ANALYSIS OF ROMANIA'S LEVEL OF DIGITIZATION IN THE REPORT OF THE INDEX OF THE ECONOMY AND DIGITAL SOCIETY (DESI) 2022

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Abstract: In recent years, Romania has made remarkable strides in advancing its digitization efforts, which have become a top priority for the Romanian government. Substantial initiatives have been launched to expedite the country's digital transformation. Romania boasts a well-developed IT infrastructure, with widespread high-speed internet access and extensive coverage. Most urban households have internet connectivity, and smartphone usage is pervasive. In the corporate sphere, digitization has taken center stage for many businesses. The online commerce sector has witnessed significant growth, as has e-banking. Moreover, there is a noticeable uptake of emerging technologies like artificial intelligence, data analytics, and the Internet of Things. Digitalization has permeated nearly all economic sectors in Romania, albeit to varying degrees and complexities, making it an integral part of both public and private services. However, the socio-economic impact of this digitalization varies across sectors. To gain a comprehensive understanding of this landscape, a detailed assessment of Romania's level of digitization is imperative. This is the focal point of the article, which offers a concise analysis of Romania's digitization status in relation to the Digital Economy and Society Index (DESI).

The most recent country report, released by the European Commission in 2022, comprises four key assessment pillars: human capital, connectivity, integration of digital technology, and digital public services. To gauge Romania's level of digitization, all the indicators used in the evaluation are compared with the EU average. The primary aim of this analytical research is to present Romania's current status as reflected in official statistical data provided by the European Union. The goal is to identify strengths and weaknesses in the realm of digitization and subsequently provide recommendations and proposals to enhance the utilization of information technology across all sectors of the country's activities, particularly in socio-economic contexts.

JEL classification: M15, O40, C43, F63.

Key words: digitization, sustainability, digital economy, economic growth.

1. INTRODUCTION

The results of recent research highlight the fact that the rapid advance of technology is leading to unprecedented digital transitions. The economic, health and social crises generated by the COVID-19 pandemic, as well as the amplification of the global energy crisis caused by the Russian-Ukrainian conflict, require society to find viable solutions in terms of procedural changes to the global economic system. These transformative changes, according to economic analysts, are generated by the new economic paradigm known in specialized literature as the fourth industrial revolution or, in scientific terms, the digitalization of the economy (Demoly & Andre, 2021).

According to Deloitte (2021), this new industrial revolution involves an "emerging technological and economic paradigm characterized by the advanced integration of digital technologies and artificial intelligence in industrial and social processes". This industrial revolution is characterized by the convergence of technologies such as the Internet of Things, big data, advanced automation, robots, chatbots, virtual and augmented reality, 3D printing and other emerging technologies.

In 2022, Romania had a growing level of digitization, but there were still many challenges and opportunities for improvement. The Romanian government and other institutions have implemented various programs and initiatives to promote digitization in all sectors of the economy and society. In terms of digital infrastructure, Romania has made significant progress in developing high-speed internet connections. There is good coverage of fixed and mobile Internet networks, and Internet access is widespread in urban areas and many rural areas. However, there are still areas with poor or no infrastructure in remote rural areas.

Also, in the field of online services, Romania reported a significant increase in the use of the Internet for various activities, such as online shopping, bill payment, banking and online communication, and the Romanian IT sector has seen steady growth and has become a force important in Europe in terms of software development, IT services and outsourcing.

2. SPECIALTY LITERATURE

The emergence of novel technologies like robotics, artificial intelligence, and the Internet of Things has given rise to fresh challenges and dimensions that necessitate enhancements in Romania's digitalization efforts. The Digital Economy and Society Index (DESI), issued in 2022, serves as a yardstick for assessing the level of digitalization in comparison to the European Union's average. Among these aspects, digital literacy and cybersecurity are pivotal (Tacu, 2022).

Sustained endeavors are essential to bolster digital literacy, particularly among older individuals or those with limited access to technology. Encouraging the adoption of digital technologies and offering appropriate training and courses can mitigate the digital divide, especially as our reliance on technology and online services intensifies.

