

# EXAMINING THE RELATIONSHIP BETWEEN SUSTAINABLE DEVELOPMENT AND DIGITAL LEADERSHIP USING BIBLIOMETRIC ANALYSIS METHOD

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*The convergence of sustainable development and digital leadership has become a vital research area, driven by the global need for economic growth, social inclusion, and environmental sustainability. This study uses bibliometric analysis to examine 79 academic articles published between 2011 and 2024, highlighting key trends, themes, and structures in the literature. The findings reveal increasing interest in the potential of digital technologies to enhance sustainability by improving resource efficiency, fostering economic growth, and promoting social inclusivity. However, challenges like environmental concerns and the digital divide persist. Key themes in the literature include innovation, impact, management, and transformational leadership, with journals like Sustainability publishing high-impact research. This study offers valuable insights into the complex relationship between sustainable development and digital leadership, guiding future research and practice in this evolving field.*

**Key words:** Sustainable Development, Digital Leadership, Bibliometric Analysis, Innovation Transformational Leadership.

## 1. INTRODUCTION

In recent years, the intersection of sustainable development and digital leadership has emerged as a crucial area of research and practice. Sustainable development, characterized by the pursuit of economic prosperity, social inclusion, and environmental sustainability, has become a global

imperative (United Nations 2015). Concurrently, digital leadership, defined by the ability to leverage digital technologies to drive organizational change and innovation, has gained prominence in the digital age (George et al. 2016).

The relationship between sustainable development and digital leadership is complex and multifaceted. Digital technologies

have the potential to enable sustainable development by improving resource efficiency, enhancing decision-making processes, and fostering collaboration. Conversely, sustainable development goals can provide a framework for guiding digital leadership efforts towards socially and environmentally responsible outcomes.

Despite the growing interest in this topic, there remains a need for a comprehensive understanding of the relationship between sustainable development and digital leadership. This study aims to address this gap by conducting a bibliometric analysis of the existing literature. Bibliometric analysis offers a systematic and quantitative approach to mapping the intellectual structure of a research field, identifying key trends, and uncovering hidden patterns in the literature.

This study aims to uncover the main topics, movements, and structures in the research on sustainable development and digital leadership by examining an extensive collection of academic articles. The results of this analysis will offer valuable insights for policymakers, business leaders, and stakeholders who are focused on promoting sustainable development through digital leadership, in addition to enhancing academic understanding of this relationship.

In general, the goal of this research is to explore the changing connection between sustainable development and digital leadership, emphasizing the possibilities and hurdles linked to this convergence. This study aims to lay the groundwork for future research and practice in this vital and ever-changing field through a thorough bibliometric analysis.

## **2. LITERATURE REVIEW**

The concept of sustainable development is considered crucial for finding a harmonious balance among economic growth, societal fairness, and environmental protection according to the United Nations in 2015. The concept emphasizes the significance of advancements that meet present demands and guarantee future generations are able to do so as well. Digital leadership has become more important as a key skill in using digital technologies for innovating and transforming organizations (Mwita and Joanthan 2020). It requires more than just utilizing technology effectively; it also involves inspiring change, promoting collaboration, and achieving sustainable results.

Digital technologies have a lot of potential to improve sustainable development in different sectors. For example, IoT devices have the

capability to oversee and control the usage of energy, resulting in improved resource utilization and lower environmental effects (Hossein Motlagh et al. 2020). Similarly, blockchain technology could enhance transparency and monitoring in supply chains, promoting sustainable sourcing methods (Saber et al. 2019). Recent technological advancements emphasize the importance of digital leadership in encouraging sustainable practices in organizations (Wang et al. 2018).

Furthermore, digital leadership can help promote social inclusivity and economic growth, both essential elements of sustainable development. Through the utilization of digital platforms, organizations are able to increase the availability of services and opportunities for marginalized communities, thus empowering them (Heeks 2008). Digital leaders are essential for driving these projects, guaranteeing that digital changes focus on the well-being and fairness of society (George et al. 2016).

Still, there are challenges when it comes to the connection between digital leadership and sustainable development. Worries exist regarding the environmental effects of digital technologies, including how much energy they use and the creation of electronic waste (Van Dijk 2006). Furthermore, the digital

divide and disparities in technology access can impede the inclusivity and equity objectives of sustainable development (Warschauer 2003). Therefore, effective digital leadership must guide through these challenges to ensure that digital transformation has a positive impact on sustainable results.

