, vast, prevail.

words that appeared in less than 0.5% of the abstracts in the resulting matrix. The resulting dtm contained 1108 words.

After preprocessing the text of the abstracts, we proceeded to structure the abstracts into research topics. We implemented the mentioned process, also called topic modeling, using the Latent Dirichlet Allocation method, also known as LDA (Blei et al., 2003). LDA is a probabilistic generative process, the result of which is a set of topics that represent the composition of the entire space into individual parts. Based on the words in individual documents, the so-called latent topical structure is created, while latent topics are a mixture of several documents. Based on the posterior estimates of the hidden variables, we can estimate the structure of the latent topics. Hidden variables in our case represent latent topical structure (Blei & Lafferty, 2009).

Topic modeling using LDA was implemented in the R programming language using the topicmodels library. Topic modeling itself assumes the number of topics into which the entire space needs to be divided. There are several approaches for finding the number of topics. Since the approach based on the evaluation of statistical criteria resulted in a large number of topics, we decided to prefer an expert approach. This approach consisted in manually assessing the interpretability of the most frequent words in individual alternatives. As part of the testing itself for a suitable number of topics, we gradually manually evaluated solutions with the number of topics $k = \{6, 7, 8, 9, 10, 11, 12\}$.

To quantify the parameters of the LDA model, we used Gibbs sampling (Gelfand, 2000; Griffiths & Steyvers, 2004; Grün & Hornik, 2011). For parameter quantification, we used 2000 iterations, taking into account only every 200th observation for a higher degree of independence between. For each k, we repeated the process five times, always recording only the best solution. Based on the results of the expert analysis, we chose a solution with the number of topics $k = 8$. Finally, we realized the visualization of topics, which was performed using the ldavis package (Sievert & Shirley, 2014).

Results

Development of Related Research Papers

The direct or indirect role of organizational culture in various processes of digital transformation has been the subject of a lot of research. The studies that formed the basis for our analysis were identified from the Scopus bibliometric database through a search query, which is presented in the "Research Methodology" section. The data was collected on March 30, 2023, while on this date, 3065 valid documents were registered in the mentioned database. A significant increase in the number of studies has only been noticeable since 2018. Still, it must be said that studies investigating the links between organizational culture and digitalization appeared sporadically even before that. Figure 1 shows an overview of the annual development of published papers and the number of citations related to the given papers. We can notice that in the last 5 years, research has an exponential character (measured through the

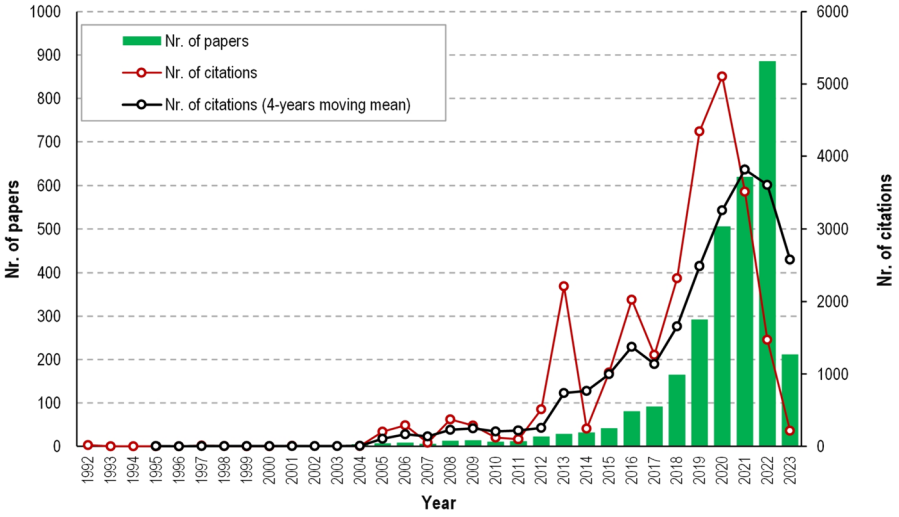

Fig. 1 Development of published papers related to organizational culture and digital transformation

number of published papers per year), but at the same time, this research area is interesting for academics (measured through the absolute number of citations).

The analyzed amount of papers were published in 1619 sources (journals, proceedings, books, etc.) with various research impacts. Table 5 shows the ranking of the sources that had the greatest impact on research on organizational culture and digital transformation in terms of the total number of citations. The research impact is primarily dominated by journals that directly or indirectly deal with the business environment, which is natural considering the nature of the papers. Of the ten listed top influential papers, as many as seven are from the last 5 years, which indicates

Table 5 Journals with highest research impact

Journal	No. of published papers	No. of citations	Top paper
Sustainability (Switzerland)	129	1357	Yun et al. (2020)
Procedia CIRP	5	817	Schumacher et al. (2016b)
Journal of Manufacturing Technology Management	9	597	Nascimento et al. (2019)
Technological Forecasting and Social Change	16	447	Chung et al. (2015)
Journal of Cleaner Production	18	370	Isensee et al. (2020)
International Journal of Production Economics	5	348	Dubey et al. (2019)
Industrial Marketing Management	10	322	Tronvoll et al. (2020)
Production Planning and Control	10	293	Bibby and Dehe (2018)
TQM Journal	14	282	Sony et al. (2020)
Industrial Management and Data Systems	6	274	Yeh et al. (2006)

that since 2018, research interest and the research impact of the given topic have grown dramatically.

