Digital Transformation Playground - Literature Review and Framework of Concepts

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Abstract

Digital transformation (DT) introduces strategy-oriented and customer-centric changes, based on innovative usage of emerging information and communication technology (ICT), to implement improved or new processes in modern organizations. This paper provides insights into academic publishing trends and offers an analysis of scientific fields in which researches were made followed by a brief analysis of the most influential articles. Paper also identifies and discusses key determinants and influence factors of DT and some emerging trends and technologies, in order to explain organizational and technological context of DT. For better understanding of this mix of business and ICT related concepts, a framework of concepts on DT was developed and called Digital transformation playground (DTP). Its purpose is to get better understanding of what are the mainstream concepts of today, what other and emerging ICT or digitalization concepts in the context of DT arise, and how these technology elements impact business related concepts.

Keywords: digital transformation, literature review, framework, concepts, digital transformation playground

1. Introduction

Digital transformation of enterprises is a new paradigm in both, IT and business world. The main goal of DT is to change organizations by implementing contemporary technologies and introduce new business processes in order to create new or improve existing products and services and deliver them to the global market faster, cheaper and in new innovative ways. According to i-SCOOP.eu [1] online guide to digital business transformation, DT is defined as "the profound transformation of business

and organizational activities, processes, competencies and models to fully leverage the changes and opportunities of a mix of digital technologies and their accelerating impact across society in a strategic and prioritized way, with present and future shifts in mind".

Westerman et al. [2: 108] has grouped all digital changes in organizations into three main groups or categories: Substitution (digital technologies are used to replace a function/process that is already performed in the organization), Extension (digital technologies are used to improve the functionality of a process/product) and Transformation (digital technologies are used to fundamentally redefine a process/product). Digitization has not penetrated yet equally in all industries, but it has begun to transform many of them, and it has a significant impact on the economic performance of companies within those industries. Led by this possibility of digitalization, the impact on revenues, profits and new opportunities implied by digital transformation will be drastic [3: 2].

While identifying the main drivers of digital transformation, several quotes can be seen as main determinants, that explain what is being put in front of today's businesses as demands or requests from customers. By Tiersky [4] customers' expectations are raising and speed is more important than ever, so digital transformation needs to be understood as business transformation, meaning it is a new opportunity for the business sector to speed up and meet expectations of more and more demanding customers. Candito [5] brings up that digital transformation influences the unlocking of data silos, empowers intelligent working processes and creates information "on the go". Roche [6] asserts that everyone is doing it, big change can and should bring new opportunities, while the main driver is cost reduction and pursue of better process efficiencies. Basically the faith is to "Innovate or die" [7].

With aim to explore the developments in this area, researches were conducted, and insights provided into the field of digital transformation as part of the research project (IRI) *Development of innovative platform for digital transformation of enterprises*. Following analyses were made:

- The literature analysis on digital transformation, including the analysis of scientific databases Web of Science (WOS) and Scopus on journal and conference papers, in order to see the current state of research in the field of digital transformation and its potential for further research (Section 2).
- Upon the literature analysis insights into the researches on DT analysis were made, in order to see in which research areas most of the papers were published (Section 2).
- Also, the most cited papers (top 10) in DT research field (according to WOS and Scopus together) were found and analysed, in order to identify what influences the research field of DT, what were the beginning initiatives, were does it stand today and what are the predictions for the future (Section 2).
- Key determinants and influence factors of digital transformation show that DT is not (only) based on technology, so an overview of DT methodologies, pillars and determinants which influence digital maturity of enterprises and enables digital transformation of businesses were analysed and described as well (Section 4).

- New trends and some emerging technologies in the field of digital transformation are outlined in order to explain the technological context of digital transformation, also known as Industry 4.0 technologies. To better understand and see the impact of some new technology, Gartner hype cycle of emerging technologies is presented and discussed (Section 5).
- As a result of all technological trends and their impact on today's organizations or business in general, and the fact that each technology and/or its combination with others can be good for some industries, but not necessary or applicable for other, framework of concepts on digital transformation was created and named Digital Transformation Playground (Section 6).

Following sections present insights into this new and interesting field which is already happening.

