Digitalization as a Path to Sustainability: Ecological, Economic and Social Aspects of the Creative Industry in Slovakia

Kristian Drugda[1], Helena Majduchova[2]

Abstract: This study explores the impact of digitalization on the sustainability of creative industries in Slovakia and the Visegrad Group (V4), focusing on ecological, economic, and social dimensions. Through a mixed-method approach combining qualitative trend analysis and quantitative correlation studies, the research identifies digitalization as a driver of resource efficiency, innovation, and economic independence. However, challenges such as increased energy consumption, e-waste, and digital inequities persist. The findings highlight the need for green technology adoption, improved digital infrastructure, and inclusive policies to ensure balanced and sustainable development, leveraging digitalization's transformative potential for the creative sector.

Keywords: Creative industry, Digitalization, Eco-friendly business models
JEL Classification: L82, Q56, O33

1 Introduction

The creative industry plays an increasingly key role in national economies worldwide, and Slovakia is no exception. Over the last decade, the sector has experienced significant growth, driven by digitalization, which has transformed content creation, distribution, and consumption. Digital tools and platforms have enabled Slovak creators to explore new forms of artistic expression, reach global audiences, and reduce production costs. However, this transformation also brings challenges, particularly in terms of sustainability. The ecological, economic, and social implications of digitalization need careful evaluation to ensure long-term sustainability in the creative sector.

In this article we examine the impact of digitalization on the creative industries within the V4 countries - Slovakia, Czech Republic, Poland, and Hungary - by comparing their ecological, economic, and social dimensions. While digitalization brings significant opportunities for innovation and growth, it also poses challenges related to energy consumption, e-waste, and social inequalities. By comparing these trends across the V4, we aim to identify shared patterns and unique differences within the group, offering policy recommendations that can foster sustainability in the digital transformation of their creative sectors.

2 Methods

The term "creative industry" encompasses a wide range of economic activities that involve the generation, creation, and commercialization of intellectual property, cultural content, and creative expression. According to the United Nations Conference on Trade and Development (UNCTAD), creative industries include sectors such as advertising, architecture, arts, crafts, design, fashion, film, music, performing arts, publishing, and software development, among others. These industries thrive on individual creativity, skill, and talent, while also contributing to economic and social well-being.

In the context of this study, the definition of the creative industry is aligned with the European Union’s Cultural and Creative Sectors (CCS) framework, which emphasizes the dual economic and cultural value of these sectors. Key characteristics of creative industries include high levels of innovation, significant contributions to employment and GDP, and their capacity to shape cultural identity and social cohesion. This study specifically focuses on the ecological, economic, and social aspects of digitalization within Slovakia's creative industries, examining its impact through both qualitative and quantitative lenses.

This study adopts a comparative mixed-method approach to analyze the effects of digitalization on the creative industries’ sustainability in Slovakia, Czech Republic, Poland, and Hungary. The research methodology combines

[1] University of Economics in Bratislava, Department for Business Economy, Dolnozemska cesta 2410/1 85104 Bratislava, Slovak Republic, kristian.drugda@euba.sk
[2] University of Economics in Bratislava, Department for Business Economy, Dolnozemska cesta 2410/1 85104 Bratislava, Slovak Republic, helena.majduchova@euba.sk

https://doi.org/10.32725/978-80-7694-102-1.30

qualitative and quantitative techniques to offer a comprehensive view of digitalization's impact across ecological, economic, and social dimensions within the V4.

Qualitative analysis of industry trends: We conducted an in-depth examination of trends in content creation, distribution, and emerging business models within the V4 creative industries. This involved analyzing industry reports, governmental documents, and academic literature across all four countries. We also reviewed sustainability metrics, such as energy consumption, resource efficiency, and digital business practices.

Quantitative correlation analysis: We gathered statistical data on employment in the creative sectors and government expenditure from national statistical office in Slovakia and Eurostat. Correlation analysis was performed to examine the relationship between employment trends and government financial support of Cultural sector in each V4 country from 2019 to 2022. This was conducted using Pearson's correlation coefficient to assess the strength of relationships.