Damaschin and Mihăilă (2023) underscore the significance of digitalizing public administration and its potential impact on the socio-economic landscape. Despite ongoing steps to digitize public services, there's still a pressing need to simplify and streamline administrative procedures. Enhancing access to online services and implementing digital solutions can trim bureaucracy and enhance citizens' interactions with public authorities.

Furthermore, to expedite digitalization, promoting innovation and attracting investments in cutting-edge technologies is paramount. Creating a conducive ecosystem for startups and investing in digital infrastructure can enhance the country's competitiveness and technological advancement (Hîncu, 2016).

Examining the four pillars analyzed by DESI 2022—human capital, connectivity, the integration of digital technology, and digital public services—offers insights into Romania's digitization progress relative to the EU average. Abramihin (2020) suggests that the digitalization of the economy necessitates adjustments for both employees and employers. With digitization spreading across the economic spectrum and business models evolving, there's an anticipation of partial substitution of human labor by automation. This may release a significant part of the workforce, ushering in fresh challenges for companies and the government. The digital economy's development has brought about substantial changes in the labor market and human capital, giving rise to a new socio-economic paradigm. Simultaneously, digital technologies and platforms can have a positive impact on the job market, facilitating new employment opportunities, streamlining recruitment and collaboration processes, and fostering innovation and productivity in diverse economic sectors (Abramihin, 2020).

In the public sector, digital technologies enable more efficient government operations and citizen-centric services. The rapid technological advancements, budget constraints, and demographic shifts have introduced new challenges that public authorities must address (Avram, 2020). The use of information and communication technology (ICT) and e-government strategies showcases a marked progress toward digital maturity, encompassing digital government, where technologies and user preferences are integral to service production and delivery, constituting part of public sector reform processes (Ozols & Nielsen, 2018).

Another facet scrutinized by DESI indicators is internet connectivity, an essential requirement in this digital era. The internet has evolved into a potent tool for connecting people, ideas, information, resources, and services, fueling the economy with new employment prospects, enhancing economic market infrastructure, and ensuring swift and effective communication between businesses and individuals across the globe (Salac & Kim, 2016). Internet access through broadband communication is regarded as a fundamental right and an aspiration for which governments must continually strive to bolster development.

In summary, Romania has made headway in its digitalization journey, but numerous areas warrant further improvement. The government and other organizations persist in their efforts to advance digitalization across all sectors and bridge the digital divide.

3. METHODOLOGY

The level of digital transformation within specific economic and societal sectors significantly influences a country's position in the digital economy and its global rating. Various indicators are employed to evaluate this transformation, including the adoption and utilization of digital technologies, connectivity levels, the digital skills of the population, digital innovation, the availability of online services, and more. These

indicators offer valuable insights into a country's digital economy development and facilitate comparisons and performance assessments in terms of digital transformation (Tarihi, 2021).

This study focuses on analyzing Romania's degree of digitization, utilizing the Digital Economy and Society Index (DESI) as an assessment tool. DESI is an indicator used to gauge the digital performance of European Union member states and to monitor their progress in digitizing both public and private sectors.

We will present findings from the European Commission's 2022 DESI report, which evaluates member states' progress in digitization. The DESI report has been collecting data on the digital advancements of EU member states since 2014. Through the analysis of these results, we aim to gain a deeper understanding of the state of digital economy development and country rankings in terms of digital transformation.

The primary goal of this research is to underscore the pivotal role digitization plays in driving economic and societal transformation and progress. Additionally, it seeks to assess the strides made by EU member states in adopting and advancing digital technologies, leveraging the indicators provided by the Digital Economy and Society Index (DESI). Analyzing these DESI indicators enables us to evaluate how effectively member states are adapting to the digital era, identify associated challenges and opportunities, and discover instances of best practices that can be applied in other national or regional contexts.

The 2022 DESI reports primarily focus on data collected in 2021 and examine the digital progress achieved by EU member states. According to Tarihi's research, conducted against the backdrop of the COVID-19 pandemic, member states have made significant headway in digitization by embracing digital technologies to address the challenges posed by the crisis. Nevertheless, there are still ongoing efforts to bridge the digital skills gap within the population, stimulate the digital transformation of small and medium-sized enterprises, and promote the use of advanced 5G mobile communication networks (Tarihi, 2021).

