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FROM DIGITAL DIVIDE TO CONSUMER ADOPTION OF SMART CITY SOLUTIONS: A SYSTEMATIC LITERATURE REVIEW AND BIBLIOMETRIC ANALYSIS

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The research dedicated to the digital divide has been on the rise over the last three decades, although the individual level of such a phenomenon remains underexplored. This is in line with the citizen-centric trend noted in the research pertaining to consumer reluctance to adopt digital innovations aimed to improve the quality of life as part of smart city solutions. According to studies, consumer participation in development and modification of smart city solutions, for which a city provides the required access and infrastructure, tends to augment their value for consumers thereby boosting their willingness to accept those smart city solutions. By intertwining these research streams, the article explores the factors determining the individual level of digital divide which relates to consumer adoption of smart city solutions through the bibliometric and systematic literature review analysis. The paper aims to propose the antecedents and factors of consumer adoption of smart city solutions based on Motivation, Opportunity, Ability framework underlying the digital divide phenomenon. The results revealed the factors related to motivation, cognition and competence which are to be considered conjointly rather than step-wise. Due to the multifaceted nature of smart city solutions, motivation is triggered by various factors discussed by behavioural, innovation diffusion and technology acceptance theories. By definition, smart city solutions derive from the extant solutions of urban challenges. Hence, competence is related to the previous experience, whereas cognition and willingness to innovate refer to the intention to adopt novel smart city solutions. Theoretically, the study provides propositions to further empirical research in the consumer smart city solutions adoption field. Managerially, it presents the factors to be considered prior to launching smart city solutions.

Keywords: smart city solutions, digital divide, consumer adoption, consumer behaviour, motivation, opportunity, ability model, cognition, competence.

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INTRODUCTION

Today, digital technology ingrained in human's lives and providing new opportunities and value continues transforming the ways the usual things are done. School and university curricula, work duties, shopping, restaurant business [Iansiti, Richards, 2020] and banking predominantly have been digitally transformed lately due to such an unfortunate reason as COVID-19 [Milanesi, 2020]. This situation exposes a lot of people to the digital technology and forces them to adopt solutions for performing their duties, attending doctors, and shopping. Fortunately, these options have already been available. However, some of them are developments of the extant solutions which are aimed to augment the quality of life, such as smart mirrors helping consumers to estimate the fit and suitability of clothes on themselves with the aid of the appearance digital modelling; or extension of e-government services where citizens receive proactive acknowledgements and notifications of the required actions they need to complete by a certain deadline, which in turn can be done online. Although these solutions transform the way people handle habitual things [Lee, Lee, 2014] to improve the quality of life [Yeh, 2017], they go hand in hand with the challenge of adoption or rejection. The article implies adoption as a decision to make use of innovations [Rogers, 2003] such as smart city solutions, which represents a contrast to rejection or reluctance to adopt them.

Given a choice, people might or might not adopt such solutions due to various reasons which are related to digital divide. Researchers have been extensively studying this phenomenon which stems from a mere access to digital solutions — first level digital divide, to the challenge related to knowledge and skills ensuring the possibility of coping with such solutions — second level digital divide, and inferring benefits from them and weighing tangible results of the use of such solutions — third level digital divide [Scheerder, Van Deursen, Van Dijk, 2017]. Most of the research focuses on the macro level aimed to investigate the factors shaping the digital divide: cross-country [Quibria et al., 2003; Hawash, Lang, 2019] or country [Stump, Gong, Li, 2008; Bilon, Lera-Lopez, Marco, 2010; Afshar, Alam, Taylor, 2019].

