

Consumerisation of IT – intersection of development streams of business and personal IT

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Abstract

Background: In the age of IT consumerisation, private owned IT artifacts are increasingly used for business purposes. Management's approval is not required, but various approaches are used to create effective management strategies.

Purpose: The historical development trends of business and personal ICT are examined in the paper to understand their intersection - IT consumerisation.

Study design/methodology/approach: The paper provides a preliminary research assessment. The informative outcomes drawn from diverse perspectives and the comprehensive nature of 'gray literature' should serve as guidance for the direction, adjustments, and modifications of future research.

Findings/conclusions: A number of technological and market factors have led to the consumerisation of IT. As a spinout from business IT, personal IT has had a feedback effect on it: the proliferation of computers and mobile devices on the consumer market, combined with affordable Internet-related resources, not only changed personal IT usage patterns, but also redefined the expectations that users have for enterprise software. In order to create an effective IT consumerisation management strategy, it is imperative to understand them.

Limitations/future research: The paper is a starting point for future empirical research in the field of IT consumerisation, and as such, may be amended according to new knowledge that is obtained subsequently.

Keywords

Business IT, personal IT, IT consumerism, history of business IT, history of personal computing

Introduction

The first steps in the development of business IT are fascinating when viewed in the context of their time. Business IT was the privilege of large organizations in the 1950s. It is a result of complex and financially challenging requirements for operability, as well as high levels of required technical education for computer system users. Even so, optimism regarding computer

technology's further development prevailed despite all this. Technical and technological developments over the past 70 years have often exceeded expectations expressed many decades ago (Freiberger & Swaine, n.d.). However, it is unlikely that anyone in the era of vacuum tubes and transistors would have predicted that IT would cause such a source of frustration as contemporary literature reveals: enterprise IT consumers today are dissatisfied with insufficient performance and

technological obsolescence of their business IT artefacts, unintuitive user interfaces, fragmentation/non-integration of business applications, etc. Personal IT devices (such as smartphones, laptops, tablets, etc.) play a significant role in shaping such attitudes. As a result, their use - often described as pleasant, intuitive, simple, and personalized - enables mobility, independence, and instant access to shareable, personalized information. Users acquire the necessary technical skills and knowledge easily, intuitively, *during* (and not necessarily *before*) using personal IT devices. Therefore, it comes as no surprise that business IT is also subject to these demands. Users often turn to personal IT devices when these requirements are not met. This trend is called the consumerisation of IT (CoIT). In spite of the fact that it is no longer considered to be nascent, many companies are still not addressing it adequately or even at all.

The general premises in the paper are that “roots” have an important role to play in determining the trajectory of development, making decisions, setting goals, and creating opportunities. Therefore, we believe that, among other things, being informed about CoIT’s creation history, which is the focus of the study, is *conditio sine qua non* to determining an appropriate CoIT management strategy. Due to the well-known and widely disseminated history of information technology, only the level of detail necessary to highlight those development milestones that led to the intersection of business and personal IT, thus shaping the technological landscape of today’s workplaces, will be covered in the paper.

1. The course of development of business computers

The following section describes the development process of business computers through the decades, as well as the key milestones that paved the way for the emergence of personal IT.

1. The development of computing for war.

Most 1940s to 1950s computers were located in universities and used technology (vacuum tubes) and knowledge that were used in wartime. For instance, Great Britain built the first electronic computer in 1943, Colossus, to crack Nazi codes. Two years later, the Harvard Mark I was constructed in the USA and used for ballistic calculations, while ENIAC was used for hydrogen bomb calculations (Freiberger & Swaine, n.d.). The SAGE computer system developed in 1958 was used to detect incoming Soviet missiles

(Taylor, n.d.). Programming was a privilege of a few elite, highly educated specialists who wrote software in machine and assembly languages.

2. The emergence of business computers. The first business computers were built using transistor technology. Although the number of computers increased and their performance improved, computers remained few in number, underperforming, and difficult to handle without specialized knowledge. The idea that ordinary, non-tech savvy users will use them was therefore unfounded (Alfredo, 2017). Computer manufacturers believed that professional computer operators would be the only ones who would use them (Freiberger & Swaine, n.d.). Data processing was made easier with the first corporate mainframe, the UNIVAC. It was initially used by the government, military and academia (Freiberger & Swaine, n.d.), until General Electric became its first private sector customer in 1954 as an attempt to reduce costs through automation (Fruhlinger, 2018). Every computer science text book mentions UNIVAC, but it is also interesting to point out the LEO 1, run in 1951, which was used to compute the costs of ingredients in a British chain of hotels and restaurants (Fruhlinger, 2018). The progress of computing during this period can be attributed to the development of high-level programming languages (FORTRAN, ALGOL, COBOL) and single-stream batch processing operating systems (Craviero), such as the General Motors Operating System developed for IBM701 (OSdata.com, 2010), General Motors GM-NAA I/O developed for IBM704, and Manchester University Atlas Supervisor, which is the first modern operating system with the idea of virtual memory (Evren, 2022).

3. Laying the groundwork for general purpose computing. Time-sharing systems were developed from the 1960s to the 1970s. New programming languages and operating systems appeared, which are still known today in their modern incarnations (e.g. BASIC, UNIX). The arrival of minicomputers resulted in their use in scientific laboratories and businesses. Typical examples include PDP-8 built in 1965, and IBM System 360. The advent of integrated circuits and high-level programming languages paved the way for desktop computers. As a result, computers grew faster, more efficient and more reliable, while their dimensions and prices were reduced (Freiberger & Swaine, n.d.). A prediction made by the American engineer and businessman, Gordon Moore, in 1965 became known as Moore's Law, stating that

computer power (more precisely, processor speed, i.e., the number of elements on an integrated circuit) would double approximately every 18-24 months with the price steadily declining due to the exponential miniaturization of electronics (Rotman, 2020) (Shalf, 2020). As a result, Moor argues, component prices are inversely proportional to their number, with a constant decrease in size and an increase in computer speed. In the same year, Moor also predicted the appearance of personal computers, portable communication equipment, electronic watches, self-driving cars, etc. (Moore, 1965). Every time Moore's Law has been predicted to become obsolete, the predictions have been proven wrong. According to the next prediction of this type, Moore's law will be obsolete in 2025 because existing chip manufacturing technologies will have reached their limits at that time (Figure 1) (Shalf, 2020).