2. Methodology and Data

With intention to get some insights about the progressive area of digital transformation, bibliographic and literature analysis was conducted. Analysis was made on papers indexed in two most relevant and high-quality scientific databases: Web of Science (WOS) and Scopus.

These two databases are important because they are citation databases, which means they index references and citations of scientific papers and not necessary only the papers themselves. Indexed scientific areas of research are not structured equally in both databases, so the analysis was made separately for each database. Research results can be compared, but cannot be unified to one data set.

The research was conducted, after pilot searches, on 11th December 2018, based on keyword set "Digital Transformation" appearing in the contribution title. The analysed databases index papers throughout time, and update indexation with papers published from 1 to 3 years in the past on a weekly basis, so they are not stochastic! Our search was limited to journal articles and conference proceedings papers, from the year 2000, since it has been established that the term „digital transformation" in the present-day organizational and ICT sense was first defined and used between 2000 and 2003, including also year 2019 for papers included in database in year 2018, which are published online dated till 2019, but not jet printed or "published" formally. Papers before year 2000 were excluded, since they use the term "digital transformation" as digitalization of analogue media or digitalization in sense of informatization.

Following table presents the sample of papers extracted by the three criteria mentioned in previous paragraph:
- a) term appearing in the title of paper,
- b) time span 2000-2019 and
- c) paper type as journal article and conference proceedings (books and book chapters were excluded).

Papers in	Term "Digital Transformation"	Time span 2000-2019	Paper type "Article and Proceedings papers"
WOS	284	279	202
Scopus	448	440	326
Total:	732	719	528

Table 1. Papers sample extraction from databases WOS and Scopus

From the initial sample almost 1/4 of entities was excluded by time or format, leaving 528 papers for further analysis.

3.   Results of Literature Analysis

The following figures (Figure 1 and Figure 2) present papers from the research sample, published in WOS and Scopus, by year of publication, showing an increasing trend. By the time of research, papers from 2019 have not yet been published.
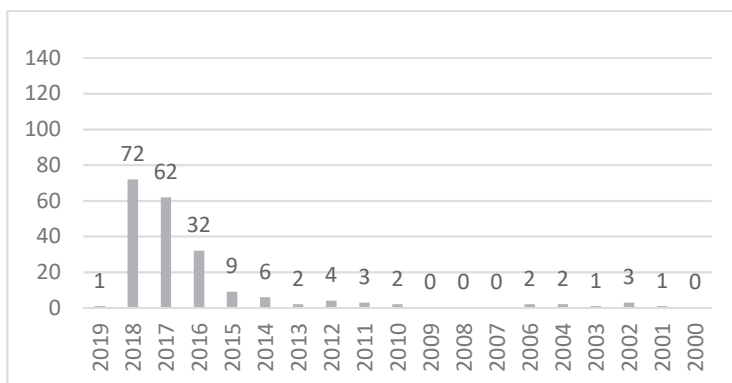
* Papers are limited to articles and conference proceedings!