Nevertheless, there exists the paucity of research addressing “digital divide phenomenon from the theoretical perspective of individual level technology” [Goncalves, Oliveira, Cruz-Jesus, 2018, p. 276]. In fact, the studies pertaining to the digital research on the individual level are gathering pace [Bartikowski et al., 2018; Chipeva et al., 2018; Goncalves, Oliveira, Cruz-Jesus, 2018; Sánchez-Torres, 2019]. To follow the trend and cater for the balance between narrowing down and the generalizability of the research the article will focus on the particular type of digital or data-based solutions which are aimed at improving the way the challenges are solved within a city given the environmental sustainability and participatory perspectives. Those solutions are implemented in the context of smart cities and are called smart city solutions (SCS) [Woetzel, Kuznetsova, 2018]. Interestingly, although the digital divide aspect has been extensively scrutinized from various lens to conclude that it negatively affects adoption of solutions, such as e-commerce [Sánchez-Torres, 2019], it has not been regarded on the individual level of the research pertaining

to adoption of SCS as a central factor hindering such adoption. The topic of consumer adoption of SCS is considerably understudied and for the time being has not been analysed from the digital divide perspective. The abovementioned instigates the following research question: What digital divide factors underpin consumer adoption of smart city solutions?

Due to the fact that cost efficiency of SCS might override all other factors, the study eliminates it and instead focuses on the broad pool of solutions that do not require monetary expenditures, which are the majority of SCS representing services [Lee, Lee, 2014]. Further, following the future research suggestions by [Vodanovich, Sundaram, Myers, 2010] to consider digital natives and taking into account that smart cities are still at a nascent stage, the research will elaborate the factors determining adoption of SCS by digital natives [Vodanovich, Sundaram, Myers, 2010] or generation Y [Lissitsa, Kol, 2016].

In view of the scarcity of research in the intersection of digital divide and consumer adoption of SCS and following the practice of leading authors in the business research area in top-tier ABS ranking journal papers [Donthu, Kumar, Pattnaik, 2020], the paper conducts the quantitative bibliometric and qualitative literature review analysis to explore the phenomena in question and their interlinks in order to infer the insights relevant to the topic of consumer adoption of SCS.

The aim of the article is to provide the outlook of the digital divide factors influencing consumer adoption of smart city solutions. The paper has scrutinised digital divide holistically and discovered that its levels, in fact, represent motivation, opportunity, ability (MOA) framework. Since the concept of digital divide has not been “underpinned by any particular theoretical framework” [Afshar, Alam, Taylor, 2019, p. 645], the research contributes to the digital divide theory by proposing it and inferring the factors applicable to the topic of consumer adoption of SCS — motivation, cognition and competence. The article suggests a roadmap for the consumer adoption of SCS, namely a theoretical framework to consider for SCS adoption studies, as well as an array of concepts presented in propositions for future research.

The article is divided into five sections. First, it outlines methodology of systematic literature review. Secondly, it proceeds to digital divide and its relation to consumer adoption. Further, the paper delves into smart city solutions and the challenge of their adoption, followed by propositions for future research and conclusions.

METHODOLOGY OF LITERATURE REVIEW

Digital divide being a clearly coined term and a rather frequently discussed topic, was used as key words for the search without other alternatives or alterations in Scopus database, which yielded 6 226 results. This acknowledges the relevance of the topic at hand. Further, the search was narrowed down after filtering the relevant keywords and selecting the articles in journals ranked by the Association of Business Schools recognised world-wide, which resulted in 116 articles. Upon scrutiny of abstracts 88 relevant papers were selected. Another round of search based on the references in the selected articles resulted in six more articles. Thus, overall 94 articles have been selected for scrutiny.

In order to understand the digital divide in totality and identify a place of consumer adoption, as well as to view their interrelation with other concepts and trends, following the research methodology by [Bartolacci, Caputo, Soverchia, 2020; Donthu, Kumar, Pattnaik, 2020] the article embarks upon the two-step analysis of the topic. First, with the aid of the quantitative bibliometric analysis the paper investigates the relations of the digital divide with other concepts. Second, the article performs a qualitative analysis of the identified links with the concepts through systematic literature review. Thereafter, the paper proceeds with the development of the “roadmap” for future theoretical and practical research in the field of consumer adoption of SCS, including a theoretical foundation and propositions. It is worth noting that in the process of analysis other resources were referred to which are outside the scope of the indicated 94 articles. Hence, the process of literature review was not linear, yet rather back and forth and ad hoc to provide a balanced outlook on the topic.