The majority of indicators utilized in the DESI reports are sourced from Eurostat, the statistical office of the European Union. It provides pertinent statistical data for assessing the extent of digitization within member states. Additionally, certain indicators, such as those related to broadband, are collected by the European Commission services through the Communications Committee. Other indicators, like those pertaining to e-government and broadband, rely on data obtained from studies commissioned by the European Commission. These data and information form a robust foundation for evaluating digital progress and the performance of EU member states with respect to digitization.

In a study presented by Piciu at the "Economic growth in the conditions of globalization" Conference (2021, pp. 108-113), the need to develop a comprehensive methodology for assessing the level of digitization is supported, in order to clarify this concept. Therefore, we will focus on the analysis of the indicators presented in the Digital Economy and Society Index.

3.1. Ranking of the Digital Economy and Societies Index (DESI) 2022

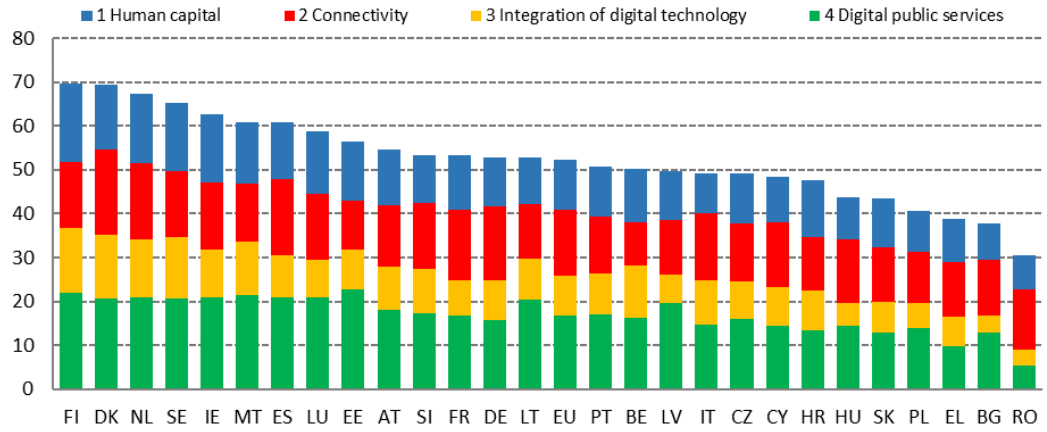

Figure 2.1. Overview of the DESI 2022 report

Source: *European Commission, Digital Economy and Society Index (DESI) 2022, Romania*

According the 2022 Digital Economy and Society Index (DESI), Romania occupies the last position among the 27 EU member states. Furthermore, the rate of growth in Romania is insufficient to bridge the gap with other member states, especially concerning human capital. Basic digital skills in the country are significantly below the European average. However, on a positive note, Romania stands at the top of the rankings in terms of the percentage of female IT specialists, securing the second position, and ranks fourth in the number of graduates specializing in information technology.

In to the same report, Romania excels in the field of broadband connectivity, surpassing the EU average with an impressive 87% penetration rate. This is a significant achievement, especially considering the EU's "digital decade" objective for 2030, which aims to have 100% of internet users utilizing broadband with high speeds and network traffic. Nevertheless, technology integration in both the public and private sectors remains relatively low in Romania, with the country scoring below half of the EU average.

The Romanian economy is grappling with low levels of digitization and a relatively sluggish adoption of digital technologies. This hinders the full exploitation of available opportunities. The situation is compounded by the notably deficient provision of digital public services, catering to both citizens and businesses. This inadequacy in digitization and the efficacy of digital infrastructure can adversely impact economic competitiveness and administrative efficiency.

3.2. Human capital

Following the analysis of the Human Capital pillar of the Digital Economy and Society Index (DESI) 2022, it is found that Romania ranks last in this dimension among the member states, with a score of 30.9 compared to the EU average of 45.7.