Case study methodology: To assess practical implications, we selected a case study from Slovakia's film, music, and visual arts industries. This case study was chosen based on their prominent adoption of digital tools and their measurable environmental and economic outcomes. We examined how these sectors have adapted to digitalization and its impacts on sustainability.

3 Research results

3.1 Ecological Aspects

Digitalization in the creative industry has led to significant reductions in the need for physical materials, helping to lower the industry's carbon footprint. The shift from physical to digital media, such as music streaming and e-books, reduces the ecological impact associated with producing and transporting physical goods. However, digitalization introduces its own environmental concerns.

The growing demand for cloud-based services, streaming platforms, and digital content creation tools significantly increases energy consumption. According to the International Energy Agency (IEA), data centers and networks account for about 1-1.5% of global electricity use, with this number expected to rise. Slovakia's developing digital infrastructure may struggle to keep up with this demand, especially if renewable energy sources are not fully integrated. Rapid obsolescence of digital devices used by creatives (e.g., computers, cameras) contributes to the rising problem of e-waste. Slovakia generated over 52,000 tons of e-waste in 2021, a figure that has been growing by approximately 6,000–7,000 tons annually. This represents an ecological challenge that digitalization introduces, which must be mitigated through recycling programs and energy-efficient technology.

3.2 Economic Aspects

Digitalization offers substantial economic benefits for Slovakia's creative industry. It has allowed creators to adopt new business models, such as direct-to-consumer sales, online subscriptions, and crowdfunding. These digital platforms reduce creators' dependency on traditional intermediaries, offering them greater autonomy and the ability to reach international markets.

In 2021, the creative industry contributed 1.55% to Slovakia's GDP, employing approximately 2.9% of the workforce. Despite this growth, the percentage of employment fell slightly in 2023 to 2.7%, in part due to the economic effects of the pandemic. While digitalization creates economic opportunities, access to the necessary tools remains uneven across Slovakia. The digital divide, especially between urban and rural areas, remains a significant challenge. In 2022, 90.7% of Slovak households had internet access, but this was still below the EU average, limiting economic opportunities for creators in underserved regions.

In recent years, Slovakia's film industry has embraced digitalization, particularly following the pandemic. In 2022, the industry hit a record high with the production of 50 films, up from 44 in 2019. This shift was driven by digital technologies enabling more efficient production workflows and the rise of home-based consumption through streaming platforms. However, this also increased the demand for energy-intensive data storage and streaming services, underscoring the ecological trade-offs of digitalization. Films such as Nightsiren by Tereza Nvotova are emblematic of this transformation, highlighting how digital tools are reshaping film production and distribution in Slovakia.

3.3 Social Aspects

The social impact of digitalization in Slovakia's creative industry is twofold. On one hand, digitalization democratizes access to creative tools and platforms, enabling a broader range of individuals to participate in the creative economy. On the other hand, it risks exacerbating social inequalities. There is a noticeable gap in digital literacy, especially among older populations. In 2023, only 23% of Slovaks aged 45–74 reported having basic digital skills, compared to 98% of individuals aged 16–44. This skills gap limits the ability of older creative professionals to fully leverage digital technologies, making it harder for them to adapt to the changing landscape.

Marginalized groups, such as ethnic minorities and those from lower-income backgrounds, are at risk of digital exclusion. Without access to technology and training, these groups may miss opportunities created by digitalization. Ensuring that digital platforms and tools are accessible to all members of society is essential to promoting social equity in the creative sector.