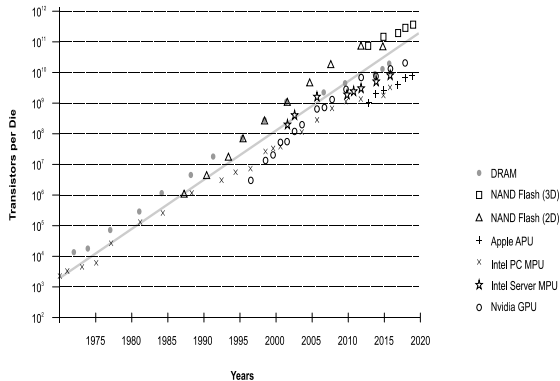


Figure 1 Transistor Count Trends
Source: IC Insights, 2020

4. The emergence of business software.

Microprocessors were introduced between the 1970s and the 1980s, which, according to Moore's law, led to a significant reduction in the size and price of computers, as well as a rapid increase in their power, resulting in many corporations using them for inventory management, reports and payrolls (Alfredo, 2017). INTEL produced the 4004 chip in 1971 - the first commercially produced microprocessor for use in simple business systems: calculators, cash registers, ATMs, etc. (TechTarget contributor, 2012). During 1977, the General Ledger program was created as the first, compared to today's standards, serious business software, followed by the Electric pencil word processor program, and two years later VisiCalc, which was the first tool to perform tabular calculations (spreadsheets) (Freiberger & Swaine, n.d.), succeeded by Lotus 1-2-3 (1980),

Multiplan (1982) and Excel (1985). Using these computers, non-procedural programming languages were developed that were easily mastered by users without a technical background. "One computer - many users" described the wave of computer development up to the 1980s, when one business computer was used by several people in a company.

5. IT companies are starting to take an interest in the consumer market. This interest was sparked by IBM's first personal computer with an open architecture, which allowed other companies to manufacture not only components for IBM computers, but also entire clones (Freiberger & Swaine, n.d.), which will be discussed in Section 2.

6. IT companies shifted their focus from the business market to the personal computer market following the burst of the dot-com bubble. Between 1998 and 2000, the value of shares of IT companies increased dramatically as a result of the popularity of the Internet and computing, which took on an increasingly important role in people's lives, as well as the development of e-business, investments in IT and e-business companies (Geier, 2015). A large number of young firms went public and achieved high stock market valuations, creating the illusion that anyone with a good idea can get rich quickly using the Internet and IT. The Internet boom prompted investors to invest in technology companies without considering the usual metrics of profitability. In 2000, however, most tech stocks had lost up to 75% of their value, causing the bubble to burst and resulting in losses of \$1.75 trillion (McCullough, 2018). Quarterly losses for many companies ranged from 10 to 30 million dollars (Geier, 2015). The effects of the dotcom mania went beyond the United States, as the recession affected the entire world. Business consumers' demand for IT equipment dropped - Silicon Valley alone lost 200,000 jobs as a result. Due to such circumstances, the IT industry shifted its focus from business to consumer IT market niche (McCullough, 2018).

7. Internet maturity and low-cost Internet resources were enabled by the remaining optical infrastructure. After the dot-com bubble had burst, the remaining optical fibre Internet infrastructure with significant bandwidth enabled new, low-cost Internet services, which, among other things, became the basis for IT consumerisation. The global network of optical fibres extends over 400 million kilometres today

(Sivers, 2021), a significant part of which is at the bottom of the ocean (Cooper, 2022). AT&T and Version took advantage of high bandwidth after the dot-com bubble burst to offer Internet services to consumers. A significant future growth in communication needs was also taken into consideration when laying optical cables, so additional, so-called “dark fibres” were installed, which remain unused and, according to National Geographic, account for approximately 90% of all optical fibres in America (Plouffe, 2017).

2. The course of development of personal computing

As mentioned earlier, in the 1980s, the technological prerequisites were present for IT to expand from the business to the personal sphere. With the advent of gaming computers and general purpose computers, users were able to acquire a higher level of digital literacy from the comfort of their own home. Through the Internet, users had access to information, online communication, social interactions, and entertainment, and the mobile and smart phone enabled access to the digital world while they were on the go. The following paragraph is the overview of personal IT development by decades, highlighting important milestones that shaped personal IT users into what Prensky called “digital natives” (Prensky, 2001).

1. Gaming computers and the declining price of computers. The popularity of computers was greatly influenced by gaming computers. Thus, every-day information technology became accessible to consumers who were not tech-savvy. The leading companies were Apple, Commodore, Tandy and Atari (Press, 2022). Games such as text adventure or role-playing made ordinary users aware they can operate a computer (Taylor, n.d.), and computers were no longer just a tool for business, but also for entertainment. This is illustrated by the Guinness Book of Records listing for Commodore 64 (a gaming computer released in 1982) as the best-selling computer model of all time (about 30 million units sold in 5 years) (Caplan & Lowe).

2. The emergence of the Internet and open architecture led to mass production of personal computers. From 1980 to 1990, computers became mass-produced. In 1981, IBM introduced the IBM PC to the market with the Microsoft MS-DOS operating system. The IBM PC was built on an open architecture, so other manufacturers could manufacture compatible components or even produce complete clones. The possibility offered

was widely accepted. The very next year, Compaq Computer Corporation introduced a computer compatible with IBM PC. PC users outnumbered mainframe users in 1984 as a result of the mass demand for personal computers (Sanger, 1984). As a result of these events, personal computing emerged, which can be summed up by the expression “1 user - 1 computer”.

3. The Internet left the military and academic sphere in 1983, 14 years after its creation, and became available to ordinary users. Basing his estimates on data from the period 1983-2019, Nielsen determined that high-end users’ connection speed grows by 50% per year (Figure 2) (Nielsen, 2019). There has been an increase in Internet connection speeds from 300 bps in the mid-80s to more than 350 Mbps today. Personal devices have become more attractive platforms for communication, entertainment, and multimedia consumption as a result of this growth, which has enabled faster interconnection of users, instant loading and playback of content as well as the development of new applications.

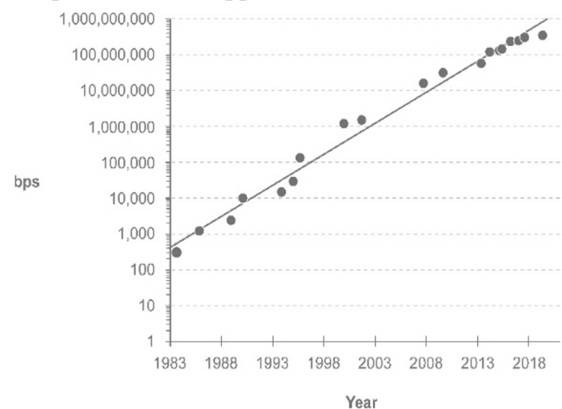


Figure 2 High-end user's connection speed 1983-2018
Source: Nielsen, 2019

4. Graphical user interface made computers easier to use. During the early 1980s, milestones were set in the field of operating systems. The Lisa computer was launched in 1983 by Apple, which introduced a new way to interact with users through graphical user interface (GUI) and graphical icons instead of command lines (Freiberger & Swaine, n.d.). In the following year, Apple introduced the first desktop computer with a screen, mouse, and user interface - Macintosh (Press, 2022). The process of interacting with ICT was simplified and made more intuitive through the use of buttons (icons) rather than complex text commands, thus improving accessibility and interactivity. The GUI also enabled multitasking,

meaning that users could simultaneously perform multiple tasks using multiple work windows. During the 1980s and 1990s, the Microsoft vs Apple saga began (both operating systems were conceptually based on Xerox GUIs) (Dormehl, 2023).

