EVOLUTION OF USAGE PATTERNS FOR ONLINE TOOLS IN THE CONTEXT OF DIGITAL TRANSFORMATION

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ABSTRACT

The paper focuses on analysis of data available from various sources regarding the usage of internet services. The paper goal is to put the data about internet usage in the context of digital transformation (DT) of the society. Both social and human-resource aspects of the DT were emphasized in the presented research oriented primarily to the investigation of share of population accessing the internet in various countries, its relation to various parameters reflecting public services (e.g. government efficiency). For selected relations, correlation and/or regression analyses were performed as well. The main conclusion is that a relation between internet user ratio and government efficiency seem to exist but it is weak.. Also, the study argues that the minority not adopting the digital transformation tools is large enough and should not be neglected in making decisions, e.g. by eliminating non-IT ways to use public services.

Keywords: Internet usage, Government efficiency, Digital transformation, Statistics, Pearson correlation

JEL Code: L86, C21, C88, O31

1 INTRODUCTION

Only slightly more than fifty years have passed since the ARPAnet (an Internet immediate predecessor) origin, and thirty-four years since Tim Bernes-Lee at CERN proposed first version of web communication (see HTTP/0.9 protocol at w3c.org n.d.) that started real dissemination of internet usage among ordinary users. During such a (historically short) period, almost everything around us has changed significantly. Such a change is usually considered as a part of the digital transformation. According to Vial (2021), the digital transformation is

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usually described as a profound change of multiple aspects in both the industry and society harnessing various facets of digital technologies in order to achieve higher efficiency of business and social life. Nevertheless, Vial (2021) focus lies in digital transformational changes to businesses. On the opposite, Hilbert (2020) emphasizes societal changes being part of the digital transformation including increasing number of people having access to the internet.

As a part of digital transformation, most people adopted to use various online services and tools, ranging from browsing web pages, communicating over e-mail or instant messengers, up to social networks of various types. Moreover, such a change is no more limited to people with an IT or related qualification or people with higher economic status. As numerous reports say (e.g. Ofcom 2024a, Statista.com 2023), even around three quarters of population from lower socio-economic groups in western countries use internet regularly. On the other hand, the remaining portion is still far from being negligible so their needs and attitudes should be considered as well in making decisions related to e.g. non-digital availability of inevitable services like public administration, banking etc. Even the non-digital population aspect of the digital transformation deserves consideration and will be the object of research in this paper, too.

In 2024, the total number of internet user worldwide exceeded 5.5 billion (making 67.5% of the world population – according to Datareportal 2024). This confirms the data from World bank and ITU (International Telecommunication Union, 2025) saying that 67% of the world population had access to the internet in 2023. Therefore, an obvious conclusion could be made that most of the worldwide population use internet services as a common tool in their daily life.

Among the changes invoked by the digital transformation, a significant simplification in searching and accessing information play an important role as documented e.g. by the study Xu and Reed (2021) documenting the increase of research results number with the increase of internet availability. On the other hand, the fact that so much information is easily accessible, poses other challenges, among which the most significant is how to select the most relevant and proper information resources and avoid those incorrect, misleading and similar (e.g. Saracevic 2022).

Obviously, there is another closely related question whether using internet makes their lives easier and more comfortable, but this is not addressed directly in the paper.

Because of the reasons mentioned above, the main emphasize of the paper lies in the research how the internet usage evolves in recent years. To achieve the goal, the paper explores selected sources of data about usage of various internet-enabled services first. In section 2, selected interesting observation about internet usage are cited. In section 3, certain new relations were investigated and in section 4, some conclusions were formulated.

2 RELEVANT EXISTING RESEARCH OF ONLINE TOOLS USAGE

From the very beginning of the era of internet usage by wide public (started in early 1990's by the emergence of www), various attempts focusing on user behavior in the internet has appeared, primarily because of anonymous nature of www service (later partly eliminated by cookies). There is a nice overview of data resources in Nadhom and Loskot (2018) where 40 resources containing measurements of internet usage are described.