3.4 Correlation between the population employed in the creative industries and the General government expenditure by function (COFOG)

Table 1 Employed people in creative industry and General government expenditure by function between years 2019 – 2022 in Slovakia

Slovakia		2019	2020	2021	2022
Employed people (in thousands)	Men	38,3	35,6	37,3	38,9
	Women	35,5	35,8	37,6	37
	Total	**73,8**	**71,4**	**74,9**	**75,9**
General government expenditure by function (COFOG) (in millions EUR)	**Total (annually)**	**526,6**	**472,2**	**475,8**	**540,7**

Source: Own processing

Table 2 Correlation between employed people in creative industry and General government expenditure by function between years 2019 – 2022 in Slovakia

Correlation (SK)	*SK - A*	*SK - B*
SK - A	1	
SK - B	0,604223	1

Source: Own processing

In Slovakia, both employment and government expenditure on cultural services have shown consistent growth from 2019 to 2022. Employment increased steadily, with the total number of employed people rising from 73.8 thousand in 2019 to 75.9 thousand in 2022. Government expenditure on cultural services also followed an upward trend, starting at 526.6 million EUR in 2019 and reaching 540.7 million EUR in 2022, despite a dip in 2020. Our correlation analysis for Slovakia showed a moderate positive correlation (0.604223), indicating that an increase in cultural sector employment is associated with an increase in government spending on cultural services.

Table 3 Employed people in creative industry and General government expenditure by function between years 2019 – 2022 in Czech Republic

Czech Republic		2019	2020	2021	2022
Employed people (in thousands)	Men	91,6	99,1	107,6	99,1
	Women	101,2	103,9	102,1	95,2
	Total	**192,8**	**203**	**209,7**	**194,3**
General government expenditure by function (COFOG) (in millions EUR)	**Total (annually)**	**1437,7**	**1402,6**	**1461,2**	**1700,7**

Source: Own processing

Table 4 Correlation between employed people in creative industry and General government expenditure by function between years 2019 – 2022 in Czech Republic

Correlation (CZ)	*CZ - A*	*CZ - B*
CZ - A	1	
CZ - B	-0,42422	1

Source: Own processing

The Czech Republic showed the highest employment numbers in the cultural sector, with a total of 192.8 thousand employed in 2019, increasing slightly to 194.3 thousand in 2022. However, despite this increase in employment, government expenditure on cultural services fluctuated and, in 2022, stood at 1700.7 million EUR, marking the highest point in the analyzed period. The correlation analysis, surprisingly, revealed a negative relationship (-0.42422) between employment and cultural expenditure, suggesting that despite an increase in workforce, spending did not grow proportionally. This inverse relationship may reflect a shift in budget priorities or structural factors affecting cultural policy.

Table 5 Employed people in creative industry and General government expenditure by function between years 2019 – 2022 in Poland

Poland		2019	2020	2021	2022
Employed people (in thousands)	Men	273,3	257,3	246,5	269,9
	Women	302,1	307	320,3	333,7
	Total	**575,4**	**564,3**	**566,8**	**603,6**
General government expenditure by function (COFOG) (in millions EUR)	**Total (annually)**	**3887,8**	**3543,3**	**3280,8**	**3605,9**

Source: Own processing

Table 6 Correlation between employed people in creative industry and General government expenditure by function between years 2019 – 2022 in Poland

Correlation (PL)	*PL - A*	*PL - B*
PL - A	1	
PL - B	0,275794	1

Source: Own processing

Poland demonstrated a fluctuation in both employment and expenditure on cultural services. Employment dipped slightly from 575.4 thousand in 2019 to 566.8 thousand in 2021, followed by a recovery to 603.6 thousand in 2022.

Similarly, government spending on cultural services dropped in 2021 to 3280.8 million EUR but rebounded to 3605.9 million EUR in 2022. The correlation analysis showed a weak positive correlation (0.275794), indicating a slight alignment between employment and expenditure, though the relationship is not particularly strong.

Table 7 Correlation between employed people in creative industry and General government expenditure by function between years 2019 – 2022 in Hungary

Hungary		2019	2020	2021	2022
Employed people (in thousands)	Men	87	95,1	75,3	75,9
	Women	76,9	79,6	91,1	87,7
	Total	**163,9**	**174,7**	**166,4**	**163,6**
General government expenditure by function (COFOG) (in millions EUR)	**Total (annually)**	**1664,2**	**1772,7**	**1564,4**	**1840,6**

Source: Own processing

Table 8 Correlation between employed people in creative industry and General government expenditure by function between years 2019 – 2022 in Hungary

Correlation (H)	*H - A*	*H - B*
H - A	1	
H - B	0,141638	1

Source: Own processing

Hungary's employment in the cultural sector remained relatively stable throughout the period, with total employment fluctuating slightly around 164 thousand. Government expenditure, however, showed a more pronounced upward trend, rising from 1664.2 million EUR in 2019 to 1840.6 million EUR in 2022. The correlation analysis for Hungary indicated a very weak positive correlation (0.141638), suggesting that changes in employment had little to no effect on government spending in this sector.