5. WWW. The World Wide Web, a system of links between pages created by users, made the Internet a public medium for communications in 1991 (Freiberger & Swaine, n.d.). With the Mosaic browser, (Science Media Museum, 2020), the Internet became a universal source of information accessible to a large portion of the population thanks to the modest means required to access and create websites. Figure 3 shows the growth of Internet users.



Figure 3 Growth of the Internet from 1995 (millions of users)
Source: adjusted according to Internet World Stats, 2021

The Netscape Navigator browser was released in 1994 (Science Media Museum, 2020) and since then the number of websites has grown exponentially (Armstrong, 2021) (Figure 4). In 1998, when Google was founded, there were about 2.4 million websites, while in 1994, when Yahoo was founded, only 3,000 websites existed; Facebook was launched in 2004 as one of 51.6 million websites, and six years later Instagram was launched with over 200 million. There were 1.83 billion websites in January 2021 (Ahlgren, 2021), and today there are over 1.97 billion.

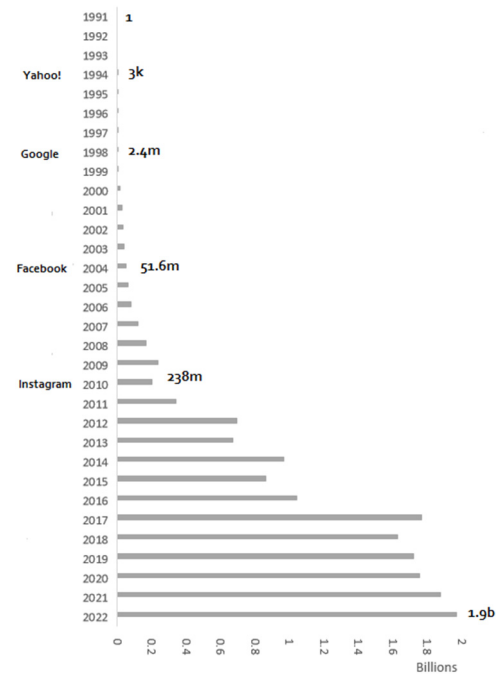


Figure 4 Number of web sites (1995-2022)
Source: Armstrong, 2021

6. The emergence of cloud technology. As personal computing and the Internet have proliferated, the demand for digital storage space (photos, videos, etc.) has risen significantly. The so-called cloud proved to be a good solution for personal storage (Mar, Law, & Chin, 2015). It is easy to use (Iansiti & Richards, 2012), easy to administer (Kiryakova, Angelova, & Yordanova, 2015), and has a low learning curve (Farah, 2010). Therefore, users like the fact that they can securely store their images, videos, documents, etc. and access them from any device they choose. Although cloud is primarily about data storage, it is also about enabling distribution of software as a service (SaaS) that allows users to access various applications via the Internet rather than installing them locally (Bawab, 2014), which will be discussed in detail in the following sections. Apparently, the cloud is also useful for business: it facilitates file sharing and collaboration among colleagues, joint work on files and projects, and access to current information, all without requiring sophisticated technical expertise from the user. Data showing the growth of the cloud use supports some analysts' predictions that personal clouds will replace personal computers in the future (Alamoudi & Alamoudi, 2016) (Figure 5).

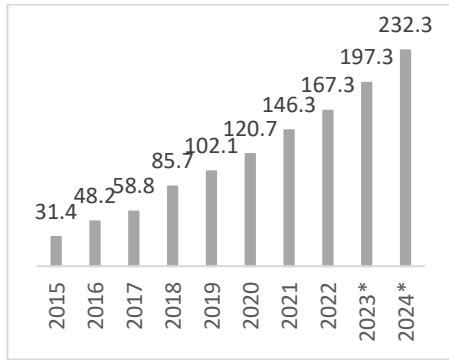


Figure 5 Public Cloud Application Services/Software as a Service (SaaS) Consumption by End Users Worldwide 2015 to 2024 (2023 and 2024 are projections)

Source: Vailshery, 2023

7. Mobile and smart phone market development. The development of mobile devices, especially smartphones, is important for the consumerisation of IT. Having access to these devices enabled users to have a mobile phone and take advantage of advanced technological capabilities and multipurpose functionality which, in addition to making phone calls, also provides: sending texts, taking photos, recording videos, surfing the Internet, listening to music, playing games, etc. Figure 6 shows the growth of mobile subscribers, and Figure 7 shows the number of smartphones sold worldwide.

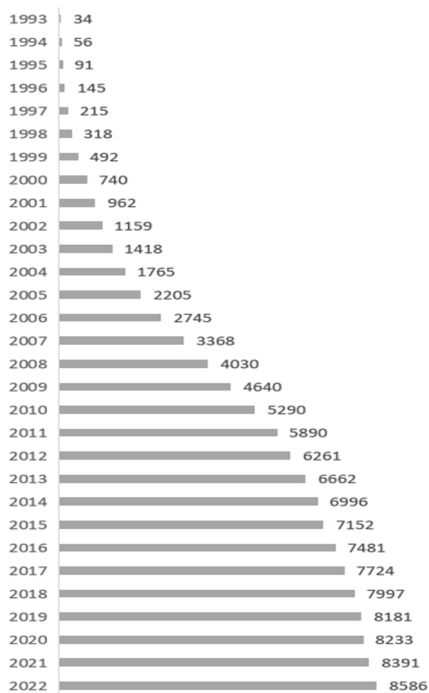


Figure 6 Number of mobile subscriptions worldwide 1993-2022 in millions of units

Source: Petroc, 2023

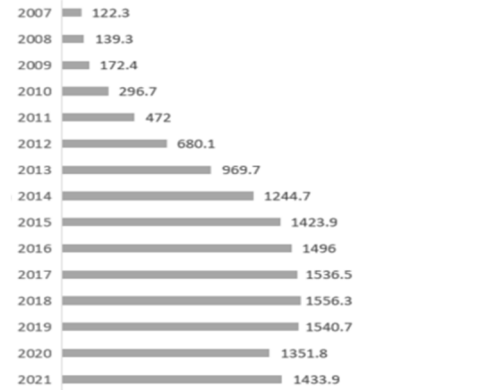


Figure 7 Number of smartphones sold worldwide 2007-2021 in millions of units

Source: Laricchia, 2022

Some kind of milestone devices were Nokia 9210 Communicator, one of the first internet-enabled mobile phone on the market in 2000 and iPhone as one of the first smartphones in 2007. A year later, HTC Dream was released, running Android, today's leading mobile operating system. Telecommunications and ICT services are becoming more affordable worldwide, as on average, mobile service prices are steadily decreasing (Measuring Digital Development: ICT Price Trends 2019), resulting in a rise in mobile users (Figure 8) (Laricchia, 2022). Mobile device prices are declining, as illustrated by the following example: Motorola DynaTAC costing \$3,995 was the first mobile phone to appear on the consumer market in 1983. Mobile phone prices in the USA are more than five times lower in 2023, at \$718, and devices for the consumer market are less expensive than those for corporations (Laricchia, 2023).