Figure 1. Papers related to Digital transformation published in WOS from 2000 till 2019 *
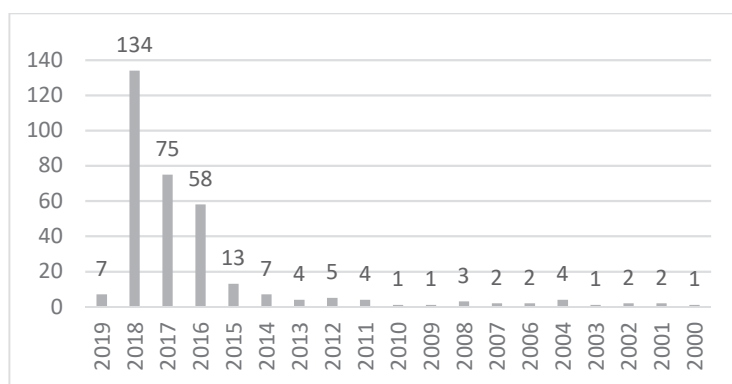
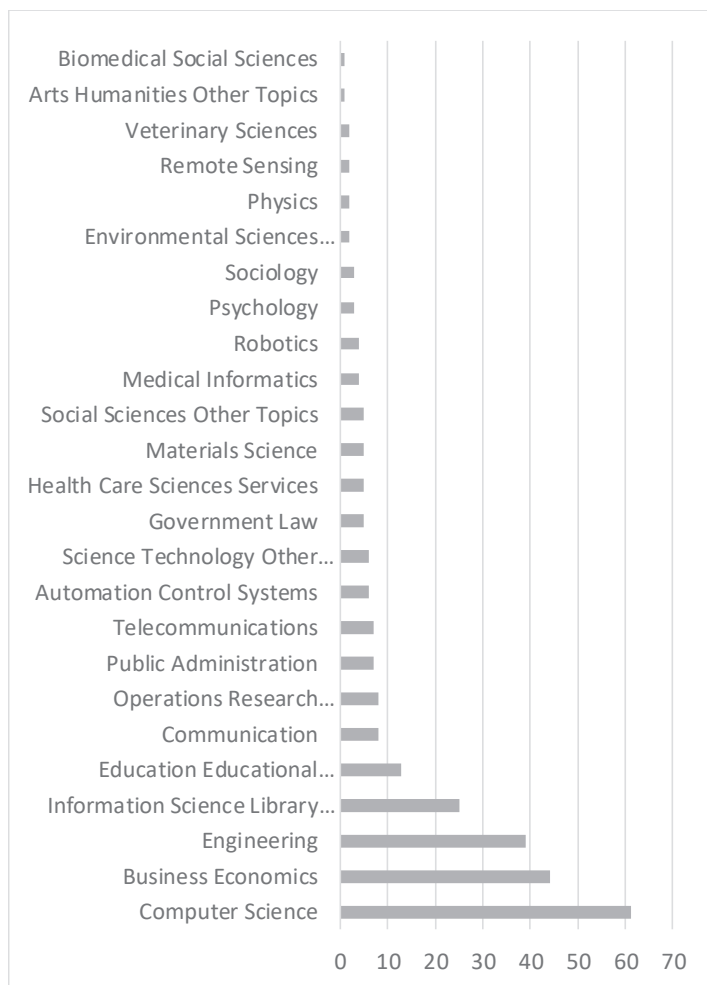** Papers are limited to articles and conference proceedings!*

Figure 2. Papers related to Digital transformation published in Scopus from 2000 till 2019 *
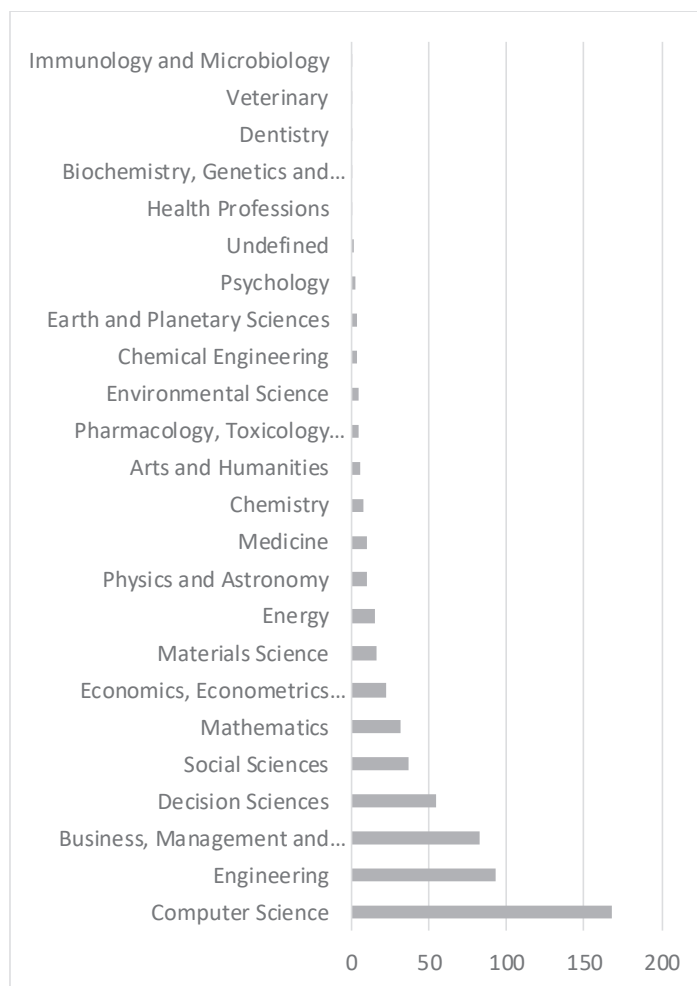
The highest number of publications was published in the last 3 years, from year 2016, letting us conclude that this area is still young and has potential for further growth and maturity.