For the bibliometric analysis the paper deployed VOSviewer software which was successfully used by researchers in the management field [Bartolacci, Caputo, Soverchia, 2020; Donthu, Kumar, Pattnaik, 2020] and allows for mapping the research landscape of selected papers. We opted for the co-occurrence type of analysis to track the links and relatedness of concepts based on the number of documents wherein they occur together. The unit of analysis were selected as author keywords to follow the focus identified by the authors. The results of the bibliometric analysis of the selected scope of 94 articles are given in Figures 1 and 2.

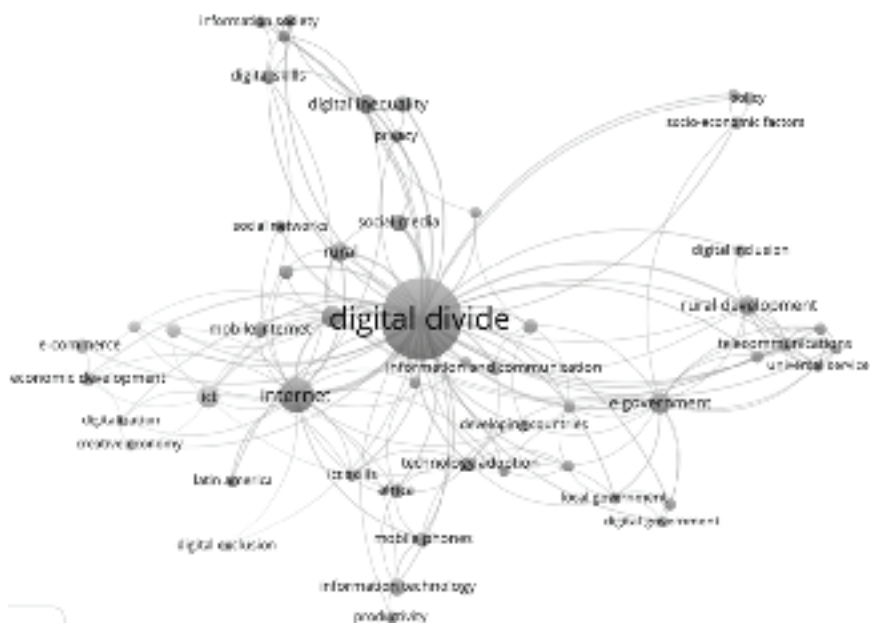


Figure 1. Bibliometric analysis of digital divide based on 94 articles retrieved in Scopus

Note: the analysis has been done based on the VOSviewer software.

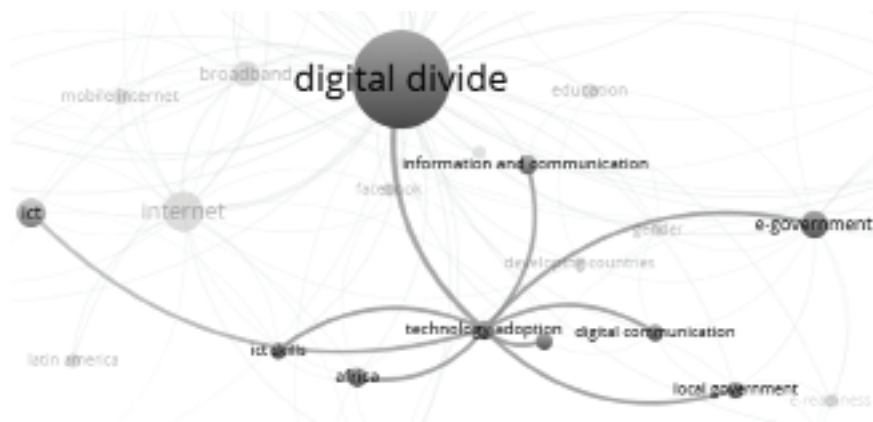


Figure 2. Links of technology adoption concept with other concepts within digital divide based on bibliographic analysis of 94 articles retrieved in Scopus

Note: the analysis has been done based on the VOSviewer software.

