The social impact of digitalization and gamification the field of transport

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Introduction

In the last decades, new technologies, especially in the digital field, gave us the opportunity to better fight modern challenges such as the climate change. The potential of new technologies to decrease the carbon footprint is significant, but the transition is highly dependent on people's choices and behaviour. This is why, a new way of motivating people around the world emerged: gamification. But, as good and innovative this idea seems to be, as many concerns it rises. Because the focus is mainly on technology, this course will focus on the process of gamification in the transportation sector and its possible social impact.

This course will tackle the issue of gamification in the transportation field, focusing on the social impact of digitalization and gamification. Thereby, I will start by defining digital transformation as being a game changer in various social and economic areas such as businesses, governing models, education or transport. Then, in the second chapter, I will bring into discussion the digitalization's impact on transportation sector by presenting the cases of freight transport and passenger transportation. The third chapter is dedicated to gamification as a tool of the digitalization process. Gamification is describing those features of an interactive system that aim to motivate and engage end-users through the use of game elements and mechanics. In the last chapter, I will focus on she social implication of the spreading of digitalization and gamification in the transportation field, by exploring the concept of digital divide.

The digital transformation

'*Like air and drinking water, being digital will be noticed only by its absence, not its presence*.' Nicholas Negroponte

Digital technologies had largely developed in the last two decades, being a game changer in various social and economic areas such as businesses, governing models, education or transport. Michel

Noussan, Manfred Hafner and Simone Tagliapietra are stating that the availability of huge computational power and vast amount of data gathered from different sources leads to the deployment of new services for the customers. As a consequence, a large part of the population worldwide is connected to the internet, and an increasing share of traffic is related to mobile connections (Noussan, Hafner and Tagliapietra 2020).

All these transformations are considered by authors like Ceren Salkin, Mahir Oner, Alp Ustundag and Emre Cevikcan as being part of the fourth Industrial Revolution, or the "Industry 4.0". They are considering that since first Industrial Revolution that took place after the emergence of steam engine, the radical changes that followed were: digital machines, automated manufacturing environment, and caused significant effects on productivity. The main reasons of the radical changes were the individualization of demand, the resource efficiency and the short product development periods. In this context, enormous developments such as Web 2.0, Apps, Smartphones, laptops, 3D-printers appeared and this situation creates a big potential in the development of economies (Salkin, Oner, Ustundag and Cevikcan 2018, 4). The potential impact of these new technologies (Industry 4.0) and the necessity to implement them in economy, made the German government to declare them during Hannover Fair in 2011 as the beginning of the 4th industrial revolution.

The evolution towards Industry 4.0 can be seen in the Figure 1:

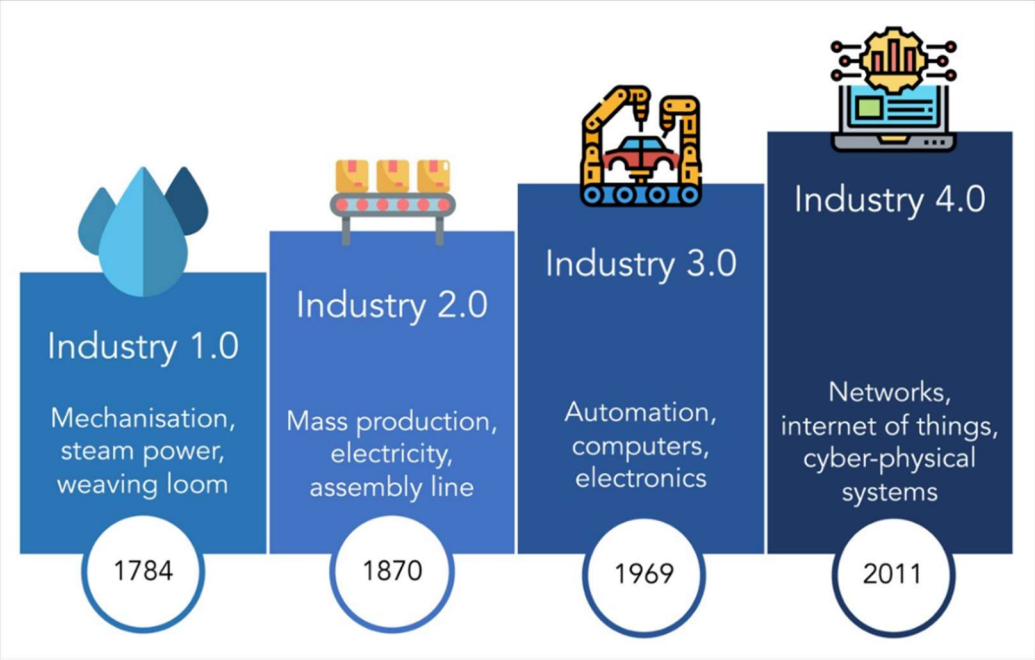

Figure 1 (Palfreyman 2020)

According to John Palfreyman, “the fourth industrial revolution (or Industry 4.0) drives organisational efficiencies through the seamless integration of digital technologies with business processes and people” (Palfreyman 2020). The impact of Industry 4.0 is still challenging both manufacturing and service organisations and is likely to continue to do so in the coming future.
Following John Palfreyman, there are three concepts at the heart of Industry 4.0:

- Ubiquitous connectivity through the availability of high-speed networking.
- The internet of things, connecting small embedded devices together which are usually sensors, actuators or a combination of the two.
- Cyber-physical systems[1] which bring together modern digital technology with physical systems and processes (Palfreyman 2020).

As one can see, digital transformation could lead to fundamental rethinking and radical redesign of different systems and processes in terms of businesses, public services, communication or management. Following Sumit Chakraborty the main objectives of digital transformation are:

- improved quality of service (QoS);
- fast and correct transaction processing;
- efficient management of resources;
- fast decision making in adaptive situation;
- improved accuracy in decision making (e.g. intelligent scheduling, coordination);
- discovery of hidden intelligence from large pool of data;
- supporting knowledge creation, storage, transfer and application in an enterprise;
- supporting office automation and workflow control;
- effective asset management, cost control, revenue management, strategic pricing and supply chain management and corporate social responsibilities (Chakraborty 2014, 5).

But besides the general objectives that I mentioned above, there are also important constrains for the digital transformation:

- time;
- cost;
- resources;

[1] Cyber-physical systems are physical and engineered systems whose operations are monitored, controlled and coordinated, and integrated by a computing and communicating core (Palfreyman 2020).

- skill;
- regulatory compliance;
- capacity;
- old and obsolete technology;
- malicious and irrational business practice;
- policy paralysis and administrative failure (Chakraborty 2014, 5).

Digitalization of transportation system

Transport services are also deeply changed by the Industry 4.0 generating in a way that can improve the overall quality and efficiency. Urban citizens in different parts of the world can now access shared fleets of cars, bikes, and scooters through their smartphone, or they can just opt for a driver to pick them up to their desired destination. The users can compare in real time different mobility options and find the most cheap, fast or comfortable solution for a given trip, based on live data on the traffic conditions. Mobility is increasingly being seen as a service, and the traditional model centred on private cars is being challenged by the possibility of paying for the actual mobility needs rather than owning a personal vehicle, with potential advantages for cost and convenience. Furthermore, the future deployment of connected and shared automated vehicles may completely change the way people move (Noussan, Hafner and Tagliapietra 2020).
In order to provide a broad perspective on the digitalization of this economic sector, both freight transport and passenger transportation should be considered.

Freight transport

Freight transport provided the physical link between manufacturing and distribution to consumers. If the transportation industries would have never used computer and telecommunications technologies as other industries did, the efficiencies noted in previous chapters could not have occurred, nor could the raft of changes in the relationships between retailers and manufacturers that had developed by the end of the twentieth century. This industry developed faster by using computers, telecommunications, and embedded digital processors (chips) in a wide variety of machines and other objects. The ability of information systems to transmit data among themselves

and with employees became just as much a revolutionary transformation in transportation as in manufacturing and retailing (Cortada 2004, 228).