Among those that are extremely useful, an overview about internet usage through the period from 2000 till 2015 is given by Perrin and Duggan (2015) for the US market excels. The main conclusions include the gradual increase of people with internet access (from 52% US adults in 2000 to 84% in 2015) with significant differences among age groups (only 58% seniors 65+ vs. 81–96% in younger age groups in 2015), a bit smaller among groups according to the highest education (from 90–95% for university through 76% for secondary till 66%

for lower), and income level (highest above 95%, medium 85% and low only 74%). This is complemented by newer data from OECD (2025) reporting 77.8% share of internet users in the US population in 2023.

A rather historical view from an econometric perspective is brought by an older study Bauer *et al.* (2002) where US and EU market were investigated via a multivariate panel regression model. The main conclusion hereof is that structural factors including regulator policy, economic conditions of country and the communication infrastructure play an important role in explaining cross-national differences in Internet access. This conclusion is based on data from 1999 and earlier, but it is true in most cases even in 2025.

The (cyber)security aspect of internet access has also been addressed in some research papers recently. Among them, Lysenko *et al.* (2024) and Pour *et al.* (2023) were chosen as the most relevant to this paper. While the latter thoroughly summarizes the existing measurements with regards to various security aspects of internet communication ranging from routing, through DNS attacks, up to phishing, including newer vector like IoT devices, (Pour *et al.* 2023), Lysenko *et al.* (2024) focuses on specific attacks using phones (in fact a variant of phishing where the vector for the initial message is a phone call instead of common mail message) and analyzes possibilities to detect and avoid such attacks

As the research results mentioned above demonstrates, there are still some niches that were not addressed sufficiently. Overall, lots of available statistics exist but their differences in methodology, data collection period, variables etc. avoid being comparable. The authors consider just the analysis of internet usage patterns in the context of actual changes in the society as one of such niches and therefore the following sections address just this topic.

3 INTERNET USAGE RESEARCH

3.1 Internet usage pattern investigation

As mentioned in the previous sections, one of the acutest issues at present stage of internet usage is inequal share of internet users in population both according to age and to the economic status. The “age digital gap” meaning the fact that older generations tend to use digital technologies less and have fewer digital skills seems to be a serious issue as illustrated e.g. by Fig. 1 containing share of internet users in population from OECD countries. While Norway and Iceland of the left reach almost 100% share of internet users and the difference between qualification group seems negligible, the situation is much worse in other countries including the ones considered “rich” like UK (92.3% share seems good but only 64.3% among people with low education looks as a warning), or USA (here, even the total share 80.4% is much lower that the average number for the whole population that was 84 % even 9 years earlier, and just 57.1% share among people with low education seems not to correspond the overall economic status of the country. And in poorer OECD countries, the situation is even worse (30.6% share among people with low education in Poland, 29% in Lithuania, 25.2% in Chile).

The more detailed view on this issue in UK has been recently offered by OFCOM Adults’ Media Use and Attitudes (Ofcom, 2024a) and Online Nation (Ofcom, 2024b) reports. In the latter, reasons why people do not have internet access from home were summarized and costs were reported as the most significant reason form medium age group (51% for age 16–64), and primarily for 28% of respondents from lowest socio-economic groups. This seems a motivation point for digital transform promoters because these data demonstrate that a non-negligible minority in the society is not likely to adopt using digital tools (e.g. being part of the digital transform) just because it is not affordable enough for them.

There is another aspect of the digital transform in societies as well. As a recent survey by EUs Eurobarometer Digital decade reported (European Union 2024), 23% of respondents claim that digitalization of daily public and private services is making their life more difficult