In spite of these obstacles, digital leadership has great potential to further sustainable development agendas. Embracing digital innovations can improve organizations' environmental stewardship, social impact, and economic resilience (Yoo et al. 2012). Competent digital leadership can facilitate this change, encouraging a mutually beneficial connection between digitalization and sustainable development objectives.

In summary, the connection between sustainable development and digital leadership is complex, as digital technologies present both advantages and obstacles. By comprehending and utilizing this connection, companies can promote beneficial transformations towards a more environmentally friendly and diverse future.

### **3. METHOD**

#### **3.1. Research model**

This research employs bibliometric analysis to examine the relationship between sustainable

development and digital leadership. The study is centered on identifying and analyzing academic publications regarding this subject in order to understand trends, patterns, and main themes in the literature. Through a systematic review and synthesis of previous studies, this research seeks to offer a thorough summary of the present understanding of the topic. The results could help improve understanding of the relationship between sustainable development and digital leadership. The information was obtained on 29<sup>th</sup> May 2024 from the Web of Science (WoS) database through a search for the keywords "digital leadership" and "sustainable development" followed by a filtering procedure. The screening procedure included only articles written in English that were listed in SSCI and SCI-Exp. A total of 79 academic papers were included in the research after meeting the criteria.

### 3.2. Research area

The research includes articles from the period 2011-2024. From 2020 to 2024, a total of 60 articles were approved for publication and incorporated into the study during the early access phase. The papers were made public for early access, ensuring the authors' work is quickly accessible, as it can take around 2-3 years to assign them to a specific

issue in indexed journals post publication acceptance. 65 journals have published all the research articles. There is a total of 4.855 mentions of published works in the documents. Below the 1<sup>st</sup> table shows fundamental data on the essays contained in the study sample.

**Table 1** Main Information About Data

<i>Description</i>	<i>Results</i>
<b>MAIN INFORMATION ABOUT DATA</b>	
Timespan	2011:2024
Sources (Journals, Books, etc)	65
Documents	79
Annual Growth Rate %	14.78
Document Average Age	45.294
Average citations per doc	21.459
References	4.855
<b>DOCUMENT CONTENTS</b>	
Keywords Plus (ID)	226
Author's Keywords (DE)	363
<b>AUTHORS</b>	
Authors	250
Authors of single-authored docs	15
<b>AUTHORS COLLABORATION</b>	
Single-authored docs	15
Co-Authors per Doc	44.621
International co-authorships %	30.38
<b>DOCUMENT TYPES</b>	
article	52
article; book chapter	2
article; early access	5
editorial material	1
proceedings paper	13
review	6

### 3.3. Data analysis

Due to the fact that scholarly studies rely heavily on information,

the ease of access and user-friendliness of this information are crucial aspects of the academic writing procedure. Transitioning from raw to useful data requires a significant undertaking. Similar to other disciplines, bibliometric studies involve numerous distinct stages. Each stage involves the use of various software applications (Aygün, Sağbaşı, and Erdoğan 2023).

#### 4. FINDINGS AND OUTCOMES

In their efforts to comprehend and organize previous research, scholars have employed a variety of techniques in their literature reviews. Bibliometric analysis, a technique based on measuring data related to academics, scholars, or academic events, is known for its ability to conduct a clearly defined and reproducible review process (Aygün et al. 2023). This examination guarantees impartial and trustworthy metrics, in contrast to alternative approaches. The abundance of recent data and advancements in cognition result in a beneficial context for the usefulness of bibliometrics. It enables the structured analysis of extensive datasets, enabling the recognition of emerging trends, the identification of changes in disciplinary borders, the identification of successful academics and organizations, and the provision of detailed scrutiny (Aria and Cuccurullo 2017).

Within this framework, a detailed analysis was carried out using the annual ratios of paper publication, top journals and writers focusing on essays, number of quotes, keyword utilization, and release location, organized by state.

Table 2 illustrates the number of articles that were published annually.

**Table 1** Breakdown of articles per year

Year	Articles	Year	Articles
2011	1	2018	5
2012	0	2019	4
2013	0	2020	6
2014	1	2021	7
2015	2	2022	23
2016	3	2023	18
2017	3	2024	6

The first study on relationship between sustainable development and digital leadership was published in 2011. Although a number of studies have been conducted in the following years, the most notable increase has been in 2022 and the following years. Between 2018 and 2024, 69 studies were published. Although the research covers publications over a period of 13 years in total, more than half of the publications included in the research in this 6-year period were published in these years. It is evaluated that the digital transformation and new leadership style has a great impact on the increase in publications in these years.