Today, the main ways to move goods are: by trains, trucks, airplanes and ships and barges. In the last decades, railroad and trucking industry were undergoing the deepest transformation as it follows:

Table 1

Type of service	**Digital transformation features**
Railroad Industry	- It was one of the first industries in the private sector to use punch-card equipment, and it became [232] a major customer for almost every type of adding and calculating machine available in the twentieth century; - Railroads continued to adopt new applications and technologies slowly. This became obvious whenever a railroad company had to link its IT applications to those in other industries; - The decline in the number of employees riding on a train also drove down operating costs, and the use of sensors and other technologies improved the quality of planned and unplanned maintenance; - Only the locomotive looked essentially the same; however, it had changed into a far more powerful machine, loaded with analog sensors and digitally based applications that

	monitored everything, from oil pressure to how fast the train should go, and communicated with dispatchers through satellites, GPS, and other digital systems;
Trucking Industry	- Trucking Industry embraced computing and other technological innovations when they made economic sense in support of improved productivity or because manufacturers and retailers forced the industry to integrate into their own systems, such as JIT[2] processes; - Trucking firms, working with warehousing and manufacturers, had to increase the number of replenishing runs to provide retailers with JIT services, often forcing truckers to supply their customers with partial loads; - This practice drove up their expenses, motivating them to find other ways to contain costs of operations; - Lean retailing practices dramatically increased the number of short loads; - Many truckers were forced to, first, invest massively in new applications of the digital and telecommunications

[2] JIT – Just in Time.

	and second, go into the business of logistics; - Logistics were included the use of information with which to move freight to the right place, at the right time, and at the right cost; - Customers shifted responsibility for doing all three to the Trucking Industry or to firms that specialized in managing logistics. That transfer of work made it possible for customers to have on hand less inventory and smaller or fewer warehouses and to reduce cycle time from order to payment; - Trucking firms have applications in the following areas: telecommunications, computerized scheduling and freight tracking, navigation and positioning systems to know where vehicles and packages were at all times, and even sensing and tagging; - Telecommunications involved the use of satellite services, cellular phones, and optic technologies.

(Cortada 2004, 231-249)

Passenger transportation

In the field of passenger transportation there is a new concept known as Mobility-as-a-Service (MaaS). MaaS is based on the expansion of the digital platforms and aims to support users

choosing multimodal trips and getting the most from the opportunities provided by each mode to fulfill specific requirements. The implementation of an effective MaaS platform, which is starting to be tested in different cities worldwide, requires as backbone an efficient public transport system, on which alternative modes could be integrated, including shared mobility, taxi cabs, and active modes. MaaS can be developed at different levels, from a basic system that help the users to compare the available travel possibilities, to a totally integrated environment where the customers can buy each travel solution through a single account, or even pay flat rates to have access to an unlimited number of trips over a certain time period (Noussan, Hafner and Tagliapietra 2020).

Shared Mobility—Sharing Assets or Trips?

The concept of shared mobility embraces a large variety of technologies and mobility models, from car sharing, bike sharing, and other shared vehicles (e.g., electric scooters) to ride-hailing and carpooling, which in turn involves the sharing of the very same trip by multiple users. These models have a different diffusion in world regions, depending also on existing contexts and specific problems (such as population density, income levels, pollution, and congestion levels etc.). However, they are generally appearing in urban contexts, especially in large cities where the high density of inhabitants allows a more interesting economic profitability (Noussan, Hafner and Tagliapietra 2020).

Table 2

Technologies and mobility models	**Features**
Car Sharing	- An alternative to car ownership; - Car sharing operators claim different advantages in comparison with privately owned cars, including the higher utilization rate, the lower emissions thanks to a faster fleet replacement, lower parking needs thanks to higher user-per-car rates;
Ridesharing	- Provide mobility services that are similar to taxicabs, by matching

	passengers with drivers exploiting websites or mobile applications companies, limiting their activity to the ownership and management of the digital platform, without owning any vehicle or other significant assets; - Ridesharing companies have been able to operate without the needing of respecting the taxicabs regulations in many countries, resulting in lower operation costs leading to lower prices for the final users; - The evolution of Uber and Lyft is an example of how digital technology can support disruptive solutions in transport, although the benefits are still to be proven;
Carpooling	- It aims at increasing the average number of passengers per car by matching users that have the same travel demand; - Some carpooling schemes are dedicated to daily commuting to work, which shows a significant potential due to the regular frequency of the trips and to the average car occupancy, which is much lower than for leisure trips, with most car owners driving alone to work; - Carpooling has been widely adopted to share the operating costs of