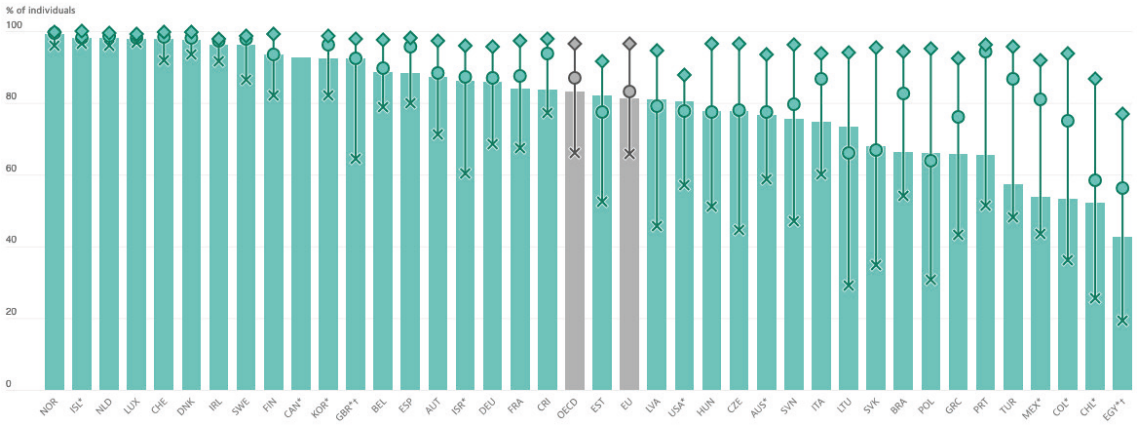

Fig. 1: Share of individuals aged 55-74 years using the Internet as of 2023 (* and + indicate a difference in data collection time) in different countries (plus OECD and EU averages – grey). Diamond, circle and cross indicate high, medium and low education, respectively.
Source: OECD 2025.

(of course, 73% claim the opposite that the digitalization make their life easier (or even much easier). This is still a significant share of population whose opinion should not be suppressed. Therefore, at least public (and preferably also critical private) services should remain available in a non-digital (like paper-based) form even after the service is digitized. Such a view is significantly critical for private sector services like banking. On one hand, submitting e.g. paper-based payment order is still acceptable for most banks but, on the other hand, some banks require quite expensive fee for this (e.g. about 6 Eur for one big Czech bank being part of a large European banking group). One should counter that this fee is not applied to people above 65. Nevertheless, it should be noted that even among younger generation, there are people not able and/or willing to participate the digital transform (at least for now), and such an approach looks adversary for them.

Anyway, the above observations demonstrate that a minority, but still significant part of rich society population still do not use IT tools so they do not participate in the digital transformation either much or at all. Sch minority should be taken into account when making decisions about the digital transformation progress, primarily bearing in mind that traditional ways of interaction with public services (as well as vital services provided by private bodies, like banking) should be kept for the above mentioned minority.

3.2 Relation between internet usage and government services

Another question to investigate was the dependence of government efficiency on the internet penetration. For this investigation, data from World bank (2025), and ITU (International Telecommunication Union 2025) were used as primary sources. The comparison for all countries seems to reveal certain tendency to correlate as shown in Fig. 2 but the correlation in not very strong (Pearson's correlation coefficient 0.67).

Even when only selected developed countries were selected (EU, UK, USA, Japan), the dependence is not much stronger as Fig. 3 demonstrates. On the other hand, a simple regression model using OLS was created with coefficient of determination 0.52 (for EU only, it had increased up to 0.62). Even though the level of dependence in not strong, still certain level of dependence has been proven.

Another important aspect of the digital transform in societies is gradual shift of public services into a digital form. As mentioned above, this shift seems to be welcome by a majority of population usually, but the unwilling and/or refusing minority is far from having negligible size. There is a frequently cited example of shifting public services into digital form, namely