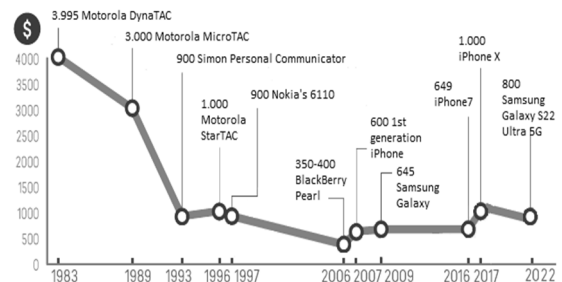


Figure 8. Mobile device prices from 1983 to 2022 in America

Source: adjusted according to Statista, 2021

In the 1990s, users signed long-term contracts for subsidizing the purchase of mobile phones, so the true price of the phone was hidden in the monthly fees, resulting in the decline of the price of mobile phones for the consumer market. As a

result of abandoning this practice and using increasingly expensive parts in the production of phones, in recent years we have seen prices rise once again (Kastrenakes, 2019). Mobile phone makers today are building phones with respectable computational performance while allowing users to stay connected on the go (Lill, 2017). By connecting the phone to a monitor, keyboard, and mouse, some manufacturers have gone further, allowing it to be used as a computer, which could result in fewer laptop sales (Wong, 2019).

Thus, it is not surprising that the sale of PCs has decreased as a result of the increased sales of mobile devices, especially smartphones. Figure 9 shows that mobile, desktop, and tablet have 55.4%, 41.96%, and 2.64% market shares worldwide, respectively, according to StatCounter GlobalStats (StatCounter Globalstat, 2021).

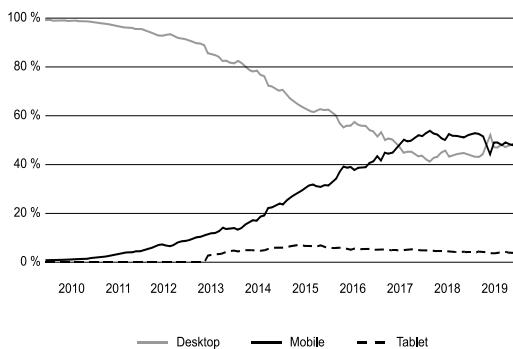


Figure 9 Desktop vs Mobile vs. Tablet Market Share Worldwide

Source: StatCounter Globalstat, 2021

Furthermore, the mobility of these devices has revolutionized the way people use IT in addition to their multipurpose functionality. Furthermore, smartphones have made it easier to download and use numerous applications and social networks, allowing users to customize their devices to suit their specific needs, entertainment, communication, and daily activities. When users become accustomed to user-friendly interfaces, mobility, and practicality that personal IT provides them, they begin to resist business IT that is not like the one they use every day.

8. The development of Web 2.0 and pervasive computing. The miniaturization of hardware, embodied mostly in the proliferation of smartphones and laptops, has contributed to the realization of the idea of pervasive computing, integrating IT into everyday life (Mahadev, 2001), as mentioned in (Sakal & Matković, 2016). Since the 2000s, pervasive computing, a new IT era, has been on the rise, characterized by the use of

interconnected computerized equipment anywhere and at any time (Figure 10).

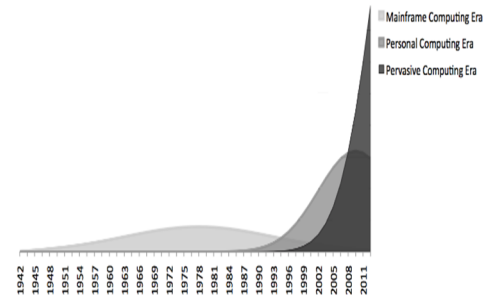


Figure 10 Three eras of computing

Source: Muller, Alt, & Michelis, 2011

The development of Web 2.0 took place a year before the dot-com bubble burst. This term includes various applications and websites such as social networks, blogs, wikis, etc., which allow users not only to consume content, but also to generate and share it online with their devices. Social networks, one of the key factors of IT consumerisation since their creation (Sen, 2012), are rapidly increasing their number of users. Using Facebook as an example (Ortiz-Ospina, 2019), we see that it had 1 million users in 2004, but it had approximately 2.9 billion users by 2021 (Number of monthly active Facebook users worldwide as of 2nd quarter 2021, 2021), which is similar to many other social networks' rapid growth (Ortiz-Ospina, 2019). Using social networks has transformed how people consume content, communicate, get information, and actively participate in the digital world. Following specific groups, brands, and people allows them to adapt the content they are exposed to according to their preferences and needs, thus creating a unique digital identity. Consumption of personalized content is becoming an integral part of everyday life, so personalizing IT is now also necessary in business.

9. Marketing aimed at consumerism and product obsolescence. Technological progress has enabled a large number of users to improve their digital literacy, but marketing, consumerism, and product obsolescence also need to be discussed. As consumerism has heavily influenced new generations, they attach importance to trying new products and following trends, so they apply the same behaviour to IT. Marketing creates a perception of value, thus creating a need for a technological product. Apart from advertisements that aim to trigger people's status consciousness, the consumerisation of IT is also fuelled by functional and psychological product obsolescence

to manipulate consumption. This is demonstrated in the market by designing inferior items that are quickly worn out, discarded and replaced at an increasing rate, which creates a need for new items to be owned. Consumerist culture is also promoted that encourages status consciousness and the need to own the latest product, even if the old one is still functional. Since 2000, this trend of faster consumption and obsolescence of products has been relevant in the field of ICT. For example, Apple launched 3 new phones on the market in 2016, while Samsung launched 31 products (Peng, 2019).