As it can be seen in the figures above, technology adoption occupies a position which can hardly be called central in the studies related to digital divide. Rather, more attention is dedicated to specific digital solutions, such as e-government. The analysis performed in the VOSviewer software has identified two clusters where the notion of adoption occurs, which we have categorised according to their conceptual meaning (Table 1).

Table 1. The results of cluster analysis

Parameter	Cluster 1 and Cluster 2 combined
Solutions/services	Digital communication Digital government e-government e-commerce Online services Creative economy
Skills	ICT-skills e-readiness
Stakeholders	Local government
Adoption	Technology adoption/Adoption
Purposes	Economic development Creative economy

Note: based on VOSviewer.

The Table 1 shows that the adoption topic discussed in the selected scope of articles is related to such solutions as digital or online government, online services and e-commerce, creative economy, and digital communication. They all require skills in information and communication technology domain which might be part of e-readiness. Economic development or creative economy as purpose indicates a trend pertaining to the level of analysis in the research: country or cross-country level. Based on the afore-said and due to the fact that technology adoption does not always refer to consumer adoption, the article proceeds to review the digital divide in detail, its relations with ICT (digital) skills and consumer adoption of SCS for discovering the empirical studies prospects.

DIGITAL DIVIDE

Based on search in the Scopus database, the first article on the digital divide was published in 1970 and was related to dividing signals while transposing speech digitally [Thomas, Flavin, 1970]. However, the term in the relevant definition was coined in the 1990s by Lloyd Morrisett, the former president of the Markle Foundation [Bartikowski et al., 2018]. Digital divide might be defined as “the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard to their opportunities to access information and communication technologies and to their use for a wide variety of activities” [Understanding the Digital Divide, 2001, p. 5]. In other words, digital divide is referred to different opportunities in the adoption of digital solutions [Sánchez-Torres, 2019]. A broader definition adds a beneficial use of such solutions and the difference between people due to the access to the digital solutions and their effective or ineffective use [Oni, 2013]. The phenomenon of the digital divide has been scrutinised from a variety of angles [Afshar, Alam, Taylor, 2019]. The digital divide articles can be bifurcated into country [Bilon, Lera-Lopez, Rocío Marco, 2010] and cross-country level [Quibria et al., 2003] vs. individual level [Bartikowski et al., 2018; Chipeva et al., 2018; Goncalves, Oliveira, Cruz-Jesus, 2018; Sánchez-Torres, 2019].

Researchers distinguish three levels of digital divide. The first one relates to the connectivity (Figure 3), the second one is concentrated on digital skills and competences (Figure 4) required for digital solutions whereas the third level measures the tangible outcomes of such use [Scheerder, Van Deursen, Van Dijk, 2017]. The first level digital divide implies the availability or a lack of access to digitalised solutions, which practically represented a dichotomy: “a separation between the ‘haves’ and ‘have nots’” [Helbig, Gil-Garcia, Ferro, 2009, p. 3]. This approach has been further enhanced with the multidimensional consideration of digital divide triggered by social, political, educational, and economic factors. Since it is believed that the abovementioned factors tend to be eventually eliminated, this type of digital divide is prone to cease to exist [Van Dijk, Hacker, 2003, p. 315]. Hence, the debate has been transformed to adoption rather than access [Connolly, Lee, Tan, 2016].