	travelling by car, with significant benefits related to fossil energy savings, lower CO2 and pollutants emissions, less traffic on the roads and lower needs for parking spaces;
Bike Sharing	- It started in 1965 in Amsterdam, when citizens organized a system to share free bikes painted in white and made available to users throughout the city; - This program suffered from the lack of dedicated locks that finally made most of the bikes to be damaged or stolen, leading the program to be shut down; - Public-based bike sharing schemes took decades to develop, and at the beginning of the century, there were still less than ten systems worldwide; - The availability of web platforms and the possibility of locating available bikes in real time based on the user location through a smartphone have supported a strong rise in bike sharing schemes in multiple cities; - Internet of things has unlocked the possibility of dockless systems (aka free-floating): since each bike is always connected to the web, thanks to an algorithm it can be locked and unlocked when needed through an app, and it can be left anywhere (or

	almost) since its position is continuously recorded;
Electric-Powered Micromobility	- Another phenomenon that is showing a considerable hype in the US as well as in major European cities is the deployment of electric-powered micromobility, notably electric scooters; - Many countries and cities are still facing the need of developing proper regulations for electric scooters, which thus remain in a gray area in many cities and states/countries; - Different companies have exploited the lack of regulation to deploy their e-scooters in cities, but in some cases, they have been subsequently forbidden to operate (e.g., San Francisco), due to issues including improper scooter parking on sidewalks and low availability of scooters in low-income neighborhoods.

(Noussan, Hafner and Tagliapietra 2020)

Gamification as a digitalization tool

In the last decade, the digital market faced significant growth and in order to survive and flourish as a business, many innovations are required. To have an app installed on a user's device seems to be one of the biggest challenges today. As a result, a new paradigm to engage people, gamification, has been adopted as a strategy for influencing and motivating people to participate in education,

training, marketing, networking, and health-related activities (Suh, Wagner and Liu 2016, 1). Therefore, gamification basically imply the incorporation of game elements into different systems to better engage users. In Table 3 I indicated few theoretical approaches:

Table 3

(Brigham 2015, 473)	"Gamification is often used to advance goals outside the context of a game, such as the goals of greener or healthier living. Unlike a game, gamification is not a self-contained unit; it does not have a clear beginning, middle and end. Gamification uses game-based elements and strategies to increase engagement, motivation, learning, and even solve problems".
(Suh, Wagner and Liu 2016, 1)	Gamification, "refers to the use of game elements, such as design techniques, thinking, and mechanics to enhance non-game contexts to engage users by increasing the hedonic value of an existing information system".
(Seaborn and Fels 2015, 14)	Gamification "is used to describe those features of an interactive system that aim to motivate and engage end-users through the use of game elements and mechanics".

A successful example of gamification is discussed by Ayoung Suh, Christian Wagner and Lili Liu: Nike+, for instance, has adopted game design elements in such a way that users are rewarded when they reach milestones in their progress toward physical fitness. Users can experience game-like dynamics to earn rewards (e.g., points and badges), track their performance, set goals, join challenges, and compete with others in the community (Suh, Wagner and Liu 2016, 1). In this way, the company successfully built a fan community of 28 million users.

A widespread misunderstanding is to confuse gamification with other related game concepts such as:

- gaming;
- game-theory;
- serious games;

- applied games;
- simulation;
- gameful design.

Best way to separate gamification from other concepts is to keep in mind that it uses a game approach in non-game situations. If gamification is properly implemented, it can provide to users a sense of accomplishment and progress.

Jamie Woodcock and Mark R. Johnson propose two distinctive forms of gamification:

- Gamification-from-above is the imposition of systems of regulation, surveillance and standardization upon aspects of everyday life, through forms of interaction and feedback drawn from games (ludus) but severed from their original playful (paidia) contexts. It is more related to different kind of projects designed by private companies or by a state.
- Gamification-from-below represents a true gamification of everyday life through the subversion, corruption and mockery-making of activities considered 'serious'. It is more related to a natural process of gamifying daily activities (Woodcock and Johnson 2017, 2).