10. Workforce evolution and changing IT needs in the workplace. Due to lower hardware prices and the proliferation of mobile applications and social media that users heavily utilize in their private lives via wireless and broadband networks (Sadiku, Foreman, & Musa, 2018), their ability to master systems of comparable complexity to those in companies has increased (Köffer, Ortbach, Junglas, Niehaves, & Harris, 2015). “Digital natives” are a new generation of users (Mallmann, Vargas, Carlos, & Maçada, 2019), whose expectations and work practices have changed significantly (Petrović, 2022) compared with previous generations, the so-called “digital immigrants” (Gregory, Kaganer, Henfridsson, & Ruch, 2018). They have advanced collaboration skills (Sakal, Raković, Seres, & Vuković, 2019), a habit of being constantly connected through social networks (Weiß & Lei, 2012) and a desire to work remotely (Köffer, Ortbach, & Björn, 2014). According to some research, 68% of millennials are more likely to be interested in an employer if the possibility of working remotely is offered (Wong, 2019). The new generation (Millennials and Generation Z) employees expect to use their own devices and applications, and if companies do not cater to their requests, they will not hesitate to use them despite the bans, if it facilitates or speeds up their work. The research shows that 80% of workers use SaaS applications at work without IT department approval, and 67% of teams introduce their own collaboration tools (Scott, 2020). Moreover, new generation employees want to be flexible, not tied to the place of employment, and want IT services to be upgraded so they can be constantly accessible on their private mobile devices (Sakal, Raković, Seres, & Vuković, 2019) and have the possibility of a compressed work week and flexible working hours (Kim, 2018). They have different definitions of success and an outward-looking perspective in which they interact

with a wide network of communities outside the company they work for (Brack & Kip, 2012). It is extremely important for them to have autonomy in their work arrangements (Kim, 2018), to have an opportunity to grow and earn more (Mayerova & Hyžova, 2020) and to have interesting work tasks (Mastrolia & Willits, 2013).

3. Intersection of development streams of business and personal technology

Figure 11 represents two parallel streams of business and personal computing development since the 1940s. The direction of IT flow from one stream of computing to another is indicated by arrows.

Since the late 1970s and early 1980s, personal computing had evolved as a separate stream of technological development from business computing. Thereafter came the mass production and sale of gaming computers, personal computers and compatible devices, which intensified after the dot-com bubble burst and the massive reorientation of IT companies towards consumers. In the 1990s, companies began developing GUIs to facilitate user interaction with computers, and at the same time, the Internet, Web 2.0, developed, and cloud computing was born which facilitated and accelerated the mass adoption of computer technology. Increasing numbers of people were using computers every day to communicate and share data, images, and videos over the Internet. During the development of technology, the price of computers and compatible devices decreased, which made them even more accessible to the masses. During the same period, computers also became more reliable, fast, and efficient, and as the generation passed, they became smaller and smaller, until they became palm-sized devices. Interaction via UI became by default intuitive, easy, fun, enabling personalized and mobile access to digital content (Figure 12). Business IT was subjected to similar demands. Business IT, however, differs from what is expected: users' experience was not its primary concern, but rather cost-effective business process support. Despite the rapid development of computing devices in the consumer market, the pace of development of business computers did not keep pace, resulting in workplaces using devices/software with model/version numbers lower than the ones of personal devices.

Consequently, between 2000 and 2010, users started bringing their own devices into the

workplace and using them for business purposes, or asked companies to let them use better devices. Companies had different reactions to this influx of personal IT into the business domain. Some companies implemented a “wait and see” strategy, completely ignoring the consumerisation of IT happening to them. Other companies recognized the importance of customizing business IT to new generations of employees and enabling them to use their own devices (Yevseyeva et al., 2014), (Managing IT Consumerization, 2014) through BYOD (Bring Your Own Device) programs or through financing the purchase of desired devices (D’Arcy, 2011). They thus found themselves in a “consumerisation catch” in which they were compelled to deal with employees’ demands for new IT in the workplace or employees will inevitably use their own devices (Petrović, 2022). The companies that refused to meet these employees’ demands were either abandoned or employees found a way to use their own devices. Therefore, the consumerization of IT has redefined employee-company relationships (Niehaves, Köffer, & Ortbach, 2012) fundamentally

transforming how IT is managed as employees now decide on business IT (Petrović, 2022).

Supporting the use of personal devices for business purposes can provide companies with some advantages, such as: reducing costs, improving processes, increasing flexibility, productivity and innovation of employees, their greater independence and satisfaction, better cooperation between employees and better connections with clients and business partners. In refusing to support it, companies risk making new generations unwilling to work for them and receiving a bad reputation. On the other hand, by accepting the consumerisation of IT, a company also accepts potential risks, such as: employee privacy issues, data security concerns, inconsistent business processes, more complex system due to the large number of heterogeneous devices it must support, etc. (Petrović, 2022). In order to select the optimal strategy, it is essential to comprehend the chances and threats as well as the reasons behind employees' desire to work from their own devices, as partially illustrated in this paper.