Table 9 Correlation between employed people in creative industry and General government expenditure by function between years 2019 – 2022 in V4 as a group

V4 Total		2019	2020	2021	2022
Employed people (in thousands)	Men	490,2	487,1	466,7	483,8
	Women	515,7	526,3	551,1	553,6
	Total	**1005,9**	**1013,4**	**1017,8**	**1037,4**
General government expenditure by function (COFOG) (in millions EUR)	**Total (annually)**	**7516,3**	**7190,8**	**6782,2**	**7687,9**

Source: Own processing

Table 10 Correlation between employed people in creative industry and General government expenditure by function between years 2019 – 2022 in V4 as a group

Correlation (V4)	*V4 - A*	*V4 - B*
V4 - A	1	
V4 - B	0,343624	1

Source: Own processing

For the V4 region, the correlation analysis yields a moderate positive correlation (0.343624), indicating that there is a general relationship between employment levels in the cultural sector and government expenditure on cultural services, though this relationship is not particularly strong. This moderate correlation suggests that while increasing employment in the cultural sector may be accompanied by higher government spending, other factors, such as economic conditions, political priorities, or the distribution of funds within cultural services, also play significant roles in shaping cultural budgets.

The upward trend in both employment and expenditure across most V4 countries reflects a growing recognition of the importance of the cultural sector in these nations' economic and social frameworks. However, the varying correlation strengths across the individual countries highlight the diversity in how each nation approaches cultural policy and investment. Slovakia's stronger correlation implies a more direct relationship between cultural employment and spending, while the Czech Republic's negative correlation indicates that cultural spending may not necessarily follow employment trends.

4 Conclusions

Digitalization holds significant potential for advancing sustainability in the creative industries of the V4 countries by promoting innovation and new economic opportunities. However, this shift also brings shared challenges, such as rising energy consumption, e-waste, and the persistent digital divide between urban and rural areas. From an ecological perspective, digitalization in creative industries has led to reduced reliance on physical media, such as printed books and CDs, which lowers the overall carbon footprint of these industries. However, it introduces significant environmental challenges, including energy-intensive digital infrastructure and rapidly growing e-waste. For example, the shift toward cloud services and streaming platforms increases the energy demand, which, without the integration of renewable energy, amplifies ecological risks. In Slovakia, the steady annual increase in e-waste generation reflects the need for systemic recycling programs and the adoption of energy-efficient technologies to mitigate these negative effects. Economically, digitalization has empowered creative professionals to adopt new business models, such as direct-to-consumer platforms, crowdfunding, and subscription-based content. These models offer independence and global market access but also expose inequalities in digital infrastructure and accessibility. Rural areas in Slovakia face pronounced disadvantages due to limited digital connectivity, highlighting a persistent urban-rural divide. Moreover, the moderate correlation between government spending on cultural services and employment in the cultural sector indicates the importance of sustained public investment to enhance economic resilience. Policies that invest in infrastructure and provide targeted support to underrepresented creators are essential for fostering economic equity within creative industries. The social impact of digitalization is twofold. While it democratizes access to creative tools and platforms, it also risks exacerbating social inequalities. Slovakia's older generations and marginalized communities are disproportionately excluded from the benefits of digitalization due to limited digital literacy and access to technology. These gaps not only hinder individual creators but also limit the broader societal contributions of the creative economy. Governments must address these disparities through comprehensive digital education initiatives and inclusive policy frameworks. In the broader socio-economic context, creative industries occupy a pivotal role at the intersection of culture, innovation, and sustainability. The challenges highlighted—such as energy consumption, e-waste, economic disparities, and digital exclusion—are interconnected with systemic socio-economic structures. To ensure sustainable growth, the V4 countries, including Slovakia, must adopt a regional framework that prioritizes:

- Environmental responsibility through green technology and efficient recycling.
- Economic growth driven by equitable access to digital resources and platforms.
- Social inclusion achieved via widespread digital literacy and education.