Brian Burke, in his book "Gamify: how gamification motivates people to do extraordinary things", identifies the following features of the gamification process:

Feature	**Description**
Motivation	- gamification is a way to motivate people to do mundane tasks by challenging them and showing them the progress that they have made; - gamification is about engaging people on an emotional level and motivating them to achieve their goals;
Give meaning to players	- gamification engages people through ways that are meaningful for them; - this is the main difference between gamification and traditional incentive and rewards programs;

Changing behaviour one step at a time	- most of people's actions are guided by habits, and it is quite difficult for them to change their routine on purpose; - gamification can help a lot by challenging people to change every day;
Using gamification to develop skills	- whether it is formal education, corporate training, or informal learning, gamification can provide the path and add motivation to learning activities;
Using gamification to drive innovation	- gamification can encourage the crowd to innovate weather they are employees, customers or other kind of community; - gamified innovation solutions provide players with the play space and create the objectives, rules, rewards, and other aspects of the player engagement model, but they don't define the outcome; - players are free to innovate within this space.

Table 4 (Burke 2014)

Gamification in mobility-related contexts is largely used in various projects related with smart cities in a public and private effort to reduce energy consumption and traffic. Additional benefits include saving costs and time, environmentally friendly transport, carbon emissions reduction, and fuel consumption reduction (Olszewski, Pałka, Turek 2018, 1). In this case, gamification emerges as a promising tool that can change the mass behaviour through innovative transportation solutions. However, it is not capable per se to induce behavior change. One should rather

appropriately conceive, deploy and manage it to maximize users' involvement. In fact, it can produce different results depending on the correlation existing between: structure adopted, context, player-types and their preferences (Marcuccia, Gatta, Le Pira 2018, 119).

Examples of gamification applied in the mobility-related contexts

As gamification introduces competition and social activity into behavioural interventions, the participants, such as public transport passengers, become "players" who can win individual or group rewards if they adjust their behaviour. Recent evidence underlines the significance of a gamified approach to behaviour change. Currently, there are few case studies in the transport field. These may not be branded directly as gamification, but the concepts of these cases are borrowed from it (Yen 2016). In the Figure 2 one can see how through a gamified process, users that choose to travel with public transport are earning points that can transform in specific rewards of even cash.

Figure 2 (Yen 2016)

There are many examples of how gamification was implemented in mobility-related contexts

Active travel

Gamified designs are used in the in the field of public health in order to transform people's daily behaviour to increase the number of physical activities.

Beat the Street project[3]

- An initiative from UK;
- Beat the Street turns towns into giant games. You can earn points, win prizes and discover more about your area by walking, running and cycling. Pick up a Beat the Street card and swipe Beat Boxes across your community;

[3] https://www.beatthestreet.me

- Beat the Street has been a great success for two years running, being both competitive and fun, and it has been instrumental in increasing the amount of walking that people of all ages reported doing;
- Following the competition in Reading 2015, a survey showed that eight out of ten people thought that Beat the Street helped them be more active (84%), walk more than usual (78%) and feel healthier (78%)[4].

Healthy Active School Travel

- This is a free, tailored program proven to help primary school students, parents and teachers to leave the car at home and use sustainable travel modes to get to school (Yen 2016);
- The transport alternatives are: walking, cycling, riding a scooter, or taking public transport.

Squats for Tickets

- The public transport operator in Moscow used the Olympic Games in Sochi as an occasion to motivate passengers to do more sport;
- People who did 30 squats got a train ticket for free (Ammon 2017).

Public transport

Singapore's INSINC program[5]

- The Travel Smart Programme aims to distribute morning peak hour travel demand on the rail network more evenly and improve commuter experiences in three ways: travel during off-peak periods, switch to other modes of transport, morning peak hours trips.
- Under the Travel Smart Programme, the first Travel Smart initiative started in 2012 as a trial to incentivise commuters to travel during off-peak hours. In 2014, LTA started to work with organisations on re-timing, re-moding and reducing their journeys. Read on to find out more about the various initiatives under the Travel Smart Programme.