The 79 scientific research is used in this study and these articles were published in 65 journals. The journals with the highest number of publications are listed in Table 3.

**Table 2** Journals with the Most Publications

<i>Sources</i>	<i>Articles</i>
Sustainability	10
International Journal of Environmental Research and Public Health	3
European Journal of Innovation Management	2
Leadership in Health Services	2
PLOS ONE	2
12 <sup>th</sup> Int. Conf. of Education, Research, and Innovation (ICERI 2019)	1
Administrative Sciences	1
Agenda-Empowering Women for Gender Equity	1
AIs	1
Business Strategy and the Environment	1

Sustainability Journal has the most publications (10). Among all published articles, 24 were published in the top ten journals. This number corresponds to 30% of the total number of articles. Bradford's Law of Distribution was used to classify the data. Bradford's law is one of several statistical expressions that try to explain the workings of science by mathematical means. Although each “law” applies to a different phenomenon, they all tend to indicate one thing: they explain a small number (journals, scientists, etc.) of things for larger number of (articles, citations, etc.). In practical terms, this means that trying to do anything exhaustively has diminishing returns (Garfield 1980). This law describes how literature on a particular topic is dispersed or distributed in journals.

The papers were gathered from three separate locations according to Bradford's law of distribution. These top ten journals, considered as core sources, accounted for 20% of the accumulated publications.

Table 4 displays the index that was created based on Bradford's scatter law.

**Table 4** Spread Table. According to Bradford Scattering Law

<i>Rank</i>	<i>Journal</i>	<i>Rank</i>	<i>Freq</i>	<i>cumFreq</i>	<i>Zone</i>
1	Sustainability	1	10	10	Zone 1
2	International Journal of Environmental Research and Public Health	2	3	13	Zone 1
3	European Journal of Innovation	3	2	15	Zone 1

<i>Rank</i>	<i>Journal</i>	<i>Rank</i>	<i>Freq</i>	<i>cumFreq</i>	<i>Zone</i>
	Management				
4	Leadership in Health Services	4	2	17	Zone 1
5	PLOS ONE	5	2	19	Zone 1
6	12 <sup>th</sup> International Conference of Education, Research, and Innovation (ICERI 2019)	6	1	20	Zone 1
7	Administrative Sciences	7	1	21	Zone 1
8	Agenda-Empowering Women for Gender Equity	8	1	22	Zone 1
9	AI	9	1	23	Zone 1
10	Business Strategy and the Environment	10	1	24	Zone 1

It is calculated according to the number of publications and citations of the authors and reveals the productivity of the researcher productivity (Hirsch 2005). It is calculated based on a list of publications in descending order of the number of citations. The value of  $h$  is equal to the number of articles with  $N$  or more citations ( $N$ ) in the list. It is a very useful calculation system as it reduces the disproportionate weight of highly cited or not yet cited articles (Engqvist and Frommen 2008).

The  $g$ -index is a development of the  $h$ -index. Since the  $h$ -index is not sensitive to the impact of highly cited publications, the  $g$ -index identifies  $g$  publications with a total of  $g^2$  or more citations. The author recommends using the  $g$ -index together with the  $h$ -index. A high  $g/h$  ratio is a value that indicates the

success of the researcher (Egghe 2006).

One method to compare academics with varying career lengths is to divide their  $h$ -index by the number of years they've been active, which is calculated from the year of their first publication. Hirsch (2005) introduced this metric, calling it the  $m$ -index. It's important to note, however, that the  $m$ -index tends to stabilize later in an academic's career, and for early-career researchers with a low  $h$ -index, small changes in the  $h$ -index can significantly impact the  $m$ -index. Additionally, as Hirsch points out, using the date of the first paper as the starting point may not always be suitable, especially if that initial publication was a minor contribution made well before the researcher began producing work consistently.

Table 5 presents data on the indices of the journals.