Table 3.1. Human capital assessment reported by the EU in DESI

	Romania			EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
At least basic digital skills % of people	N/A	N/A	28% 2021	54% 2021
Digital skills beyond elementary level % of people	N/A	N/A	9% 2021	26% 2021
At least basic skills in digital content3 % of people	N/A	N/A	41% 2021	66% 2021
ICT specialists % of employed persons aged between 15 and 74 years	2.3% 2019	2.4% 2020	2.6% 2021	4.5% 2021
Women ICT specialists % of ICT specialists	23.5% 2019	26.2% 2020	26% 2021	19.1% 2021
Companies offering ICT training % of enterprises	6% 2019	6% 2020	6% 2020	20% 2020
Graduates in ICT % of graduates	5.8% 2018	6.3% 2019	6.7% 2020	3.9% 2020

Source: *European Commission, Digital Economy and Society Index (DESI) 2022, Romania*

The report underscores a striking disparity in digital skills and IT knowledge among the population in Romania. Only 28% possess even basic digital skills, a figure well below the EU average of 54%. Furthermore, just 9% of individuals exhibit skills beyond the rudimentary level, while the EU average stands at a notably higher 26%. In terms of employed IT specialists aged 15 to 74, Romania reports a rate of 2.6%, whereas the EU average is more substantial at 4.5%. The percentage of companies offering professional IT training has plateaued at 6% in Romania in recent years, in contrast to other EU states, which have invested more in this domain and report an average of 20%, as indicated by a study from the European Investment Bank in 2023.

Despite these subpar scores, Romania manages to surpass the EU average in specific areas. Notably, the country excels in the representation of women specialists in IT, with 26% compared to the EU average of 19.1%. Moreover, Romania takes the lead in the proportion of IT graduates at 6.7%, compared to the EU average of 3.9%.

3.3. Connectivity

Romania finds itself in the mid-range of the ranking, just slightly below the EU average when it comes to connectivity. The primary hurdle lies in raising the

percentage of broadband users, both in fixed networks, where Romania stands at 66% compared to the EU average of 78%, and in mobile networks, with a rate of 82% compared to the EU's 87% average.

Table 3.2. Internet connectivity assessment reported by the EU in DESI

	Romania			EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
Global usage rate of broadband services fix % of households	**66%** 2019	**67%** 2020	**66%** 2021	**78%** 2021
Use of fixed broadband services of at least 100 Mbps % of households	**49%** 2019	**51%** 2020	**57%** 2021	**41%** 2021
Using services of at least 1 Gbps % of households	**<0.01%** 2019	**<0.01%** 2020	**8.98%** 2021	**7.58%** 2021
High Speed Broadband Coverage (NGA) % of households	**82%** 2019	**87%** 2020	**93%** 2021	**90%** 2021
Coverage of very high capacity fixed networks (VHCN) % of households	**68%** 2019	**76%** 2020	**87%** 2021	**70%** 2021
Coverage of fiber optic networks up to inside the building (Fibre to the Premises – FTTP) % of households	**68%** 2019	**76%** 2020	**87%** 2021	**50%** 2021
The 5G spectrum Allocated spectrum expressed as a % of the total harmonized 5G spectrum	**21%** April 2020	**21%** September 2021	**22%** April 2022	**56%** April 2022
5G5 coverage % of populated areas	**Does not apply**	**12%** 2020	**25%** 2021	**66%** 2021
Use of mobile broadband % of people	**65%** 2018	**65%** 2018	**82%** 2021	**87%** 2021
Broadband Price Index Score (0-100)	**92** 2019	**97** 2020	**97** 2021	**73** 2021

Source: *European Commission, Digital Economy and Society Index (DESI) 2022, Romania*

The report positions Romania with an impressive score in terms of certain key indicators. Notably, Romania achieves a noteworthy 93% in the use of fixed broadband services with speeds of at least 100 Mbps. Additionally, the coverage of fiber optic networks reaching the interior of buildings stands at an impressive 87%, outperforming the EU average of 70%. Consequently, Romania emerges as a frontrunner in the EU when it comes to population access to the internet, with a remarkable rate of 94.1%. On the flip side, the report observes that internet subscription costs in Romania are remarkably low, leading to a significant boost in internet service accessibility. Nevertheless, there persists a 20% gap between urban and rural areas, although recent years have witnessed a substantial and gradual reduction of this disparity.

3.4. Integration of digital technology

Romania grapples with a limited integration of digital technologies, standing at the 27th position in this aspect, as per the Digital Economy and Society Index (DESI). The findings reveal that the majority of the indicators fall notably below the EU average, with some experiencing stagnation or even declines in the past year.