Regarding the research area, the papers indexed in WOS and Scopus cover a variety of industries and fields of human activities. Figure 3 provides an overview of the number of papers by research area in WOS (left graph) and in Scopus (right graph), where a single paper may be listed in several fields or research areas.

Figure 3 shows that most papers were published in the field of computer science (relative to number of papers in sample WOS 30%, Scopus 52%), but also in all other fields of human activities, especially in: business, engineering, social sciences, information science, library science, education and educational research, decision science, medicine, protection of environment, law, material science etc.

Judged by the number of citations in both databases, the titles listed below can be considered as the 10 most influential in the field of digital transformation:

Immunology and Microbiology
Veterinary
Dentistry
Biochemistry, Genetics and...
Health Professions
Undefined
Psychology
Earth and Planetary Sciences
Chemical Engineering
Environmental Science
Pharmacology, Toxicology...
Arts and Humanities
Chemistry
Medicine
Physics and Astronomy
Energy
Materials Science
Economics, Econometrics...
Mathematics
Social Sciences
Decision Sciences
Business, Management and...
Engineering
Computer Science

*** Some papers are in more than one research area!*

Figure 3. Published papers by research area in WOS (top) and Scopus (bottom) from 2000 till 2019 **

No.	Paper data	Year	WOS	Scopus
1	"Innovation diffusion in global contexts: Determinants of post-adoption digital transformation of European companies" by Zhu, K., Dong, S., Xu, S.X., Kraemer, K.L. European Journal of Information Systems. [8]	2006	136	205
2	"The Digital Transformation of Healthcare: Current Status and the Road Ahead" by Agarwal, R.; Gao, G., DesRoches, C; and Jha, A.K., Information Systems Research. [9]	2010	149	-
3	"The digital transformation of traditional businesses" by Andal-Ancion, A., Cartwright, P.A., and Yip, G.S. MIT Sloan Management Review. [10]	2003	24	60

4	"Digital transformation: Opportunities to create new business models" by Berman, S.J. Strategy and Leadership. [11]	2012	-	57
5	"Options for formulating a digital transformation strategy" by Hess, T., Benlian, A., Matt, C., and Wiesböck, F. MIS Quarterly Executive. [12]	2016	16	43
6	"Hummel's digital transformation toward omnichannel retailing: Key lessons learned" by Hansen, R., and Sia, S.K. MIS Quarterly Executive. [13]	2015	20	31
7	"The digital transformation of oral health care: Teledentistry and electronic commerce" by Bauer, J.C., and Brown, W.T. Journal of the American Dental Association. [14]	2001	21	26
8	"Impact of e-book technology: Ownership and market asymmetries in digital transformation" by Jiang, Y., and Katsamakas, E. Electronic Commerce Research and Applications. [15]	2010	16	24
9	"Designing for digital transformation: Lessons for information systems research from the study of ICT and societal challenges" by Majchrzak, A., Lynne Markus, M., and Wareham, J. MIS Quarterly: Management Information Systems. [16]	2016	-	39
10	"Digital Transformation Strategies" by Matt, C., Hess, T., and Benlian, A. Business & Information Systems Engineering. [17]	2015	24	-

Table 2. Top 10 most cited papers in the field of digital transformation in WOS and Scopus combined.

From the historical point of view, the pioneers of digital transformation as we know and understand the term today, were in field of medicine. First of them with true meaning of transformation of the health care were Coile Jr., R.C. [18] in year 2000 with paper "The digital transformation of health care", followed with Bauer and Brown [14] in year 2001 with paper "The digital transformation of oral health care: Teledentistry and electronic commerce". In year 2003 Andal-Ancion and Cartwright [10] finally defined the general business change trough DT by publishing their paper titled "The digital transformation of traditional businesses", which is the third most cited paper from Table 2.