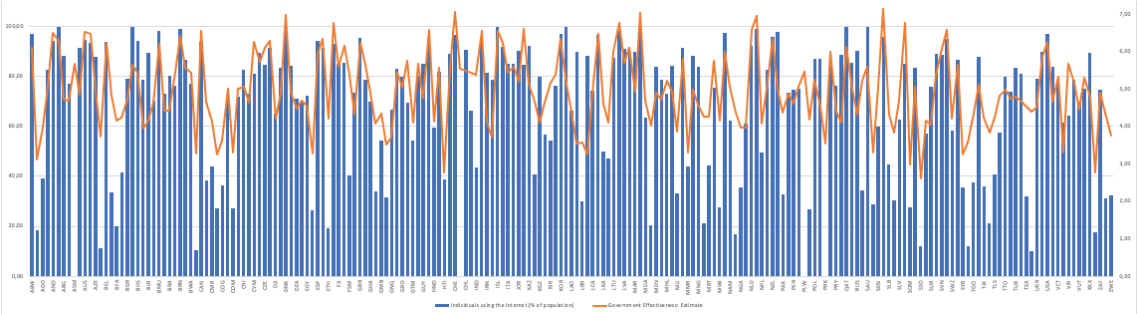

Fig. 2: Graph of countries comparing ratio of internet users in overall population (blue columns, left axis), and the World Bank government efficiency indicator (orange line, right axis)
Source: World Bank, ITU, authors' pro-cessing.

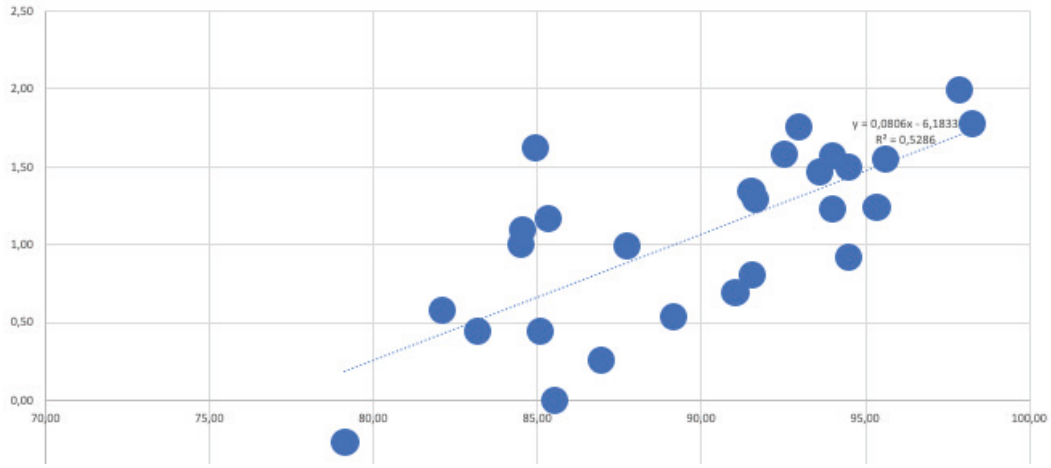

Fig. 3: Graphical demonstration of the dependence of WB government efficiency (vertical axis) on the share of inter-net users in population for EU, UK, USA, Japan
Source: WB, ITU, authors' processing.

elections in Estonia. According to a recent survey about their digitization (Ehin *et al.* 2022), the share of voters having used the digital voting (from all voters) has increased from 1.9% in 2005 (first digital elections in Estonia) up to 17.6% in 2019 (46.7% of participating voters). On the other hand, the introduction of digital voting process (despite optional for voters) did not affect either the voter turnout, or voter trust level. Also, the majority of paper-based voters recruit from older age groups, but the average age between the paper-based voters and i-voters seems to tend getting closer.

This example was mentioned here as another confirmation of the conclusion that the availability of public services in digital form is considered as a positive step forward by most people, but non-negligible portion of population do not tend to adopt to such changes. It further confirms observations about "non-digital" minority mentioned in section 3.1.

4 CONCLUSIONS

As the previous sections demonstrated, there are still numerous facets of internet usage that remain partly hidden in such a big amount of data being produced and published in this field. The presented study demonstrated that looking at the internet usage statistics from a closer view, it is apparent that the speed of adoption of changes being part of the digital transform is not so quick as expected earlier. Therefore, the society should avoid the transformatory

changes from being too quick and/or not taking into account the minor but still significant portion of population that is unable or unwilling to adopt their habits and attitudes so that to becoming users of digital services. Therefore, it is necessary to keep traditional way of interaction with public and private services in place despite (slowly) decreasing share of population using them.

In addition, a relation between the share of internet users in population and the quality (or efficiency) of the government was observed. Despite the relation seems to be weak, it can work an important role in many countries in the near future.

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