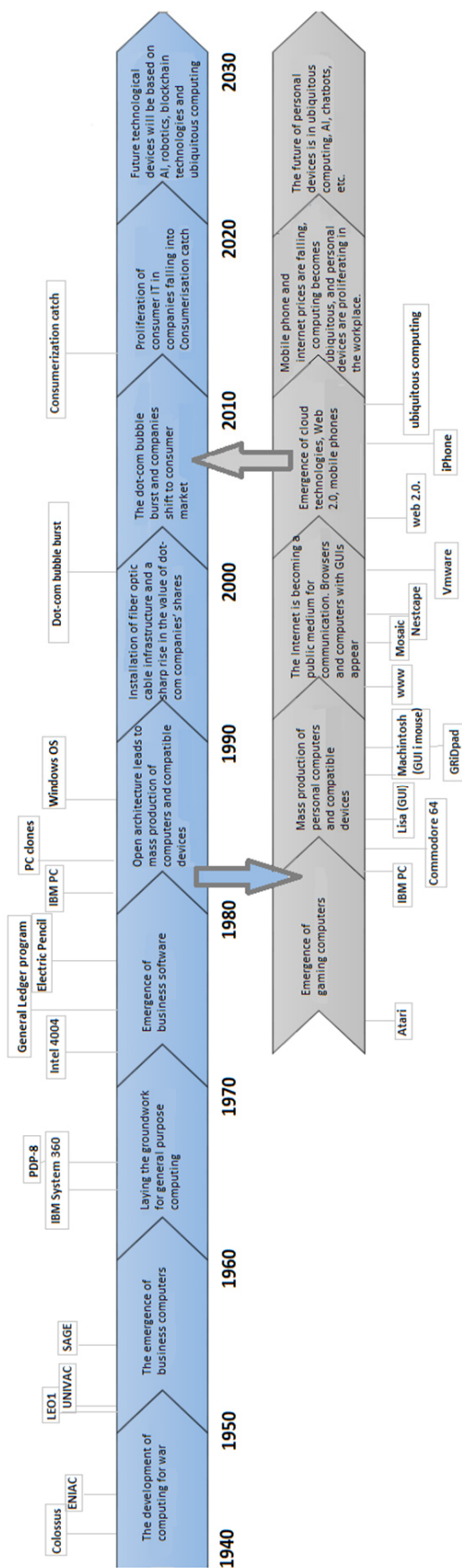


Figure 11 Flows of development of business and personal computing

Source: the authors

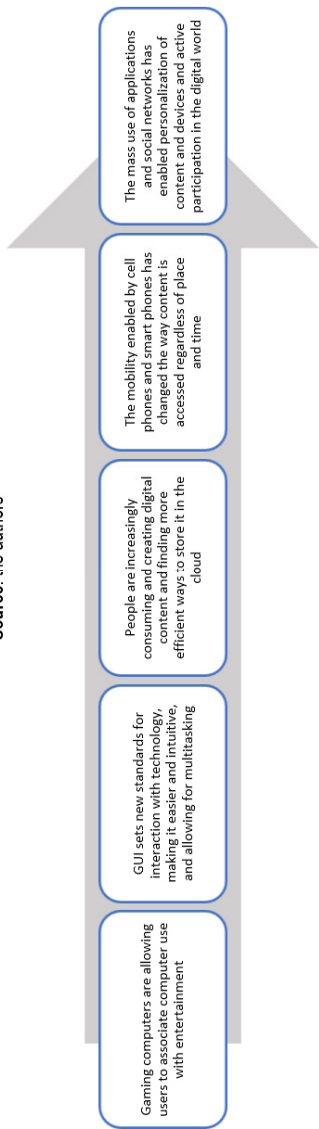


Figure 12 The evolution of the user experience of technology

Source: the authors

Several market and technological factors have contributed to the consumerisation of IT. The development of personal IT as a spin-out from business IT took place in parallel, until personal IT began to flow into the business world. Their historical development background is helpful not only for identifying the factors that led to the emergence of IT consumerism, but also for identifying what users expect from future technological solutions, based on their criticism of current IT systems in businesses. IT consumption in the future will be shaped by ubiquitous computing, faster IT development, as well as the continued growth and complexity of consumer needs for greater mobility and personalization of IT devices and applications. There is a realistic expectation that the further development of both personal and business IT will accelerate exponentially in the near future and make technologies like Web 3.0, Internet of Things, artificial intelligence, machine learning, blockchain, mass automation and robotization a common, everyday occurrence (Freiberger & Swaine, n.d.), (Ebling, 2016), (Nishitha, 2019). The above factors will, naturally, affect how the human factor implements work: staff augmentation and freelancing are also experiencing a certain increase. Research on the freelance market – Fiverr and Upwork (Payset Perspective, 2022) shows that over 80% of medium and large business owners surveyed rely on freelancers and that 56% of respondents who are not freelancers will become so in the future. Statista confirms these findings, predicting 16 million more such workers in America by 2027 (Payset Perspective, 2022). Remote employees and freelancers are the driving force for the consumerisation of IT, i.e. the adoption of BYOD policies (NordLayer, 2023). Therefore, companies will need to empower their employees, giving them the ability to make use of their own devices, which they will provide adequately (Novitović, n.d.), bringing them financial and operational benefits (Adlum, 2023).

References

- Adlum, G. (2023, 4 25). Transforming government IT: the rise of BYOD in the public sector. Retrieved July 11, 2023, from <https://thinscale.com/transforming-government-it-byod-public-sector/>
- Ahlgren, M. (2021, Jun 7). 100+ Internet statistics and facts for 2021. Retrieved June 25, 2021, from Websitehostingrating.com: <https://www.websitehostingrating.com/internet-statistics-facts/>
- Alamoudi, Y., & Alamoudi, W. (2016). Cloud computing - the future of business. *Journal of Information Systems Technology & Planning*, 8(19), 41-60.
- Alfredo, D. (2017, 09 26). The history of computers in business. Retrieved May 08, 2022, from bizfluent: <https://bizfluent.com/about-5299598-history-computers-business.html>
- Armstrong, M. (2021, August 6). How many websites are there? Retrieved June 22, 2023, from Statista: <https://www.statista.com/chart/19058/how-many-websites-are-there/>
- Bawab, H. (2014). The evolution of business computing: two trends every company should embrace. Retrieved May 08, 2022, from: <https://www.linkedin.com/pulse/20140422064201-14091619-the-evolution-of-business-computing-two-trends-every-company-should-embrace/>
- Bigelow, S. J. (2021). What is edge computing? Everything you need to know. Retrieved June 5, 2023, from: <https://www.techtarget.com/searchdatacenter/definition/edge-computing>
- Brack, J., & Kip, K. (2012). *Maximising Millennials in the workplace*. Retrieved June 5, 2023, from: <https://www.voced.edu.au/content/ngv%3A73256>
- Caplan, J., & Lowe, B. (n.d.). Most influential gadgets and gizmos - 1982: COMMODORE 64. Retrieved May 19, 2022, from: http://content.time.com/time/specials/2007/article/0,28804,1638782_1638778_1638764,00.html
- Cooper, T. (2022). Fiber-optic internet in the united states. Retrieved May 19, 2022, from: <https://broadbandnow.com/Fiber>
- Craviero, R. (n.d.). The history of operating systems. Retrieved June 28, 2023 from: <https://www.sutori.com/en/story/the-history-of-operating-systems--751ipFKEkLteiEXiGxe7XVhu>
- Dormehl, L. (2023). Today in Apple history: Microsoft gets sued for ripping off Mac OS. Retrieved June 28, 2023 from: <https://www.cultofmac.com/470399/today-in-apple-history-microsoft-sued-ripping-off-mac-os/>
- D'Arcy, P. (2011). *The Future of Enterprise Mobile Computing*. Dell.
- Ebling, M. R. (2016). Pervasive computing and the Internet of Things. *IEEE Pervasive Computing*, 15(1), 2-4. <https://doi.org/10.1109/MPRV.2016.7>
- Evren. (2022). The evolution of operating systems: from enterprising OS to OS for enterprises. Retrieved June 28, 2023 from: <https://www.evren.co/blog/the-evolution-of-operating-systems-from-enterprising-os-to-os-for-enterprises>
- Farah, S. (2010). Cloud computing or software as a service- which makes the most sense for HR? . *Employment Relations Today*, 36(4), 31–37. <https://doi.org/10.1002/ert.20271>
- Fiberplus. (2019). A brief history of fiber optic cables. Retrieved May 19, 2022, from: <https://www.fiberplusinc.com/helpful-information/a-brief-history-of-fiber-optic-cables/>
- Freiberger, P. A., & Swaine, M. R. (n.d.). *Britannica*. Retrieved 05 08, 2022, from: <https://www.britannica.com/technology/computer/Early-business-machines>