The most cited paper listed in Table 2, titled, "Innovation diffusion in global contexts: Determinants of post-adoption digital transformation of European companies", written by Zhu et al [8] is oriented on future of DT. Paper published in year 2012, authored by Berman [11], titled "Digital transformation: Opportunities to create new business models", which has taken the 4th place in Table 2, is one of generally most accepted and cited papers, as it deals with what DT change is all about.

At the end of this literature review, we would like to encompass 3 more papers, that did not fit the top 10 by citations, but are seen by the authors of this paper as important. First one is "Digital transformation by SME entrepreneurs: A capability

perspective", which is dealing with DT in SMEs from entrepreneurs' point of view [19]. Other two papers are dealing with the role of a new working place position of Chief Digital Officer (CDO) and what his obligations are in process of DT [20], [21].

All these papers can be seen as most influential in field of digital transformation and would also be relevant for further researches in this dynamic research field.

4.   Key Determinants and Influence Factors of Digital Transformation

Digital transformation is not (only) about technology. When analysing scopes, pillars and areas of methodologies used to assess DT, key determinants have been identified by Pihir et al. [22] and they are presented in the following list. These determinants need to be addressed in order to improve the digital maturity and digitally transform an organization:

a) **Strategy orientation –** vision, management, leadership. DT needs to be supported by top managers of the organization. Goals towards DT need to be visible in a clear vision statement and leaders have to direct all the efforts that need to be done to the accomplishment of these goals.

b) **Customer centricity** – tracking of customers' experiences, prediction of their needs. Customers decide if a product or a service has any market value so digitally mature organizations use their know-how, new ideas and new technological possibilities to track customer's behaviour and habits in order to influence, predict, levy or create new needs that can be satisfied with their offer.

c) **ICT and process infrastructure** – ICT resources, management of business processes. Digital transformation is not only about technology, but potentials of new digital technologies (which will be explained later as Industry 4.0) have to be considered and used for changing products, services or processes. Introducing technology in running business processes increases the level of digital maturity of an organization making it thereby more agile to environmental challenges.

d) **Talent, capability and capacity strengthening** – culture of permanent investment in new skills, knowledge and capacities. If digital technologies are used to fundamentally redefine the way how an organization works, employees need to know how technologies can be used to work, as well as how they can be used to improve the work. For that reason, investments in human resource management, education and the "right people for the job to be done" are necessary.

e) **Innovation culture and organizational commitment** – commitment to organizational culture, innovation culture and organizational factors. Employees need to "live" the transformation, all have to be "on board" and the organization has to ensure that the working environment is supporting innovation and change.

In order to change the way of doing business, every organization has to determine its current position and after that it needs to define the desired, future state for every identified determinant, identify activities that will lead to the future state that is

digitally transformed, as well as perform them afterwards. The future state is defined by improvement initiatives or by ideas for a radical change, but legacy technologies influence DT as well. Current state and position of an organization can be determined through various digital maturity accessing methods, models and frameworks [23], [24], [25].

Technologies are not all suitable for all organizations, meaning that different technologies may have different impacts on organizations in different or within same industries.

Organisational agility can be defined as capacity of an organization to redeploy or redirect its resources efficiently and effectively to value creating and value protecting [26], or simplified, organisational adaptability and flexibility [27]. Digital Darwinism [28] is a process of sorting out and shutting down those organizations, that don't adapt (or do try to adapt but not on time) to new conditions that affect their business. Organizations have to identify the need for change and adaption on time (and make it happen) possibly faster than the technologies and the environment it do.

Initiatives for introducing agility in doing business are influencing organization's choice of suitable technologies for improving their processes and further development of an agile business architecture [29], whereby the improvements can be related to many business factors and issues, as described in [30], [31].

The improvement often include a mix of suitable technologies for supporting processes engaged in the digital transformation, while all of them are oriented towards making the organization "future-ready" [32], [33]. All these new digital technologies, although developed independently of one another, can be used simultaneously to digitally transform organization's business processes.