Table 3.3. Assessment of digital technology integration reported by the EU in DESI

	Romania			EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
SMEs that have at least a basic level of digital intensity % of SMEs	N/A	N/A	22% 2021	55% 2021
Electronic exchange of information % of enterprises	2. 3 % 2019	2. 3 % 2019	17% 2021	38% 2021
Social communication platforms % of enterprises	8% 2019	8% 2019	12% 2021	29% 2021
Large volumes of data % of enterprises	11% 2018	5 % 2020	5 % 2020	14% 2020
Cloud technology % of enterprises	N/A	N/A	11% 2021	34% 2021
AI % of enterprises	N/A	N/A	1 % 2021	8% 2021
ICT for environmental sustainability % of enterprises with a medium/high intensity of green actions through ICT	N/A	68% 2021	68% 2021	66% 2021
Electronic invoices % of enterprises	20% 2018	17% 2020	17% 2020	32% 2020
SMEs selling online % of SMEs	11% 2019	17% 2020	12% 2021	18% 2021
E-commerce turnover % of the turnover of SMEs	5 % 2019	8% 2020	7% 2021	12% 2021
Cross-border online sales % of SMEs	6% 2019	6% 2019	4 % 2021	9% 2021

Source: *European Commission, Digital Economy and Society Index (DESI) 2022, Romania*

For instance, the percentage of small and medium-sized enterprises (SMEs) in Romania that exhibit even basic levels of digital intensity is merely 22%, whereas the EU average stands at a much higher 55%. This points to a subdued embrace of digital technologies within the Romanian business landscape and suggests untapped potential in reaping the benefits offered by digitalization. The report presents exceedingly low percentages in various categories, including electronic information exchange among companies at 17%, utilization of social communication platforms at 12%, adoption of

cloud technology at 11%, electronic invoicing at 17%, and online sales at 12%. A mere 1% of companies employ artificial intelligence, in stark contrast to the EU average of 8%, and cross-border online sales register at 4% as opposed to the EU's 9% average.

These findings underscore the pressing need for heightened efforts in advancing digital transformation in Romania. This should encompass the development of digital infrastructure, the promotion of digital skills among the populace, and support for SMEs in the adoption and effective utilization of digital technologies. Achieving a more robust integration of digital technologies holds the potential to enhance economic competitiveness and elevate the quality of life in Romanian society.

3.5. Digital public services

Upon examining the Digital Public Services dimension of the Digital Economy and Society Index (DESI) 2022, it becomes evident that this area poses a significant challenge for Romania. The performance metrics are notably lagging behind the EU average across all the indicators assessed.

Table 3.4. Evaluation of digital public services reported by the EU in DESI

	Romania			EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
Users of e-government solutions % of internet users	**15%** 2019	**16%** 2020	**17%** 2021	**65%** 2021
Pre-filled forms Score (0-100)	**N/A**	**N/A**	**19** 2021	**64** 2021
Digital public services for citizens Score (0-100)	**N/A**	**N/A**	**44** 2021	**75** 2021
Digital public services for businesses Score (0-100)	**N/A**	**N/A**	**42** 2021	**82** 2021
Open data % of the maximum score	**N/A**	**N/A**	**76%** 2021	**81%** 2021

Source: *European Commission, Digital Economy and Society Index (DESI) 2022, Romania*

Only 17% of internet users in Romania engage with e-government platforms, a stark contrast to the 65% EU average. The use of pre-filled forms in the country scores a meager 19 points on a scale of 0 to 100, while the EU average stands at a significantly higher 64 points. Similarly, the level of public engagement with citizens through the provision of digital services ranks disappointingly low, with Romania scoring 44 points as opposed to the EU's 75 points. The digital public services provided to businesses also fall short of satisfaction, recording a score of only 42 points compared to the EU's 82-

point average. This indicates that the interaction between companies also lacks a high level of digitization.

As per the report's recommendations, Romania is urged to boost digitization across all sectors, especially within public services. The EU's objective for 2030 is to have public authorities offering 100% of their services online, making this a critical target.