- Fruhlinger, J. (2018). *Taking the plunge: Enterprise IT firsts over the decades*. Retrieved May 08, 2022, from Hewlett Packard Enterprise: <https://www.hpe.com/us/en/insights/articles/taking-the-plunge-enterprise-it-firsts-over-the-decades-1801.html>
- Geier, B. (2015). What did we learn from the dotcom stock bubble of 2000? Retrieved May 19, 2022, from: <https://time.com/3741681/2000-dotcom-stock-bust/>
- Gregory, R. W., Kaganer, E., Henfridsson, O., & Ruch, T. J. (2018). IT Consumerization and the transformation of IT governance. *MIS Quarterly* 42(4), 1225-1253.
- Iansiti, M., & Richards, G. (2012). A study of economic impact of cloud computing. *International Journal of Technology, Policy and Management*, 12(4), 344. <https://doi.org/10.2139/ssrn.1875893>
- IC Insights. (2020, March 5). Transistor count trends continue to track with Moore's law. Retrieved July 5, 2021, from IC Insights: <https://www.icinsights.com/news/bulletins/Transistor-Count-Trends-Continue-To-Track-With-Moores-Law/>
- Internet World Stats. (2021, July 3). *Internet Growth Statistics*. Retrieved July 25, 2021, from Internet World Stats: <https://www.internetworldstats.com/emarketing.htm>
- Jayachander, S., & Chunming, R. (2019). Cloud computing: history and overview. *2019 IEEE Cloud Summit* (pp. 1-7). Washington, DC, USA: IEEE. <https://doi.org/10.1109/CloudSummit47114.2019.00007>
- Kastrenakes, J. (2019). *How phones went from \$200 to \$2,000*. Retrieved May 20, 2022, from: <https://www.theverge.com/2019/3/18/18263584/why-phones-are-so-expensive-price-apple-samsung-google>
- Kim, S. (2018). Managing millennials' personal use of technology at work. *Business Horizons*, 61, 261-270. <https://doi.org/10.1016/j.bushor.2017.11.007>
- Kiryakova, G., Angelova, N., & Yordanova, L. (2015). Application of cloud computing services in business. *Trakia Journal of Sciences*, 13(1), 392-396. <https://doi.org/10.15547/tjs.2015.s.01.067>
- Köffer, S., Ortbach, K., & Björn, & N. (2014). Exploring the Relationship between IT consumerization and job performance: a theoretical framework for future research. *Communications of the Association for Information Systems*, 35(14). <https://doi.org/10.17705/1CAIS.03514>
- Köffer, S., Ortbach, K., Junglas, I., Niehaves, B., & Harris, J. (2015). Innovation through BYOD? The influence of IT consumerization on individual IT innovation behavior. *Bus Inf Syst Eng*. <https://doi.org/10.1007/s12599-015-0387-z>
- Laricchia, F. (2022, October 18). *Number of smartphones sold to end users worldwide from 2007 to 2021*. Retrieved June 21, 2023, from Statista: <https://www.statista.com/statistics/263437/global-smartphone-sales-to-end-users-since-2007/>
- Laricchia, F. (2023). *Average price of smartphones in the United States from 2013 to 2027, by segment*. Retrieved June 1, 2023, from: <https://www.statista.com/statistics/619830/smartphone-average-price-in-the-us/>
- Lill, D. (2017). From desktop to mobile: the great big user behaviour shift. Retrieved May 20, 2022, from: <https://www.talk-business.co.uk/2017/05/15/desktop-mobile-great-big-user-behaviour-shift/>
- Mahadev, S. (2001, August). Pervasive computing: vision and challenges. *IEEE Personal Communications*, 8(4), 10-17. <https://doi.org/10.1109/98.943998>
- Mallmann, G.L., de Vargas Pinto, A., Maçada, A.C.G. (2019). Shedding Light on Shadow IT: Definition, Related Concepts, and Consequences. In: Ramos, I., Quaresma, R., Silva, P., Oliveira, T. (eds) *Information Systems for Industry 4.0. Lecture Notes in Information Systems and Organisation*, vol 31. (pp. 63-79) Springer, Cham. https://doi.org/10.1007/978-3-030-14850-8_5
- Managing IT Consumerization. (2014). Retrieved September 28, 2021, from: https://www.accenture.com/t20150623t023254_w_ro/en/acnmedia/accenture/conversion-assets/dotcom/documents/global/pdf/technology_5/accenture-managing-it-consumerization.pdf
- Mar, K., Law, C., & Chin, V. (2015). Secure personal cloud storage. *10th International Conference for Internet Technology and Secured Transactions (ICITST)* (pp. 108-113). London, United Kingdom: IEEE. <https://doi.org/10.1109/ICITST.2015.7412068>
- Mastrolia, S. A., & Willits, S. D. (2013). Millennials: what do we really know about them? *Advances in Accounting Education: Teaching and Curriculum Innovations*, 14, 45-72. [https://doi.org/10.1108/S1085-4622\(2013\)0000014009](https://doi.org/10.1108/S1085-4622(2013)0000014009)
- Mayerova, K., & Hyžová, S. (2020). Employment of generation Y, Z in the labor market in the conditions of the Industry 4.0 concept. *SOCIÁLNO-EKONOMICKÁ REVUE*, 2, 38-44.
- McCullough, B. (2018, December 14). A revealing look at the dot-com bubble of 2000 — and how it shapes our lives today. Retrieved April 10, 2021, from Ideas.Ted.Com: <https://ideas.ted.com/an-eye-opening-look-at-the-dot-com-bubble-of-2000-and-how-it-shapes-our-lives-today/>
- Moore, G. E. (1965). Cramming more components onto integrated circuits. *Electronics*, 38(8).
- Motorola Mobility LLC. (2023). Ready For assistant. Retrieved June 28, 2023 from: <https://www.motorola.com/rs/rs/ready-for>
- Müller, J., Alt, F., Michelis, D. (2011). Pervasive Advertising. In: Müller, J., Alt, F., Michelis, D. (eds) *Pervasive Advertising. Human-Computer Interaction Series* (pp. 1-29). London: Springer. https://doi.org/10.1007/978-0-85729-352-7_1
- Niehaves, B., Köffer, S., & Ortbach, K. (2012). *IT Consumerization – a theory and practice review*. *AMCIS 2012 Proceedings*. Retrieved May 19, 2022 from: <http://aisel.aisnet.org/amcis2012/proceedings/EndUser/S/18>
- Nielsen, J. (2019, September 27). *Nielsen's Law of Internet Bandwidth*. Retrieved July 12, 2021, from Nielsen Norman Group: <https://www.nngroup.com/articles/law-of-bandwidth/>
- Nishitha. (2019). *The future of business computers*. Retrieved May 20, 2022, from: <https://wittysparks.com/business-computers-future-technology/>
- NordLayer. (2023, 3 16). *Enabling all ways of working with BYOD*. Retrieved July 10, 2023, from: <https://nordlayer.com/blog/enabling-all-ways-of-working-with-byod/>