Each analyzed document in our dataset was assigned to one of the 28 subject areas used by the Scopus database for their classification. Such an assignment took place based on pairing information about the journal in which the given article is located with the categorization of the journal according to the subject areas of the Scopus database. Figure 2 shows an overview of research interest and research impact for the individual subject areas.

Until 2019, ENGI (engineering) was the most frequent category, while a dramatic increase in papers in the BUSI (business, management, and accounting) group can be seen in the last four years. This increase has caused BUSI to be the subject area with the most outstanding research impact and research interest. No such significant changes were recorded in the other subject areas. Possible reasons for the increased interest of researchers in the field of BUSI in the topic of organizational culture and digital transformation are indirectly indicated by some current studies. For example, the study by Priyanto et al. (2023) emphasizes the importance of proactively modernizing a business to maintain a competitive edge. The need to increase the

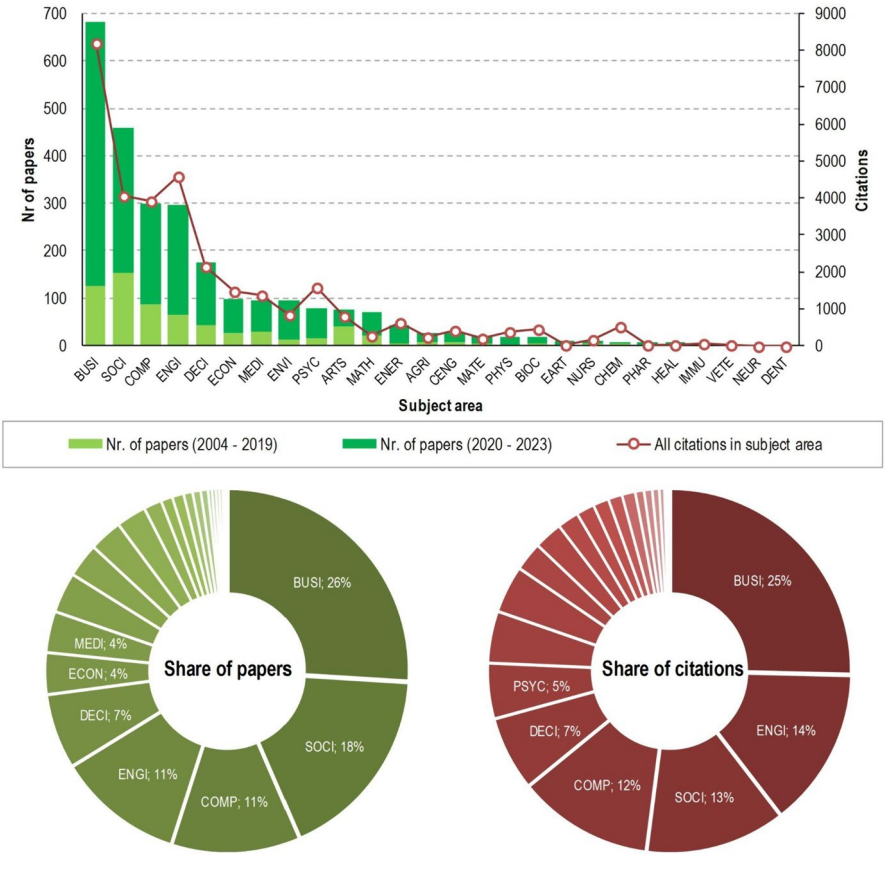

Fig. 2 Overview of research impact and research interest of subject areas

competitive edge was also pointed out in the study by Troise et al. (2022), in which the authors examined the relationships between SMEs' agility (measured by digital technologies capability, relational capability, and innovation capability) and the effects of agility on three outcomes (financial performance, product and process innovation). These studies and many others (Alomari, 2021; Carvalho et al., 2020; Chaurasia et al., 2020; Tessarini Junior & Saltorato, 2021) emphasize the managerial aspect of digitalization, which could explain the dramatic increase in research interest and research impact that we have seen over the last 4 years.