**Table 5** h/g/m Indexes of the Journals

<i>Journal</i>	<i>h</i>	<i>g</i>	<i>m</i>	<i>TC</i>	<i>NP</i>	<i>PY</i>
Sustainability	6	10	1,20	161	10	2020
Plos One	2	2	0,33	16	2	2019
Administrative Sciences	1	1	0,33	5	1	2022
Agenda-Empowering Women for Gender Equity	1	1	0,17	1	1	2019
AI	1	1	0,33	1	1	2022
Business Strategy and the Environment	1	1	0,33	62	1	2022
International Conference on Enterprise Information Systems	1	1	0,13	3	1	2017
Cities	1	1	0,33	20	1	2022
Communication and Information Technologies Annual: Digital Distinctions and Inequalities	1	1	0,10	2	1	2015
Corporate Communications	1	1	0,50	20	1	2023

Sustainability is a leading scientific journal, known for its high-impact research publications across diverse scientific disciplines. It publishes highest number of publications, contributing significantly to advancements in the field. Sustainability's extensive publication volume and rigorous peer-review process make it a central platform for groundbreaking scientific discoveries and innovations. Table 6 presents the details of author productivity. Additional information on author output is provided in Table 6.

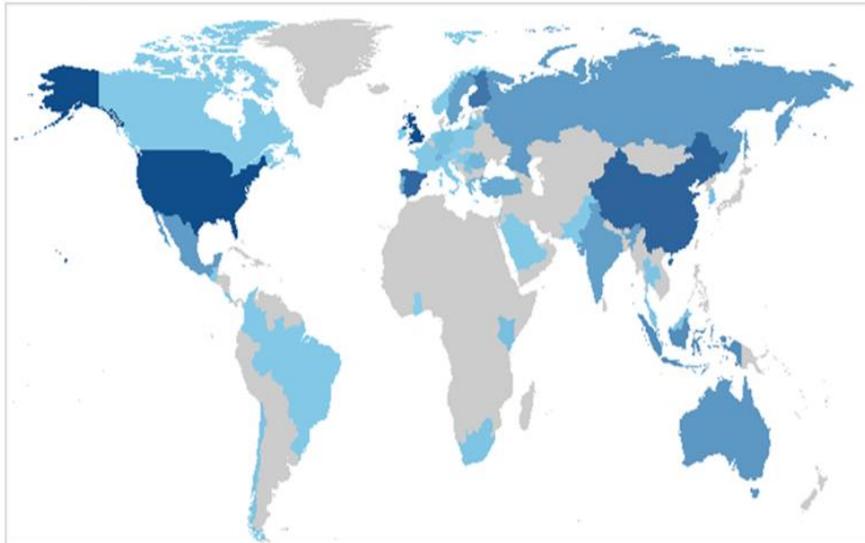
**Table 6** Author Output Dispersion

<i>Authors</i>	<i>Articles</i>	<i>Articles Fractionalized</i>
Karakose T.	2	0,42
Papadakis S.	2	0,42
Penmetsa MK.	2	1
Yirci R.	2	0,42
Aerts A.	1	0,14
Agheorghiesei DT.	1	0,33
Aksu B.	1	1
Alario-Hoyos O.	1	0,1
Allan J.	1	0,13
Almansour M.	1	1

The darker the blue in the figure, the more effective the country is. The map shows there is no publication on gray areas. Figure 1 illustrates the spread of corresponding authors across different countries.

When evaluating an author's productivity, the primary factors considered are the number of co-authors and publications. It's worth noting that single-author works tend

to contribute more per article. The institutions with the highest publication counts, based on their authors' affiliations, are detailed in Table 7.



**Fig. 1** Top Broadcasting Countries

**Table 7** Institutions that Publish the Most Articles

<i>Affiliation</i>	<i>Articles</i>
Univ Cadiz	6
St Xaviers Coll	5
Univ Oulu	5
Cetys Univ	4
Ipb Univ Bogor	4
Kth Royal Inst Technol	4
Lucerne Univ Appl Sci and Arts	4
Univ Crete	4
Univ Novi Sad	4
Hacettepe Univ	3

A Turkish university is listed among the most productive publishing institutions. Turkish scholars often struggle to gain recognition in the academic community due to their publications having many co-authors and low citation rates. Table 8 visually represents the number of publications by country.

**Table 8** Distribution of Articles by Countries of Corresponding Authors

<i>Country</i>	<i>Articles</i>	<i>SCP</i>	<i>MCP</i>	<i>Freq</i>	<i>MCP_Ratio</i>
Usa	9	7	2	0,11	0,22
United Kingdom	8	4	4	0,10	0,50
China	6	4	2	0,08	0,33
Spain	5	3	2	0,06	0,40
Australia	3	2	1	0,04	0,33
Finland	3	2	1	0,04	0,33
Mexico	3	1	2	0,04	0,67
Romania	3	3	0	0,04	-
Russia	3	2	1	0,04	0,33
Germany	2	1	1	0,03	0,50

A review of the articles reveals that the United States produced the highest number of publications, with 9 out of 79. Among these, 7 were authored solely by Americans (SCP), while 2 involved international collaborations. Publications exclusively by American authors constitute 11% of the entire collection.