5. Trends and Technologies in Digital Transformation

New development trends involve implementation of new digital technologies under the common name of Industry 4.0 or Fourth Industrial Revolution. Digital technologies are an upgrade of information and communication technologies, whereby they "inherit" all their useful characteristics and in addition make the content transfer almost fully digital [34].

Schwab [35] made a list of Industry 4.0 technologies, which have a potential to bring digital transformation into an organization, when they are introduced or used separately, or combined with another technology, with the challenge of choosing the right one. This list includes also:

- **Implantable technologies** Devices implemented into bodies, from pacemakers, and smart tattoos to „built-in" smartphones
- **Wearable Internet** - Technologies in mobile phones designed to fit in clothes and accessories
- **Internet of things -** Connecting to „everything" on the Internet via sensors and appropriate applications
- **Smart cities** - Management of energy, material flows, logistics and traffic through sensors and data platforms

- **Big data** - Management and use of huge amounts of data in automated decision making and real-time services customization
- **Driverless cars** - Cars started and driven by means of built-in applications
- **Robotics** - Design, construction, operation, and application of robots
- **Blockchain** - Distributed trust mechanism designed to keep track of transaction
- **Sharing economy** - Exchange of physical goods, assets or services
- **3D printing** - Creation of a physical object by printing it layer by layer from a drawing or model etc.

Gartner [36] developed a Hype Cycle, which is an annually updated graphic representation of results from evaluating technologies and applications regarding their maturity and adoption in organizations, giving also a prediction of their evolution over time. In the Hype cycle every emerging technology is placed on a curve (Figure 4), representing technology's state in one of the five key phases of a technology's life cycle (Innovation Trigger, Peak of Inflated Expectations, Trough of Disillusionment, Slope of Enlightenment or Plateau of Productivity). By determining the place of a technology, that an organization potentially wants to use, on the Hype cycle curve, the organization can evaluate the business value and the risk of investments in that particular technology.
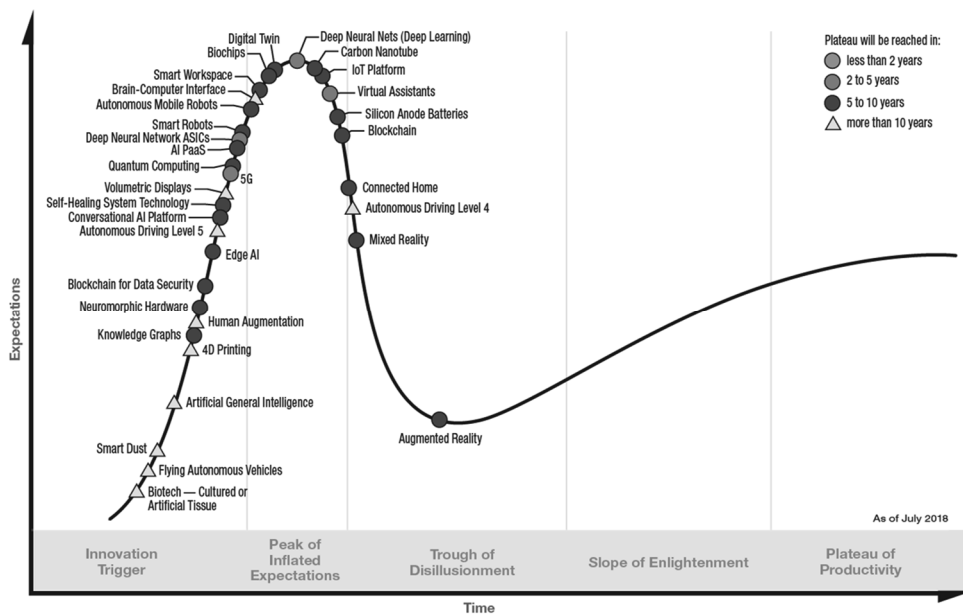

Figure 4. Gartner Hype Cycle for Emerging Technologies in 2018 [33]

6.   Digital Transformation Playground

Although Gartner [36] is giving a pretty good picture on how every technology stands in relation to its current phase within the technology's life cycle (Figure 4), Morrar

Arman and Mousa [37] stated that "the rate of the technological development in Industry 4.0 is exponential and, therefore, anticipating the challenges and even the benefits is much more difficult than what the world experienced in the previous industrial revolutions. This increased difficulty is due to the high convergence of technologies that could complement or compete with different possible diffusion scenarios that may result in more frequent breakthroughs that are difficult to forecast."