Carpooling system that solved the traffic problem in the capital of Poland, in an area called "Mordor of Warsaw"

- Carpooling is a system through which users with similar routes can use one car;
- Its main goal is to match people who commute to work;

[4] http://www.intelligenthealth.co.uk/best-foot-forward-for-reading-as-beat-the-street-returns/

[5] https://www.lta.gov.sg/content/ltagov/en/getting_around/public_transport/plan_your_journey.html#travel_smart_by_planning_your_journey

- carpooling can be an effective method of alleviating traffic jams during rush hours (Olszewski, Pałka, Turek 2018, 2).

Road safety

To motivate people to drive more safely, many apps and programs have been developed, especially by the insurance companies.

Driver Alert Trivia

- In the vast expanses of Australia, it can take a long time to reach your destination, or at least see civilization, so a campaign was launched to battle fatigue at the wheel;
- In addition to a "Driver Reviver", a free coffee for all drivers at rest stops, there are also trivia questions on the roadside in the "Fatigue Zones";
- After the quiz announcement comes the question, mostly relating to Australia in general or the stretch of land you're currently driving through, and a few kilometers later comes the answer;
- It keeps your mind and attention alert, it's fun, and you might even learn something (Ammon 2017).

Ping Pong Traffic Lights

- To make the waiting time at traffic lights more pleasant for pedestrians, a city in Germany integrated a ping pong game into the traffic light button;
- While the pedestrian traffic light is red, two people can pass a virtual ball from one side of the road to the other (Ammon 2017).

Gamification process and its social implications

Technological development is involving also deep changes in the societal superstructure. Younger generation are facing changes of mindsets, developing different habits, values or needs. National and local policies are crucially important here because the spread of technologies come along with and there is a large segmentation of preferences and choices across countries, gender, age, and income that may lead to social inequalities. Therefore, an additional aspect to be considered is the potential digital divide triggered by these innovative solutions, which can exacerbate the difference among low-income and high-income classes, young and old generations, urban and rural citizens.

These growing dualities may be caused by differences in access to technologies related both to financial availability, but also to the digital know-how of different classes of citizens (including literacy, gender, and age) (Noussan, Hafner and Tagliapietra 2020).

The digital divide is not a new idea, but a quite common concept during the past three decades. The concept of digital divide was first coined in the middle of 1990s by the US Department of Commerce's National Telecommunications and Information Administration. Since then, it was broadly adopted by the scientific community and it became the subject of different meanings and definitions.

According to Pål André Aarsand, the digital divide is in fact the difference between:

- those who know and those who do not know how to act in a digital environment
- people who had access to, compared to those who did not have access to computers and the internet (Aarsand 2007, 236).

Following Jan van Dijk (see Figure 3), there are three main conditios one should pass through in order to avoid the digital divide: motivation, material access and skill access.

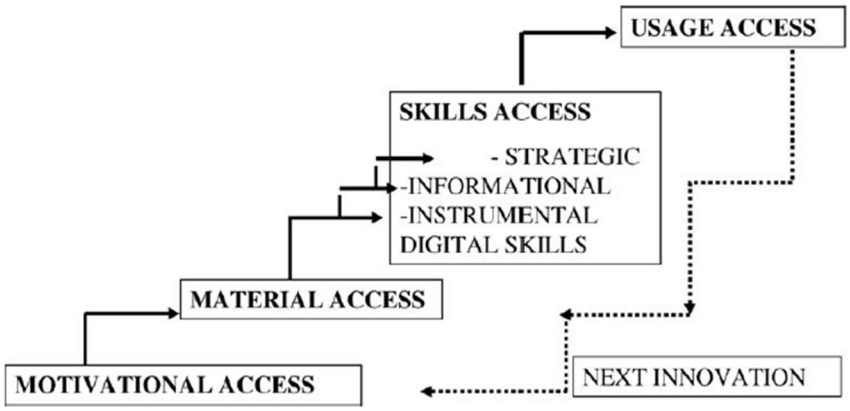

Figure 3 (van Dijkm 2006, 226)

Motivation

- Many of those who remain at the 'wrong' side of the digital divide have motivational problems;
- The motivational issues often emerge from no need of using digital devices in the daily life or career, lack of money, lack of time or lack of skills.

Material access

- It involves permanent or temporary material access to ICT infrastructure;
- The situation occurs because various people cannot afford to buy new devices.

Skills access

- The school should be the place where children would acquire their main digital skills;
- This could give them equal opportunities in their future careers and reduce, in time, the gaps generated by the digital divide.