These results are also confirmed by a more detailed analysis of the development of the annual number in the five most numerous subject areas (Fig. 3). In the left part, we can see the absolute number of articles in the given subject areas, while the dominance of BUSI is visible mainly in the last three years. However, comparing the share of papers in particular subject areas is very interesting (right part of Fig. 3). We see that the increase in the BUSI subject area is continuous, while the share of SOCI (social sciences) and COMP (computer science) is decreasing in the long term. Areas such as ENGI and DECI (decision science) maintain a relatively constant share. According to the long-term trend, it can be assumed that the share of the BUSI subject area will grow in research on topics related to organizational culture and digital transformation in the coming years.

Topics Identification and Their Development

By analyzing the abstracts of the individual papers, it was possible to categorize documents into thematically related clusters using LDA. Such clusters contain papers with the occurrence of the same terms and are called topics. The individual steps of extracting topics from the analyzed dataset are listed in the "Topic Modelling" section. To choose the number of topics, several experiments were carried out with the aim of identifying such a constellation in which the individual topics would be well interpretable and, at the same time, sufficiently distinguishable from each other. The number of topics $k=8$ was selected by expert assessment according to these criteria. The results and a brief description of the topics via the top-5 most frequent terms can be found in Fig. 4 as an intertopic distance map between two principal components (PC).

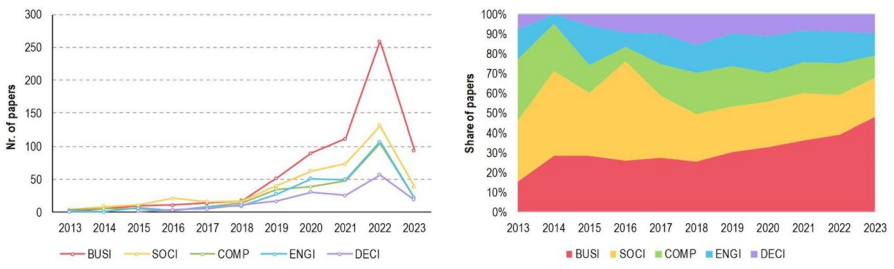

Fig. 3 Development of papers in top 5 subject areas — absolute numbers (left) and share (right)

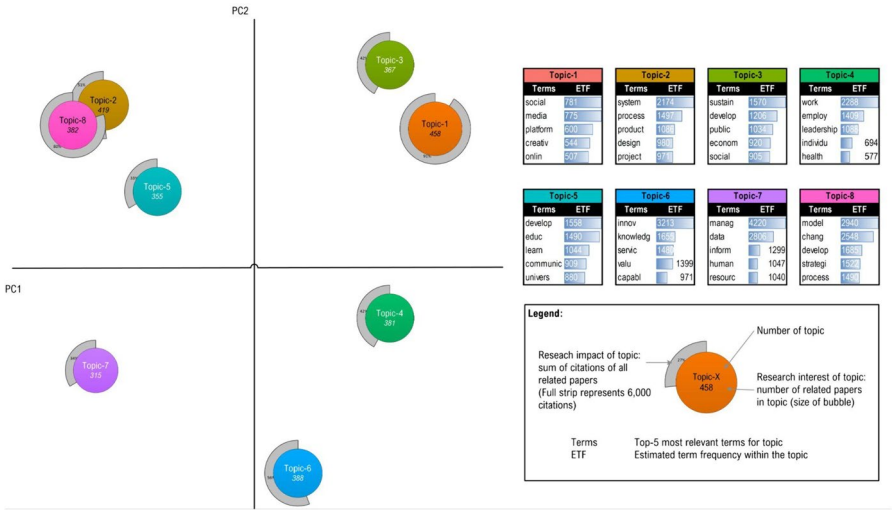

Fig. 4 Intertopic distance map

Eight identified topics were analyzed with regard to the most frequented words, and at the same time, the most cited articles in the given topic were also used for their better characterization. This allowed these topics to be named and briefly characterized:

Social Media Connectivity (Topic-1)

This topic includes various aspects of digital and social media, as well as online platforms and the cultural impacts of digital technologies. The Social Media Connectivity topic focuses on main areas like the rise of social media (Munar, 2012; van Dijck, 2013), its platforms (Mikos, 2016; Morris, 2015), as well as structural change (Kim, 2020; Peukert, 2019). The articles of topic-1 explore a wide range of subjects in particular such as social media strategies, digital engagement with heritage, digital storytelling, cultural globalization, and the transformative effects of digital technological change. There are many different inter-organizational subcultures present within organizations that are dealing with convergence and cooperation across media platforms. According to Erdal (2009), cooperation between those cultures is frequently linked to competition. It is the topic with the most significant research interest (measured through the number of papers), and at the same time, it is the topic with the highest research impact (measured through the number of citations). There are 458 related papers in this topic with a sum of all citations of 91% (based on a 6000 citation strip).