4. CONCLUSIONS

The digitization journey in Romania is a multifaceted endeavor that remains in the phase of exploration and development. This partly accounts for the underwhelming results seen in the Digital Economy and Society Index (DESI) 2022, especially in comparison to other EU member states. Romania grapples with specific challenges related to digitization, including an underdeveloped digital infrastructure, lower levels of digital proficiency among the general populace and businesses, as well as limited usage of digital public services.

Nevertheless, it's important to acknowledge that Romania is actively adapting and exploring the potential presented by digital technologies. Ongoing efforts are directed towards improving digital infrastructure, enhancing digital skills, fostering innovation, and boosting the adoption of digital technologies within the business landscape. These measures have the potential to enhance performance in the digital domain and narrow the gap with other EU member states.

It's worth noting that the Digital Economy and Society Index (DESI) 2022 provides only a limited glimpse into the vast realm of digitization, which has far-reaching implications beyond merely measuring technology utilization and well-being indicators. The intricacies of digitization encompass numerous intertwined factors, including educational levels, public administration efficiency, political and business environments, and extend beyond information infrastructure.

Digitization exerts its influence across an array of domains, spanning economic, social, educational, and cultural spheres. A comprehensive understanding of these implications and the formulation of effective digitalization policies and strategies necessitate collaborative efforts across various disciplines and areas of expertise. To fathom the intricate interplay between digitization and diverse facets of life, a multidisciplinary approach and collective input from researchers with diverse backgrounds, such as psychologists, economists, and innovation experts, are indispensable.

In the context of contemporary societal evolution, digitization assumes a pivotal role in driving economic, political, and social transformations. This opens up significant opportunities in public administration, state cooperation, industrial processes, corporate management, societal dimensions, and individual living space organization. To attain sustainable economic and social development within the European Union, there is a need to enhance organizational and economic structures, develop technical and material infrastructure, promote innovation in production, elevate enterprise competitiveness in the region, foster public-private partnerships, invest in human capital development, and maintain social competitiveness.

These measures are essential for fully unlocking the potential offered by digitization and ensuring an efficient and well-balanced transition to a technology-

driven society and economy. Enhancing organizational and economic capacities can expedite the digital transformation process, making it easier to adopt and integrate digital technologies across various sectors and fields. Investments in technological and material infrastructure can lay solid foundations for developing and implementing digital innovations. Promoting public-private partnerships and encouraging collaboration between public and private sector stakeholders can contribute to the advancement of digital solutions and the creation of added value.

Investing in the development of human capital, through avenues like training and education in digital skills, technology education, and research, is paramount. This helps cultivate a skilled and adaptable workforce capable of meeting the evolving demands of the digital age, thereby stimulating innovation and economic growth.

The analysis of the DESI 2022 report underscores the imperative for Romania to redouble its efforts in narrowing the gap in transitioning to a digital economy when compared to other EU member states. Digitization presents significant opportunities for the country, such as sustainable development, economic growth, the provision of high-quality services and products, labor market flexibility, and the creation of an environment conducive to innovation.

The implementation of digitization within public services in Romania can lead to more streamlined and effective administration, improved revenue collection, simplified interactions between public administration and citizens, and a reduction in corruption within the public sector. The integration of digital technologies into economic processes is poised to have a direct and positive impact on increasing the competitiveness and productivity of the Romanian economy.

It is crucial for Romania to invest in digital infrastructure, promote the adoption of digital technologies across all sectors, and foster digital literacy among the populace and the workforce. Moreover, creating an innovation-friendly environment and supporting digital entrepreneurship, facilitating access to finance for digital projects, and promoting collaboration between the public and private sectors in the development of digital solutions are of paramount importance.

In conclusion, Romania stands to gain substantial advantages from digitization, and the effective integration of digital technologies into all aspects of society and the economy has the potential to drive sustainable growth and enhance the well-being of its citizens. Such an encompassing endeavor calls for a coordinated approach and continued efforts from all stakeholders to ensure a successful and balanced transition to a thriving digital economy and society.

Notably, Romania can advance toward these growth objectives through the National Recovery and Resilience Plan, which allocates 5.97 billion Euros to digitization projects, constituting 20.5% of the total value of the PNRR. Within the 15 components of the PNRR, Component 7, dedicated to digital transformation, connectivity, and cybersecurity, receives the most substantial allocation of 1.81 billion Euros.

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