Carmen Steele identifies 3 types of digital divide:

1. Gender Divide – although digital technologies are broadly spreading into society, they are not spreading equally while women are still lagging. Men in low-income countries are 90% more likely to digital technologies than women.

2. Social Divide – more then ever, digital technologies have influenced social stratification which is evident in societies among those that are connected to the internet and those that are not.

3. Universal Access Divide – some people could remain segregated from the digital technologies and their vast potential due to lack of digital literacy skills, low education levels, and inadequate broadband infrastructure (Steele 2019).

Another form of the digital divide found by Don Tapscott is the inter-generational digital divide. He states that today we face a "generation lap"—kids are outpacing and overtaking adults on the technology track, "lapping" them in many areas of daily life. The gap is generated by the technology itself who seems to determine the way children think: "the brain is particularly adaptable to outside influences in the first three years of life and then during teenage and early adult years, which is just when most Net Geners are immersing themselves in interactive digital technology 20 to 30 hours per week" (Tapscott 2009, 98).

Marc Prensky goes even deeper stating that the present educational system is outdated due to the digital gap between teachers or decision makers and children. He states that today's average college grads have spent less than 5,000 hours of their lives reading, but over 10,000 hours playing video games (not to mention 20,000 hours watching TV). Computer games, e-mail, the Internet, cell phones and instant messaging are integral parts of their lives (Prensky 2011, 4). These kids are digital natives, which means that they can natively speak the language of computers, video games and the Internet's, while other are digital immigrants.

Digital Natives	Digital Immigrants
- They better handle multitasking processes;	- Digital Immigrants learn—like all immigrants, some better than others—to adapt to their environment;

- They prefer to learn from graphics/pictures/videos, rather than from text; - They work better in networks; - For motivation, they need frequent rewards; - They prefer to play games rather than to focus on work.	- They always retain, to some degree, their "accent," that is, their foot in the past; - They can be seen in such things as turning to the Internet for information second rather than first, or in reading the manual for a program rather than assuming that the program itself will teach us to use it;

(Prensky 2011)

In order to link gamification with the generational gap and the digital divide, one should determine how different generation relate with game-related elements, especially with videogames. According to the time table proposed by the Figure 4 and with the fact that video-games massively spread in the 1990s along with personal computers, Millennials and Generations Z are those who grew up or still growing up with games as a part of their lives.

Figure 4 (Corey, 2018)

According to Liliia Matraeva, Ekaterina Vasiutina, Alexey Belyak, Petr Solodukha, Nataliya Bondarchuk and Marina Efimova each generation has developed different cultural background due to the historical events and specific condition that they grew up with, as it follows:

- Generation GI (the Generation of Winners - 1900-1922) - revolutionary events of 1905 and 1917;
- Silent Generation (1923-1942) - repression, World War II, the restoration of a destroyed country;
- Generation of baby boomers or boomers (1943-1962) - the Soviet "thaw", the USSR – is the world superpower, the "cold war", the unified standards of education

in schools and the guarantee of medical care, the generation with the psychology of the winners;

- Generation X (Unknown Generation 1963-1982) - the continuation of the Cold War, Perestroika, AIDS, drugs, the war in Afghanistan;
- Generation Y ("Network generation", the generation of "Millennium" 1983-2002) - the disintegration of the USSR, terrorist attacks, military conflicts, outbreaks of epidemics, economic crises, the development of digital technologies, the era of status items;
- Generation Z (2003-2023) - digital revolution and economy, instant accessibility to information and accumulated knowledge, gamification (Matraeva, et all. 2019, 126).

Conclusions

1. New technologies such as Web 2.0, Apps, Smartphones, laptops or 3D-printers are considered to be part of the Industry 4.0;
2. Freight transport and passenger transportation have undergone deep changes due to the digitalization process;
3. Gamification is a process where elements from video-games such as design techniques, thinking, and mechanisms used in totally different contexts, in order to increase the motivation of users, to give them a meaning, to change their behaviour or to support the development of new skills;
4. In the mobility-related contexts, gamification can be a useful tool to change the transport routine, especially in big cities as part of smart cities programmes;
5. The introduction of gamification in the field of transportation could increase the digital divide between people belonging to different generations;
6. The most adapted generation to the gaming elements is Gen Z while for Millennials video-games are more related with free time and leisure activities;
7. If Gen X is weakly related to video-games, as they lived in a time when this new type of human activity was just starting to spread, the other generations are mainly excluded.