Digital Innovation Ecosystems (Topic-2)

This topic captures the overarching theme of digital transformation across various domains. It emphasizes the integration of digital technologies, innovation processes and the development of ecosystems to drive transformative change in industries and organizations with regard to culture. Regarding the function of organizational culture throughout this transformation process, two alternative viewpoints may be seen. When individuals are empowered to use their problem-solving skills, their capacity for learning and their sense of responsibility, a culture may result in a workforce that is people-centered and engaged driving the integration of digital technologies. On the other hand, there is a culture that focuses primarily on promoting this technology for the purpose of managing or substituting processes neglecting the input and use of people (Rossini et al., 2021). The main subjects of this topic include healthcare (Jacob et al., 2020), manufacturing (Reinhardt et al., 2020), and a digital transformation focus of information systems and organizational practices (Ulas, 2019). Additionally, the challenges for the organization and management in rapidly changing environments are analyzed (Granlund & Taipaleenmäki, 2005). This topic has a relatively considerable research interest with 419 papers published, but its research impact is average with 51%.

Socio-economic Sustainability (Topic-3)

The Socio-economic Sustainability topic captures the intersection of digital transformation, sustainability and socio-economic considerations across a wide variety of domains such as urban development (Anttiroiko, 2016), corporate responsibility and sustainability (Etter et al., 2019; Lăzăroiu et al., 2020), technology management (Tasleem et al., 2019), and organizational practices with regard to culture, among others. In the case of sustainable performance, all forms of organizational culture — based on the types defined by Quinn and Spreitzer (1991) — have a positive effect on sustainable performance (Gebril Taha & Espino-Rodríguez, 2020). There is also a strong correlation between organizational culture and eco-innovation (Reyes-Santiago et al., 2017). Furthermore, the sharing economy and its cultural effects towards consumption and ownership are analyzed (Dabbous & Tarhini, 2021). The third topic has an average research interest, counting 367 papers and a slightly below-average research impact of 42% compared to the other topics.

Digital Workforce Transformation (Topic-4)

Digital Workforce Transformation highlights the themes of digital transformation with the focus of organizational resilience, leadership, and the impact of technology on work culture and employee well-being. The main focus is on the employee-work relationship, including subjects like leadership (Cortellazzo et al., 2019; Guzmán

et al., 2020), employee well-being (Coldwell, 2019; Theurer et al., 2018), and resilience (McFadden et al., 2015). In particular, the implications on cultural organizational characteristics, operations, digital transformation, and financial planning of COVID-19 for work, workers, and organizations are analyzed (Kniffin et al., 2021; Obrenovic et al., 2020). As a result of the COVID-19 pandemic, many organizations have changed their mode of operation. They adopted a pure work from home model or make use of a hybrid mode of operation. Establishing a communicative work from home culture will result in increased employee satisfaction (Fay & Kline, 2011; Mandal et al., 2023). Organizations have to educate their employees concerning these new processes and technologies. Individuals dislike change, so organizations must coordinate training and awareness programs to demonstrate the advantages of new digital platforms and related technologies (Mandal et al., 2023). Regarding research interest, this topic is average with 381 papers, and its research impact is slightly below average with 42%.

Digital Competence and Cultural Transformation (Topic-5)

This topic refers to the concepts of competence in the digital era, cultural transformation, innovation, and sustainability. These articles explore different aspects of digital transformation (Suárez-Guerrero et al., 2016), the impact of digital competence on various sectors (Konttila et al., 2019), cultural factors in innovation and enterprise, and the intersection of technology and culture (Mohelska & Sokolova, 2018). The role of leadership in the transformation of organizational culture is also a focus of analysis (Sá & Serpa, 2020). From the point of view of research interest, this is a minor topic (355 papers) that simultaneously has a relatively small research impact (33%).

Knowledge, Culture and Innovation (Topic-6)

Knowledge, Culture, and Innovation captures the common themes of knowledge management (Gandini, 2016; Yeh et al., 2006), organizational culture (Dubey et al., 2019), innovation, and the transformative effects (Ungerman et al., 2018) of digitalization across various sectors. Digital innovation is linked to organizational culture by the digital capabilities of an organization (Zhen et al., 2021). The capabilities required by management in dynamic environments are examined in particular (Karimi & Walter, 2015). Research interest, counting 388 papers, as well as research impact, with 56%, of this topic are both average.

Data and Resource Management (Topic-7)

The Data and Resource Management topic encompasses the concepts of digitalization, Industry 4.0, data management, quality management, organizational culture and the impact of technology on various industries (Durana et al., 2019; Gunasekaran et al., 2019; Sony et al., 2020). These titles explore different aspects of implementing Industry 4.0, including the utilization of big data (Chiang et al., 2017), improving organizational performance through digital transformation (Ananyin et al.,

2018) and the role of data-driven decision-making in different sectors. A number of relevant factors for Industry 4.0 implementation like the development of Industry 4.0-specific know-how, securing financial resources, integration of employees into the implementation process, and the establishment of an open-minded and flexible corporate culture are analyzed. (Veile et al., 2020). The research interest of this topic is the smallest of all with only 315 papers, and its research impact is also relatively small with 34%.