While some already traditional technologies involve minimum standards of survival and competitiveness (mainstream concepts), some others enable industries, or organizations within, to make a strategic step forward and be leaders in their domain (other ICT/ digitalisation concepts). Also, the later mentioned technologies, may have an emerging significance and impact in some industries, while the same technology in another industry can already be mainstream. IoT (Internet of Things), robotics, mobile technologies or blockchain have *de facto* become standards in some industries (e.g. automobile manufacturing industry, software industry, creative industries, and industries linked with financial institutions), but they can also be emerging technologies in agriculture.

In order to deal with and/or take advantage of the before mentioned evaluation of technologies and the fact that each technology and every combination of several of them is dependent on the industry the organization is placed in or its role within the industry, a framework of concepts designed as a playground of technologies and approaches was developed by the authors of this paper (Figure 5) and called **Digital Transformation Playground** (DTP).

Business related concepts	Improvements, Increased Effectiveness/ Efficiency	Ecosystems/ green tech.	New Business Models	New services, competencies, skills	Customer experience, Journey	New alliances
Other ICT and digitalization concepts	Social Media & Platforms	Artificial Intelligence & Gamification	Metamodelling	IoT, Big Data and Data Analytics	Virtual Technologies & Knowledge management	Robotics & Autonomous systems
Mainstream concepts	Cloud Technologies	Mobile Technologies	Reference Models	ERP & CRM	SCM & DWH	BPM & Performance Management

Figure 5. Digital Transformation Playground

Business related concepts have to be the starting point for choosing the right technology. These concepts can include: New business model development, building an Ecosystem with or within its environment, Improvement of customer value creation through development of customer journeys or any other idea of business improvement. The business improvement initiative arises from the need of the business to work better, not from the need to use a new technology just because it

exists or is emerging in another industry. After the business improvement initiative is formed, industry related concepts can help to clarify which emerging technology is suited best for implementing it. The aimed business improvement initiative (from top rectangle, Figure 5) needs to be achieved based on an underlaying mainstream technology (from bottom rectangle, Figure 5), already in use within the industry. The differentiation to the competitors can be only achieved by upgrade or combination of mainstream with emerging technology concepts for the industry (located in the middle rectangle, Figure 5).

7.   Conclusion

In this paper an insight into the current research in the field of Digital transformation is provided, in order to show the key initiatives, trends and technologies, that influence business and ICT development, identified from the published literature, as well as to present the Digital transformation playground that shows how the identified elements should be considered for implementation in organizations of various types and working in different industries.

A bibliographic analysis of the relevant journal and conference papers was done through investigating 528 articles referenced in the Scopus and WOS database. These papers were shown in relation to their year of publication and research area with the purpose to present DT as a raising trend, highly relevant in the ICT implementation approaches and business development initiatives. Additional analysis was made on 10 most cited articles from the identified sample, in order to identify those, which impacted DT research the most.

Key determinants and influence factors of DT indicate that business innovation related concepts and agility in the change process are as important as new technologies. As stated by Westerman et al.: "New digital technologies can fuel innovation and improve company performance, but only if applied in the right places" [2: 36]. The "right places" and the "right ways" while innovating the business by implementing a DT initiative, can be identified with help of our framework, called Digital Transformation Playground. Choosing the right technology combination is a "trial and error" paradigm commonly applied in digital business age and it can be seen as a digital transformation playground where almost anything is possible, as long as it brings more benefits to the way of doing business. According to our DTP, determining business related concepts needs to be the motivator of organizational change and choosing a mainstream or emerging technology (combination) becomes the driver of digital change. In that light, further research needs to be done in order to investigate feasible approaches for selecting the right combination of technologies. Also, based on the results from the literature review, the impacting factors for selection of future transformation initiatives should be investigated: new business models and their building elements, innovation diffusion as a result of the digital vortex in the operating industry, and skills for digital transformation officers assigned to lead the digital transformation.

Acknowledgments

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