By fostering collaboration across the V4, these countries can collectively address shared challenges, build resilience, and fully harness the transformative potential of digitalization. Enhanced cooperation in digital infrastructure investments, energy efficiency strategies, and inclusive policies will enable the creative industries to thrive sustainably in a rapidly evolving digital landscape.

Acknowledgement

We would like to thank our colleagues for their valuable insights and support throughout the research process.

References

United Nations Conference on Trade and Development. (n.d.). Annex 1: Creative industries—Definition and scope. Retrieved from https://unctad.org/system/files/official-document/ditctsce2024d2_annex1_en.pdf

European Commission. (n.d.). Strategic framework for the EU's cultural policy. Retrieved from https://culture.ec.europa.eu/policies/strategic-framework-for-the-eus-cultural-policy

International Energy Agency (IEA). (2023). Data centers and data transmission networks: Energy use outlook. Retrieved from https://www.iea.org/reports/data-centers-energy

Eurostat. (2023). E-waste statistics in the European Union. Retrieved from https://ec.europa.eu/eurostat/web/environment/waste

Slovak Ministry of Culture. (2022). Cultural and creative industry report 2021. Retrieved from https://www.culture.gov.sk

OECD. (2022). Employment trends in the creative sector in Slovakia. Retrieved from https://www.oecd.org/employment/

McKinsey & Company. (2022). Global digitalization in the creative economy. Retrieved from https://www.mckinsey.com/industries

European Commission. (2022). Digital skills and inclusion in Slovakia. Retrieved from https://ec.europa.eu/digital-strategy/

Slovak Statistical Office. (2022). Internet access and digital divide in Slovakia. Retrieved from https://www.statistics.sk

European Commission. (2023). Cultural creative cities monitor. Retrieved from https://composite-indicators.jrc.ec.europa.eu/cultural-creative-cities-monitor/performance-map

International Energy Agency (IEA). (2023). Energy system: Data centres and data transmission networks. Retrieved from https://www.iea.org/energy-system/buildings/data-centres-and-data-transmission-networks

Eurostat. (2023). E-waste: Electrical and electronic equipment waste statistics. Retrieved from https://ec.europa.eu/eurostat/databrowser/view/env_waseleeos/default/table?lang=en&category=env.env_was.env_wasst

Slovak Ministry of Culture. (2022). Summary results SA-CCI-SR 2016-2021. Retrieved from https://www.culture.gov.sk/wp-content/uploads/2019/12/Summary-results-SA-CCI-SR-2016-2021.pdf

Eurostat. (2023). Culture statistics: Cultural employment in the European Union. Retrieved from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Culture_statistics_-_cultural_employment

Macrotrends. (2023). Population of Slovakia. Retrieved from https://www.macrotrends.net/global-metrics/countries/ROU/slovakia/population

McKinsey & Company. (2023). Top trends in technology adoption. Retrieved from https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/the-top-trends-in-tech#enterprise-tech-adoption

Slovak Statistical Office. (2022). Internet access and digital divide data portal. Retrieved from https://slovak.statistics.sk/wps/portal/!ut/p/z0/

European Commission. (2023). Internet access and digital skills in Slovakia. Retrieved from https://ec.europa.eu/eurostat/cache/metadata/EN/isoc_i_simsih2_sk.htm

Eurostat. (2023). Cultural employment by gender. Retrieved from https://ec.europa.eu/eurostat/databrowser/view/cult_emp_sex/default/table?lang=en&category=cult.cult_emp

Cineuropa. (2023). Slovak Film Commission presents its new strategy. Retrieved from https://cineuropa.org/en/newsdetail/446809/

Eurostat. (2023). Government expenditure by function (COFOG). Retrieved from https://ec.europa.eu/eurostat/databrowser/view/gov_10a_exp__custom_13462923/default/table?lang=en