Digital Transformation Maturity (Topic-8)

This topic covers the concepts of digital transformation, Industry 4.0, maturity models, organizational culture, and the impact of technology on business strategies and performance (Gajsek et al., 2019; Teichert, 2019). These titles explore various aspects of digitalization, technology implementation, strategic management, organizational resilience, and the adoption factors of Industry 4.0 in the manufacturing industry (Kohnová et al., 2019). The analysis shows that factors like organizational identity, dematerialization, and collaboration play a key role in the digital transformation (Tronvoll et al., 2020). The size of research interest of this topic is average (382 papers), but its research impact is among the largest (of 80%).

These topics are sufficiently distinguishable from each other not only from an interpretive point of view but also within the position in the intertopic distance map (Fig. 4). In the coordinates of two principal components, almost all topics are relatively isolated, meaning they are sufficiently distinguishable from each other. In one case, however, a statistical similarity was identified, namely for topic-2 *Digital Innovation Ecosystems* and topic-8 *Digital Transformation Maturity* (Fig. 4 top left). This finding suggests that there is some interrelationship between the two topics. After a closer examination of the articles from both topics, it was found that topic-2 and topic-8 share a rather similar basis of content. The central point of investigation in these articles is the identification of various (success) factors and challenges that arise for organizations and their cultures during the phase of digital transformation (AlBar & Hoque, 2019; Cichosz et al., 2020; Shardeo et al., 2020). Topic-2 builds on this common foundation by focusing on systems and functional aspects. There, the organization's implementation, integration, and management of tools and data (ERP, big data) is examined. Additionally, this topic focuses on the organization's life cycle, evolution, business models, and processes like DevOps and Agile development (Gupta et al., 2019; Jacob et al., 2020; Nascimento et al., 2019). On the other hand, the majority of the articles in topic-8 focus on a perspective with regard to the organizational readiness of the organization towards changes related to Industry 4.0, including the impacts those changes will have on culture, the implications for strategy, and the general organization's maturity through the examination of maturity models (Ganzarain & Errasti, 2016; Mittal et al., 2018; Santos & Martinho, 2020; Schumacher et al., 2016a, b).

The eight topics identified are not static and their development may change over time. To capture such changes, we analyzed the share of papers (research interest) and the share of citations (research impact) of papers in the last 10 years. We did not

analyze the absolute numbers but their relative share primarily to avoid the risk of distortion caused by the exponential increase in the number of articles and citations. The results can be found in Fig. 5.

Several findings can be seen in Fig. 5. The first of them is a marked decrease in topic-1 both from the point of view of research interest and the point of view of research impact. As mentioned earlier, this topic is currently one of the most important. However, trend analysis shows that its importance is declining relatively quickly. It is gradually being replaced by topics with higher research interest (e.g., topic-4) or research impact (e.g., topic-6).

The downward trend of topic-1 *Social Media Connectivity* can be explained with the growing maturity of this research field. In the early start of the new millennium, the rise of social networks and communication platforms like Facebook, Twitter, Instagram, Whatsapp, and other social media services and applications changed the