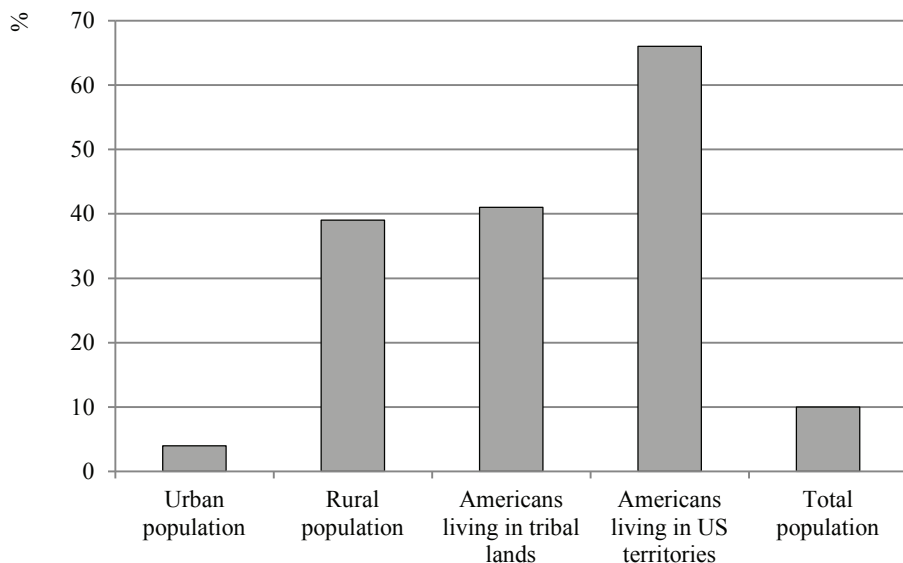


Figure 3. The digital divide in the USA: Americans without access to high-speed Internet service, 2016

Source: statista.com. URL: <https://www.statista.com/chart/5134/broadband-connectivity-in-the-us/> (accessed: 05.06.2020).

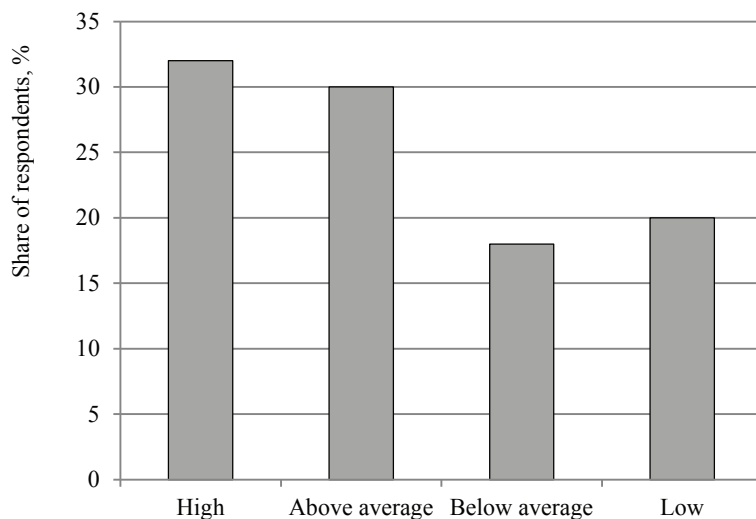


Figure 4. Distribution of Russians by level of digital competence, 2020

Note: based on VCIOM data in April 2020 as a result of telephone interviews of 1 600 respondents of 18 years and older.

Source: statista.com. URL: <https://www.statista.com/statistics/1120117/population-share-by-digital-competence-level-russia/> (accessed: 05.06.2020).

Once the access has been granted, a prospective user encounters the challenge of how to use those digital solutions which most of the times relate to different form of use [Goncalves, Oliveira, Cruz-Jesus, 2018; Salemink, Strijker, Bosworth, 2015].

The second level digital divide deals with the abilities required to use digital solutions, namely digital skills [Scheerder, Van Deursen, Van Dijk, 2017] as well as knowledge [Afshar, Alam, Taylor, 2019]. Digital divide is, hence, associated with adoption and acceptance as opposed to access [Connolly, Lee, Tan, 2016], indicating the gap between “knowledge rich” and the “knowledge poor” [Hill, Dhanda, 2004]. Digital divide refers to the digital skills required to engage with the solutions being meaningful to their needs [Hargittai, Hinnant, 2008], therefore acknowledging the differentiated use [Reisdorf, Rickard, 2018], which in turn introduces the third level digital divide.