- Novitović, Ž. (n.d.). *When business gets personal – Microsoft 365 Business & BYOD*. Retrieved July 10, 2023, from: <https://comtradeintegration.com/en/when-business-gets-personal-microsoft-365-business-byod/>
- Number of monthly active Facebook users worldwide as of 2nd quarter 2021. (2021). Retrieved May 20, 2022, from Statista: <https://www.statista.com>
- OSdata.com. (2010). *History of operating systems - 1950s*. Retrieved June 28, 2023 from: <https://www.osdata.com/kind/history.htm>
- Ortiz-Ospina, E. (2019). *Our world in data*. Retrieved July 10, 2023, from: <https://ourworldindata.org/rise-of-social-media>
- Payset Perspective. (2022). Majority of companies now rely on freelancers, Fiverr says. Retrieved July 11, 2023, from: <https://www.payset.io/post/majority-of-companies-now-rely-on-freelancers-fiverr-says>
- Peng, D. (2019). *Cell phone cost comparison timeline*. Retrieved May 20, 2022, from: <https://www.ooma.com/home-phone/cell-phone-cost-comparison/>
- Petroc, T. (2023, June 1). Number of mobile (cellular) subscriptions worldwide from 1993 to 2019. Retrieved June 21, 2023, from Statista: <https://www.statista.com/statistics/262950/global-mobile-subscriptions-since-1993/>
- Petrović, M. (2022). Positive and negative sides of IT consumerization from the company's point of view. *27th International Scientific Conference Strategic Management and Decision Support Systems in Strategic Management* (pp. 470-477). Subotica: Faculty of Economics in Subotica. https://doi.org/10.46541/978-86-7233-406-7_235
- Plouffe, J. (2017). *A brief history of fiber optic communication*. Retrieved May 19, 2022, from: <https://www.lightmyfiber.com/a-brief-history-of-fiber-optic-communication/>
- Prensky, M. (2001). Digital natives, digital immigrants. *On the Horizon*, 9(5), 1-6. <https://doi.org/10.1108/10748120110424816>
- Press, G. (2022, 04 26). *Modern computing: a short history, 1945-2022*. Retrieved May 08, 2022, from Forbes: <https://www.forbes.com/sites/gilpress/2022/04/26/modern-computing-a-short-history-1945-2022/?sh=411db73f4332>
- Rakovec, G. (2018, 09 20). *Tajne Industrije 4.0 u pojedinačnoj proizvodnji*. Retrieved May 08, 2022, from: <https://www.industrija.rs/vesti/clanak/tajne-industrije-4.0-u-pojedinacnoj-proizvodnji>
- Rotman, D. (2020, February 24). *We're not prepared for the end of Moore's Law*. Retrieved July 5, 2021, from Technology Review: <https://www.technologyreview.com/2020/02/24/905789/were-not-prepared-for-the-end-of-moores-law/>
- Sadiku, M., Foreman, J., & Musa, S. (2018). IT Consumerization. *International Journal of Engineering Technologies and Management Research*, 5 (9), 70-73. <https://doi.org/10.29121/ijetmr.v5.i9.2018.290>
- Sakal, M., & Matković, P. (2016). Društveni mediji u bankarstvu. In I. Domazet, V. Dedić, & G. Đorđević (Eds.), *Kanali distribucije u savremenom bankarstvu* (pp. 95-136). Beograd: Institut ekonomskih nauka.
- Sakal, M., Raković, L., Seres, L., & Vuković, V. (2019). Prihvatanje potrošnje IT - Dizajn programa kurikuluma poslovne informatike. *EDULEARN19 Proceedings* (pp. 9680-9685). IATED Academy.
- Sanger, D. E. (1984). Bailing out of the mainframe industry. Retrieved May 20, 2022, from: <https://www.nytimes.com/1984/02/05/business/bailing-out-of-the-mainframe-industry.html>
- A Short history of the internet. (2020). *Science Media Museum..* Retrieved October 13, 2021, from: <https://www.scienceandmediamuseum.org.uk/objects-and-stories/short-history-internet>
- Scott, J. (2020). *21 Shadow IT management statistics you need to know*. Retrieved January 28, 2022, from: <https://track.g2.com/resources/shadow-it-statistics>
- SecuritySee. (2018, 06 14). *Industrija 4.0: dolazak na srpsko tržište*. Retrieved May 08, 2022, from: <https://www.securitysee.com/2018/06/industrija-4-0-dolazak-na-srpsko-trziste/>
- Sen, P. K. (2012). *Consumerization of Information Technology Drivers, Benefits and Challenges for New Zealand Corporates*. Retrieved May 20, 2022, from: https://openaccess.wgtn.ac.nz/articles/thesis/Consumerization_of_Information_Technology_Drivers_Benefits_and_Challenges_for_New_Zealand_Corporates/1699367_5
- Shalf, J. (2020). The future of computing beyond Moore's Law. *Philosophical Transactions of The Royal Society A Mathematical Physical and Engineering Sciences* 378(2166). <https://doi.org/10.1098/rsta.2019.0061>
- Sivers, M. V. (2021). *A brief history of optical communication*. Retrieved May 19, 2022, from: <https://hackaday.com/2021/02/18/a-brief-history-of-optical-communication/>
- Stanojević, B. (2016). *Industrija 4.0 i budućnost*. Retrieved May 08, 2022, from: <https://pcpress.rs/industrija-4-0-i-buducnost/>
- StatCounter Globalstat. (2021). *Desktop vs Mobile vs Tablet Market Share Worldwide, Jan 2009-Jun 2019*. Retrieved July 5, 2021, from StatCounter Globalstat: <https://gs.statcounter.com/platform-market-share/desktop-mobile-tablet/worldwide/#monthly-200901-201906>
- Statista. (2021). Global average selling price (ASP) of smartphones from 2016 to 2021 (in U.S. dollars) . Retrieved May 19, 2022, from: <https://www.statista.com/statistics/788557/global-average-selling-price-smartphones/>
- Taylor, G. (n.d.). *Computers changed history*. Retrieved May 08, 2022, from: <https://www.bookyourdata.com/email-list-database/computers-changed-history>
- Uperfect. (2022, 6 29). *Does Huawei have a DeX mode?* Retrieved June 28, 2023 from: <https://www.uperfectmonitor.com/blogs/lapdock/does-huawei-have-a-dex-mode>
- TechTarget contributor. (2012). *Intel 4004*. Retrieved May 20, 2022, from: <https://www.techtarget.com/whatis/definition/Intel-4004>
- Vailshery, L. S. (2023). *Global public cloud application services (SaaS) market size 2015-2024* . Retrieved June 4, 2023, from: <https://www.statista.com/statistics/505243/worldwide-software-as-a-service-revenue/>

Weiβ, F., & Lei, J. (2012). IT Innovations from the consumer market as a challenge for corporate IT. *Business & Information Systems Engineering*, 6. <https://doi.org/10.1007/s12599-012-0234-4>

Wong, J. (2019). *The future of desktop computing is mobile-powered*. Retrieved May 20, 2022, from: <https://insights.samsung.com/2019/02/21/future-of-desktop-computing-is-mobile/>

Yevseyeva, I., Morisset, C., Turland, J., Coventry, L., Groß, T., Laing, C., & Moorsel, A. V. (2014). Consumerisation of IT: mitigating risky user actions and improving productivity with nudging. *Procedia Technology* 16, 508-517. <https://doi.org/10.1016/j.protcy.2014.10.118>

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