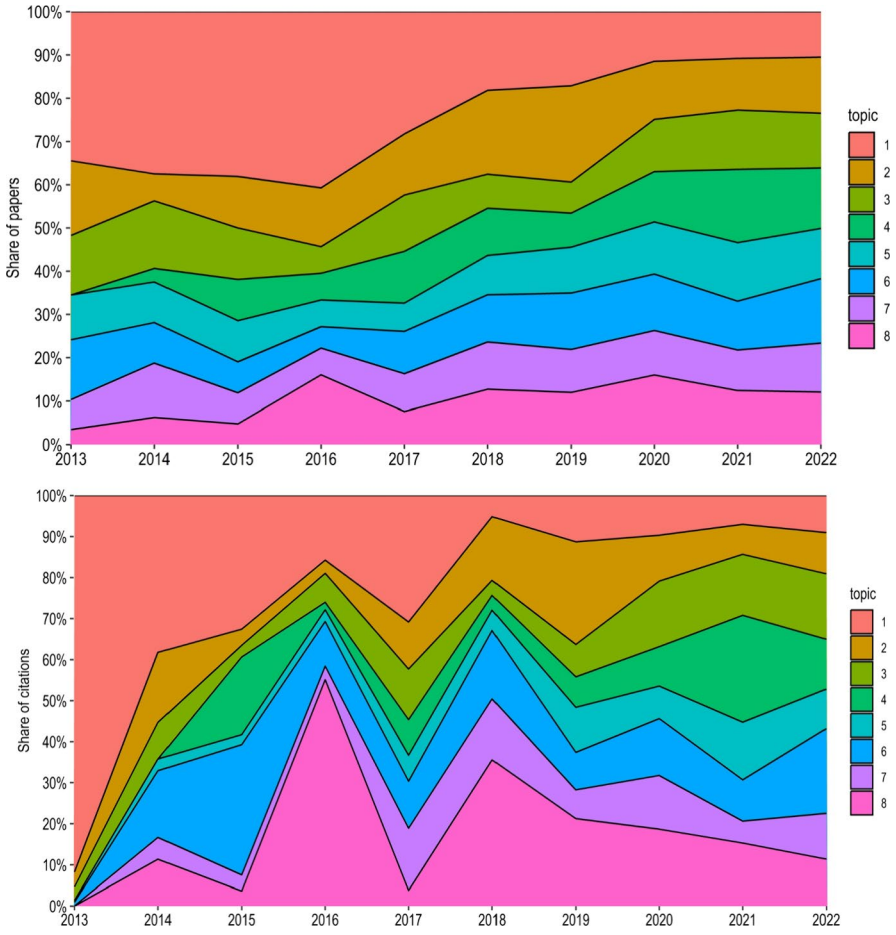

Fig. 5 Development of research interest (top) and research impact (bottom) in last 10 years

way of communication and collaboration. As of 2023, this field of research is established and many papers have been published and cited already. Based on our search query, there were 458 papers identified with over 5400 citations in total from 1997 to 2023.

The second finding is the gradual emergence of new topics. These are topics that almost or did not exist 10 years ago. The most significant representative of such topics is topic-4, which almost did not exist in 2013, but is currently one of the most important topics. The upward trend of topic-4 *Digital Workforce Transformation* is strongly connected with the emergence of new working modes and cultural shifts within the organizational landscape due to COVID-19 pandemic related effects. The rise of topic-4 with a strong focus on the employee-work relationship and employee well-being is relatively new. This was triggered with the start of the worldwide pandemic (COVID-19). The worldwide pandemic had a significant impact on how people worked and communicated. This remote work model has many implications on a number of different fields like organizational culture, collaboration, employee motivation, and productivity, among many others. Thus, the requirement for employees and the organizations to adapt to this new work reality open up many new research fields. The growing topic-6 *Knowledge, Culture, and Innovation* combines knowledge management, organizational culture, and innovation in regard to the transformative effects of digitalization across various sectors. This topic recently gained special attention because the world economy is facing challenges during the pandemic caused by less international business and trade and increased costs (Amirul et al., 2023). Competitive advantages through knowledge management, knowledge sharing, and innovation are the key to deal with the (project) uncertainty many companies face (Borodako et al., 2023).

The third finding is that increasing research interest does not necessarily increase research impact. For example, we can mention topic-5 *Digital Competence and Cultural Transformation*, which is gradually gaining research interest, but its research impact is the smallest of all. However, it should be noted here that research impact is based on processing the number of citations, which can generally have a time delay.

A more detailed characterization of topics is also possible by comparing them to the analyzed subject areas. Figure 6 shows the decomposition of individual topics into subject areas. The basis for this decomposition was the papers themselves.

Several findings can be seen in Fig. 6. Topic-1, which currently dominates research impact and research interest, but has a negative trend, is most associated with papers from the SOCI subject area. If we compare these results with the analysis of subject areas (Fig. 2), we can conclude that there are two parallel phenomena — a decrease in interest in both SOCI and topic-1. This topic played a key role in the past, but its outlook, as well as the outlook of organizational culture research in relation to digital transformation in the SOCI subject area, is negative. On the other hand, we can see that the BUSI subject area is most prominently represented in topic-6. By comparing the development of BUSI and the development of topic-6, we can also notice parallel phenomena — in this case, however, with a positive trend. Both topic-6 and the BUSI subject area have been growing in recent years, and it is assumed that this could be the case in the following years as well. In the past the focus of research has been on identification and introduction as well as adaptation of new technologies