Bibliography

- Aarsand, Pål André (2007), "The digital divide as a resource in intergenerational interactions". *Computer and Video Games in Family Life*. Vol 14, No. 2, p. 235–256.
- Ammon, Martina. 2017. Gamification in transport. Available at https://blog.car2go.com/2017/07/22/gamification-in-transport/
- Brigham, Tara (2015). "An Introduction to Gamification: Adding Game Elements for Engagement". Medical Reference Services Quarterly. Vol. 34, No. 4, p. 471-480.
- Burke, Brian (2014), Gamify: how gamification motivates people to do extraordinary things. Harvard: Bibliomotion. Ebook.
- Chakraborty, Sumit. 2014. Healthcare System Innovization through Digital Transformation. Reference: HSIDT/ V1.0/ CR 15082014
- Corey, Austin (2018), "Gaming: The Key to Gen Z". Accessed May 20, 2020. https://richards.com/blog/gaming-key-gen-z/
- Cortada, James. 2004. The Digital Hand. How Computers Changed the Work of American Manufacturing, Transportation, and Retail Industries. New York: Oxford University Press.
- Marcuccia, Edoardo, Valerio Gatta, Michela Le Pira (2018). "Gamification design to foster stakeholder engagement and behavior change: An application to urban freight transport". *Transportation Research Part A*. Vol. 118, p. 119–132.
- Matraeva, Liliia; Ekaterina Vasiutina; Alexey Belyak; Petr Solodukha; Nataliya Bondarchuk; Marina Efimova (2019), "Economic Model of Generation Z Behavior". *Academic Journal of Interdisciplinary Studies*. Vol 8, No 3, p. 123-134.
- Noussan, Michel, Manfred Hafner and Simone Tagliapietra. 2020. The Future of Transport Between Digitalization and Decarbonization. Trends, Strategies and Effects on Energy Consumption. Springer. Open Access. ISSN 2191-5520. https://doi.org/10.1007/978-3-030-37966-7.
- Olszewski, Robert, Piotr Pałka, Agnieszka Turek (2018), "Solving "Smart City" Transport Problems by Designing Carpooling Gamification Schemes with Multi-Agent Systems: The Case of the So-Called "Mordor of Warsaw"". Sensors. Vol. 18, No. 141, p. 1-25.
- Palfreyman, John. 2020. Digital Transformation Handbook. ISBN 979-8639124631. Ebook.

- Prensky, Marc (2011), "Digital Natives, Digital Immigrants." In *The Digital Divide*, edited by Mark Bauerlein, 3-12. London: Penguin Books Ltd.
- Salkin, Ceren, Mahir Oner, Alp Ustundag and Emre Cevikcan. 2018. "A Conceptual Framework for Industry 4.0" in Alp Ustundag and Emre Cevikcan, *Industry 4.0: Managing the Digital Transformation*. Birmingham: Springer.
- Seaborn, Katie, Deborah I. Fels (2015), "Gamification in theory and action: A survey". International Journal of Human-Computer Studies. No. 74, p. 14-31.
- Steele, Carmen. 2019. What is the Digital Divide? Available at http://www.digitaldividecouncil.com/what-is-the-digital-divide/
- Suh, Ayoung, Christian Wagner, Lili Liu (2018). "Enhancing User Engagement through Gamification". Journal of Computer Information Systems. Vol. 58, p. 204-213.
- Tapscott, Don (2009), *Grown up digital. How the NET generation is changing your world*. London: McGraw-Hill.
- van Dijk, Jan A.G.M (2006), "Digital divide research, achievements and shortcomings". *Poetics*. Vol 34, p. 221–235.
- Woodcock, Jamie, Mark R. Johnson (2017), "Gamification: What it is, and how to fight it". The Sociological Review, p. 1– 17.
- Yan, Barbara. 2016. How 'gamification' can make transport systems and choices work better for us. Available at https://theconversation.com/how-gamification-can-make-transport-systems-and-choices-work-better-for-us-57663