The significance of a country's contribution to global literature is determined not only by the number of articles but also by their citation rates. Table 9 details the citations each country has received. Citations are key to evaluating the quantity and quality of an article, with more citations indicating higher prestige in the scientific community. The United Kingdom, with 8 published papers, has received the most citations, highlighting its leading position in this category.

**Table 9** Total Number of Citations by Countries

<i>Country</i>	<i>TC</i>	<i>Average Article Citations</i>
United Kingdom	269	33,6
USA	182	20,2
Portugal	77	7,7
Mexico	64	21,3
China	46	7,7
Spain	42	8,4
Australia	28	9,3
Malaysia	20	20
India	16	8
Finland	15	5

Keyword analysis serves as a crucial tool for identifying key research themes. This method helps pinpoint gaps in the literature and uncover relationships between variables. Table 10 lists the most frequently used keywords for reference.

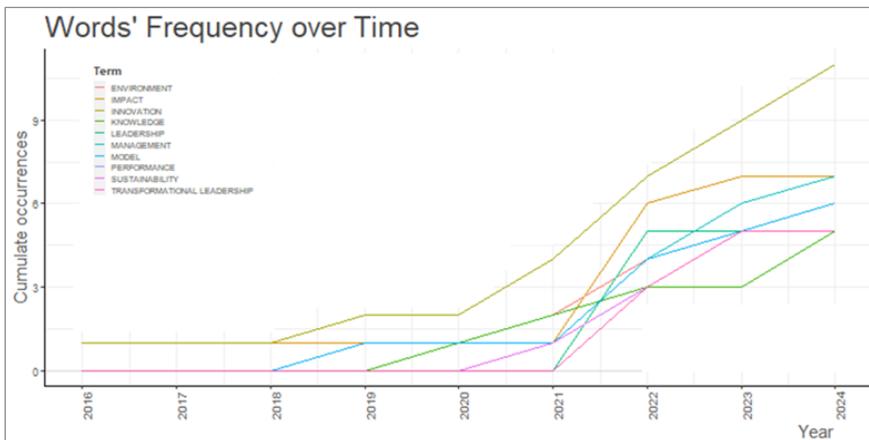
**Table 10** Most Repeated Keywords

Words	Occurrences
innovation	11
impact	7
management	7
leadership	6
model	6
environment	5
knowledge	5
performance	5
sustainability	5
transformational leadership	5

Out of 330 terms, 11 were classified as "innovation," 7 as "impact," and 7 as "management." A word cloud is often created to capture technical vocabulary and engage readers. The word cloud is considered beneficial for its visual impact and ability to enhance reader comprehension. Figure 2 displays the resulting word cloud. Figure 3 illustrates how the expressions in the word cloud have evolved over the years.



**Fig. 2** Word Cloud for Keywords



**Fig. 3** Cumulative Evolution of Keywords Over the Years

As seen from the chart, the need for innovation and impact in articles has increased rapidly in recent years.

## **5. CONCLUSION**

The intersection of sustainable development and digital leadership has become a significant area of interest in recent years, reflecting the global imperative to pursue economic prosperity, social inclusion, and environmental sustainability. Digital leadership, which involves leveraging digital technologies for organizational change and innovation, has emerged as a crucial skill in the digital age. This study conducted a comprehensive bibliometric analysis to explore the relationship between sustainable development and digital leadership, aiming to provide valuable insights into this complex connection.

The findings reveal a growing body of research on this topic, particularly in the last few years, indicating an increasing recognition of the importance of digital transformation and new leadership styles in promoting sustainable development agendas. Digital technologies offer vast potential to enhance sustainability across various sectors by improving resource efficiency, promoting social inclusivity, and fostering economic

growth. However, challenges such as environmental concerns, digital divide, and disparities in technology access need to be addressed to ensure that digital transformation contributes positively to sustainable outcomes.

The bibliometric analysis identified key themes, trends, and structures in the literature, shedding light on emerging research areas and highlighting the most influential journals, authors, and countries contributing to this field. Notably, the Sustainability journal emerged as a leading platform for high-impact research on sustainable development and digital leadership.