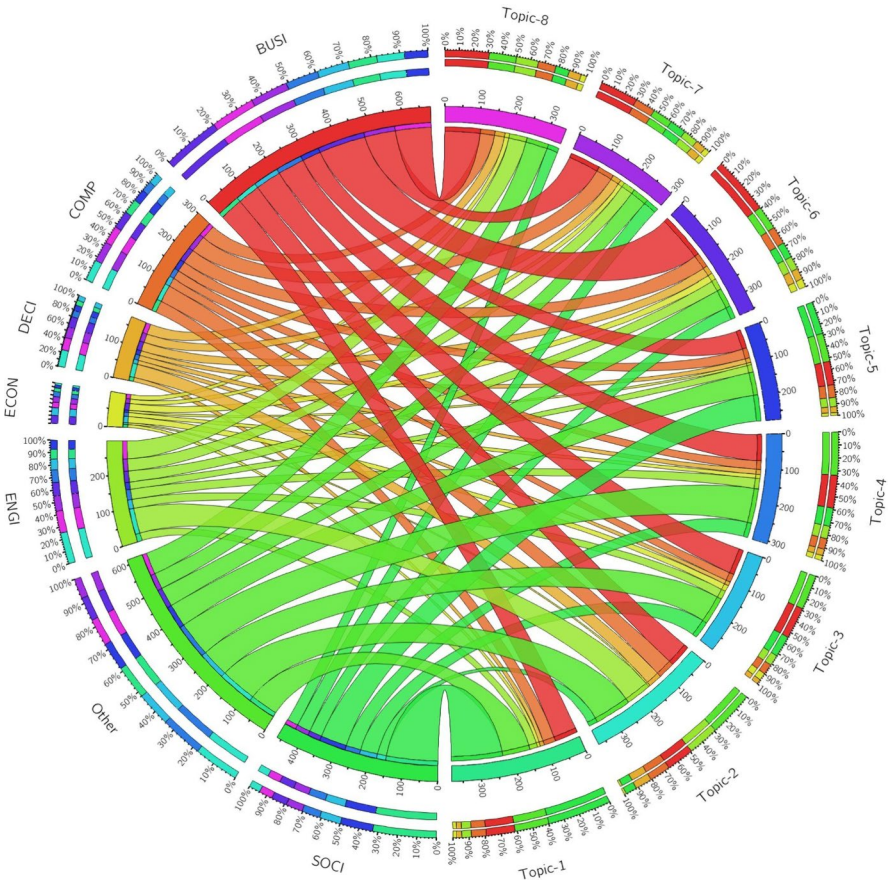

Fig. 6 Decomposition of topics to subject areas

that drive the trend of digital transformation. With this established foundation, nowadays, the research shifts more towards the application and impacts of these technologies in organizations and its consequences on innovation-orientation, knowledge generation and sharing as well as cultural effects (Kronblad et al., 2023). This can be seen with the strengthening of topic-6. Other topics appear more heterogeneous from the point of view of subject areas, and the papers that fall into them are from different subject areas.

Discussion

Summary

This article begins with a brief review of organizational culture research in relation to digital transformation. Later, an overview of the research area was presented

based on the 3065 publications listed and identified in the Scopus database. To answer research question 1, we have identified the key journals, papers and authors and have shown the development of publications over time. Research interest and research impact of the given topic have grown dramatically since 2018. According to research areas, from 2004 until 2023, the share of papers (research impact) as well as the share of citations (research interest) is mainly contributed to the subject area of BUSI (with a share of more than 25%). The dominance of BUSI has been visible mainly in the last 3 years.

The identification of the dominant research topics (research question 2) resulted in eight topics: *Social Media Connectivity*, *Digital Innovation Ecosystems*, *Socio-economic Sustainability*, *Digital Workforce Transformation*, *Digital Competence and Cultural Transformation*, *Knowledge, Culture and Innovation*, *Data and Resource Management*, and *Digital Transformation Maturity*. The topic with the most significant research interest (measured by the number of papers) and the highest research impact (measured by the number of citations) is *Social Media Connectivity* (topic-1). This is because of the strong role of this topic in the past. The outlook is declining for this topic as well as the related subject area SOCI. Two rising topics were identified. In recent years *Digital Workforce Transformation* (topic-4) and *Knowledge, Culture, and Innovation* (topic-6) gained strong interest. Both are from the area of BUSI.

To fulfil the aims of the article, following the completion of the literature review, we were able to identify a number of research topics that are distinct due to the methodology that we have utilized. As a result of their development over time, some of these topics are also relatively new; for instance, as of 2013, topic-4 (*Digital Workforce Transformation*) did not exist at all. In light of the fact that the topics have developed over time, it is clear that the most important areas influencing culture have been transformed under the conditions brought about by digital transformation.

Implications

Firstly, this study demonstrated a machine learning–supported method for identifying and segmenting the current state of this research field. This method, as used in this paper, can be applied to other fields to obtain a systematic overview of research topics.

Secondly, organizational culture has been a field of research for many years and research on digital transformation is constantly growing. The interrelation of these two research areas is relatively new, and their findings will have a lasting effect on the formation and effectiveness of organizational culture in the future.

With the increased interest in *Digital Workforce Transformation* and *Knowledge, Culture, and Innovation*, we could identify a shift in the research field on organizational culture in relation to digital transformation towards the subject area of BUSI. Those two rising topics show a need to focus on the impact of technology on work culture and employee well-being, as well as on knowledge management and innovation in relation to organizational culture.

The long-term trend of the share development of the BUSI subject area indicates that this area will also grow continuously in the future. From 2019 onwards, the constant increase of papers published per year implies that additional distinct new topics will be established in this field of research. These and other future trends will help researchers to focus on relevant topics and areas for their work.