The analysis also underscores the importance of innovation, impact, management, and transformational leadership as key themes in the literature, indicating a growing emphasis on driving positive change and achieving sustainable results through digital leadership.

In conclusion, the relationship between sustainable development and digital leadership is multifaceted, with digital technologies offering both opportunities and challenges. By understanding and leveraging this connection effectively, organizations and policymakers can promote sustainable practices, enhance social inclusivity, and drive positive change towards a more

environmentally friendly and equitable future.

This study provides a foundation for future research and practice in this evolving field, offering insights that can inform decision-making and contribute to the advancement of sustainable development goals in the digital era.

## REFERENCES

- [1] Aria, Massimo, and Corrado Cuccurullo. 2017. "Bibliometrix : An R-Tool for Comprehensive Science Mapping Analysis." *Journal of Informetrics* 11(4):959–75. doi: 10.1016/j.joi.2017.08.007.
- [2] Aygün, Salih, Murat Sağbaş, and Fahri Alp Erdoğan. 2023. "Bibliometric Analysis of Sustainability in Civil Aviation." *Journal of Aviation* 7(3):448–56. doi: 10.30518/jav.1358871.
- [3] Egghe, Leo. 2006. "Theory and Practise of the G-Index." *Scientometrics* 69(1):131–52. doi: 10.1007/s11192-006-0144-7.
- [4] Engqvist, Leif, and Joachim G. Frommen. 2008. "The H-Index and Self-Citations." *Trends in Ecology & Evolution* 23(5):250–52. doi: 10.1016/j.tree.2008.01.009.
- [5] Garfield, E. 1980. "Bradford's Law and Related Statistical Patterns." *Essays of an Information Scientist*, 476–83.
- [6] George, Gerard, Jennifer Howard-Grenville, Aparna Joshi, and Laszlo Tihanyi. 2016. "Understanding and Tackling Societal Grand Challenges through Management Research." *Academy of Management Journal* 59(6):1880–95. doi: 10.5465/amj.2016.4007.
- [7] Heeks, Richard. 2008. "Researching ICT-Based Enterprise in Developing Countries: Analytical Tools and Models." *SSRN Electronic Journal*. doi: 10.2139/ssrn.3477388.
- [8] Hirsch, J. E. 2005. "An Index to Quantify an Individual's Scientific Research Output." *Proceedings of the National Academy of Sciences* 102(46):16569–72. doi: 10.1073/pnas.0507655102.
- [9] Hossein Motlagh, Naser, Mahsa Mohammadrezaei, Julian Hunt, and Behnam Zakeri. 2020. "Internet of Things (IoT) and the Energy Sector." *Energies* 13(2):494. doi: 10.3390/en13020494.
- [10] Mwita, Mawazo Magesa, and Joan Joanthan. 2020. "Digital Leadership for Digital Transformation." Tanzania: Centre for Information and Communication Technology.
- [11] Saberi, Sara, Mahtab Kouhizadeh, Joseph Sarkis, and Lejia Shen. 2019. "Blockchain Technology and Its Relationships to Sustainable Supply Chain Management." *International Journal of Production Research* 57(7):2117–35. doi: 10.1080/00207543.2018.1533261.
- [12] United Nations. 2015. *GLOBAL SUSTAINABLE DEVELOPMENT REPORT*. UNITED NATION.
- [13] Van Dijk, Jan A. G. M. 2006. "Digital Divide Research, Achievements and Shortcomings." *Poetics* 34(4–5):221–35. doi: 10.1016/j.poetic.2006.05.004.
- [14] Wang, Wenbo, Haidong Yang, Yingfeng Zhang, and Jianxue Xu. 2018.

- “IoT-Enabled Real-Time Energy Efficiency Optimisation Method for Energy-Intensive Manufacturing Enterprises.” *International Journal of Computer Integrated Manufacturing* 31(4–5):362–79. doi: 10.1080/0951192X.2017.1337929.
- [15] Warschauer, Mark. 2003. *Technology and Social Inclusion: Rethinking the Digital Divide*. The MIT Press.
- [16] Yoo, Youngjin, Richard J. Boland, Kalle Lyytinen, and Ann Majchrzak. 2012. “Organizing for Innovation in the Digitized World.” *Organization Science* 23(5):1398–1408. doi: 10.1287/orsc.1120.0771.