A possible explanation for this shift in research could derive from the impact technological changes have on businesses today. The work-related requirements during the COVID-19 pandemic acted as a catalyst for many technological advancements due to the necessity to work instantly remote, changing many processes and all communication to digital. This growing importance of technology for every business could lead to an increased relevance and importance for management practice as well as for researchers. An additional cause for organizations to reevaluate matters related to knowledge and innovation is the pervasive integration and accessibility of AI technology in routine business operations. The alignment of current processes, particularly the innovation process within organizations, with this novel capability will be a subject of interest for managers and researchers as well.

Following the functionalist perspective on organizational culture, the management of organizations can attempt to control and change culture (Alvesson, 1993). The introduction of these two topics has significant implications for management practice. A strong organizational culture that is people-centered is essential for successful knowledge-driven organizational innovation. As a result, managers must pay special attention to the factors that influence work culture, address the challenges that arise during the transformation, and understand and improve their organization's digital capabilities.

Managers can focus their efforts on a variety of areas to foster an adaptable, innovative, and supportive work culture while effectively leveraging technology for digital transformation. Enhanced emphasis is placed on the behavior and collaboration of the team and managers, while these recommendations also encompass measures pertaining to the structure and processes.

The delegation of decision-making authority and work ownership responsibility to employees by managers is a critical structural element. Utilizing data to facilitate well-informed decision-making can provide support for this. Establishing a work environment that offers adequate resources and support, including tools, training, and assistance in adjusting to digital transformations and fostering innovation, is an additional critical element (Veile et al., 2020). Furthermore, it is beneficial to measure and communicate progress by assessing the impact of digital transformation on work culture, employee well-being, knowledge management, and innovation on a regular basis. The manager should be willing to make the necessary cultural changes to align, adapt, and evolve organizational culture in the digital age (Cortellazzo et al., 2019).

During digital transformation, an open and productive organizational culture will be fostered through the promotion of a flexible and inclusive work environment that actively solicits employee feedback and input, with a focus on employee well-being (Coldwell, 2019). Managers who set a good example and encourage their employees' continuous learning and skill development, as well as cross-functional collaboration, will be better able to promote an adaptive organizational culture in

an increasingly digital and competitive landscape (Sá & Serpa, 2020). Creating a culture that values innovation and encourages employees to come up with new ideas and solutions, as well as celebrating successful innovations, can help managers create a people-oriented work culture that is essential for organizational innovation (Karimi & Walter, 2015). This can be seen in the increased interest in the area on *Knowledge, Culture, and Innovation* by organizations as well as by researchers.

Limitations and Future Research

This study has a number of limitations, which can be mainly attributed to the way the analysis was conducted. The focus of this study is on an automated bibliometric analysis of the literature. While the quantitative focus has many advantages, it also has some limitations. The main advantage includes the possibility to process and analyze a large number of papers via automation and machine learning techniques. A total of 3065 papers were analyzed. This approach — in comparison to a standard systematic literature review — does not analyze the papers manually. Therefore, some relevant documents could be missing, as well as some irrelevant ones might be included. The authors have selected a search query that yields highly relevant search results. Thus, it is assumed that the share of notable articles that are missing is very small and therefore neglectable and does not have a significant impact on the results.

The applied dataset covers most of the important publications, but all the data comes from just one database (Scopus). This is not comprehensive, and some relevant articles (or journals) could be excluded. In addition, some information may be missing because the source of analysis is not the full text of the articles. Another limitation comes from the fact that the primary focus in the topic modeling are the abstracts of the relevant papers and not the whole text. The analysis of the full text could potentially provide a more extensive understanding, but at the same time, it would take much longer.

We decided on the expert approach by determining the number of topics, as the statistical approach resulted in a large number of topics. This may be of a subjective nature, but it resulted in eight well interpretable and sufficiently distinguishable topics. The title, abstract, and keywords of each topic's top-30 papers (based on citation count) were used to name each topic. This results in subjective topic names but helps to sum up each topic with a generalized distinct phrase.

This study suggests a number of possible future directions for additional research. It is recommended to extend the data sources to other databases than Scopus as well as the search query. This could result in capturing an increased number of relevant papers. In this research two developing, fast growing topics (topic-4 and topic-6) were identified. Further research should concentrate on examining this trend and focusing on those topics.

Future research could concentrate on finding various organizational culture types that reflect and favor those two emerging topics. Considering Quinn and Rohrbaugh's CVF (Cameron & Quinn, 1999; Quinn & Rohrbaugh, 1983), the characteristics of the *adhocracy* culture type may align with the aspects connected to *Digital Workforce Transformation* and *Knowledge, Culture and Innovation* as this

culture type values innovation and flexibility. This can be supported through the systematic research and cultural audits in organizations.

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Data Availability The data and code that support the findings of this study are available from the corresponding author upon request.

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