The third level digital divide occurs when a user does not realise the benefits offered by digital solutions or “beneficial outcome of the Internet use” [Scheerder, Van Deursen, Van Dijk, 2017, p. 1609]. The aspect of the beneficial outcome for an individual tends to be overlooked by researchers [Connolly, Lee, Tan, 2016], while 2013 Pew Research Center Survey unveiled the fact that the majority of Americans who do not use the Internet explained it with such a factor as a lack of digital literacy (32%), whereas 34% claimed that they consider it merely irrelevant for them [Zickuhr, 2013]. The holistic picture of the three levels digital divide is given in Figure 5.

Based on the literature, the factors which are regarded relevant for any digital divide are related to the country context, aptitude, competence and outcomes [Sánchez-Torres, 2019]. Most of the times people have a choice to adopt or reject digital solutions given the fact the infrastructure is provided. Studies distinguish determinants of the digital divide, such as social status, age and education [Campos, Arrazola, de Hevia, 2017; Quan-Haase et al., 2018], gender divide [Badran, 2014], rural vs. urban location [Nedungadi et al., 2018], as well as national income and GDP [Billon et al., 2009; Afshar, Alam, Taylor, 2019]. Other studies relate to a digital divide on an individual level — from the consumers’ perspective [Goncalves, Oliveira, Cruz-Jesus, 2018; Chipeva et al., 2018].

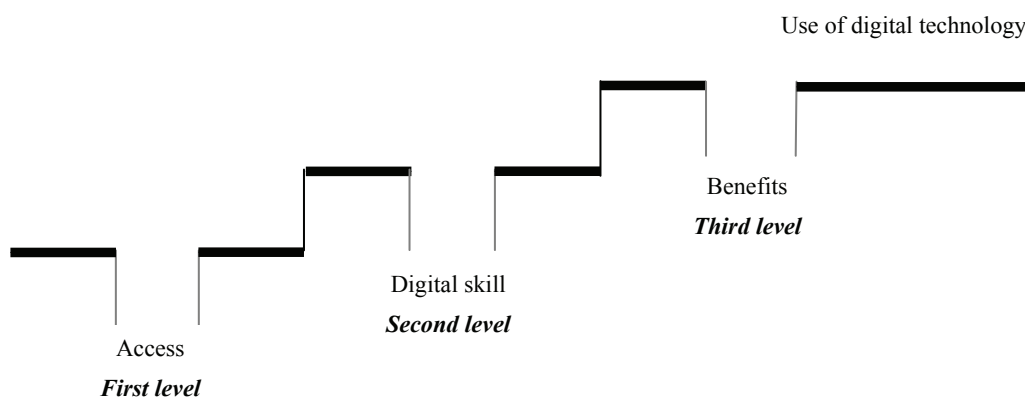


Figure 5. Three levels of digital divides

Interestingly, as it can be noticed in the figure above the divides are similar to the motivation, opportunity, ability (MOA) framework, whereby motivation is a benefit or envisaged beneficial outcome (third level digital divide), opportunity is access (first level digital divide), and ability is digital skills (second level digital divide). M. Beam, J. Hmielowski and M. Hutchens [Beam, Hmielowski, Hutchens, 2018] used MOA theoretical framework to analyse the factors for online reading and sharing [Beam, Hmielowski, Hutchens, 2018]. This leads to the idea of not a levelled representation of the digital divides if the units of analysis are individuals, yet a holistic consideration of all the factors simultaneously.

It might happen that prospective users understand the benefits they obtain from the use of this solution first, so that there is no third level digital divide. Further, they might ensure they have the access to such solutions and consider their digital skills or master them in order to use the solution. In other words, the provided benefits motivate bridging digital divides: the user might get the required digital skills or overcome an access gap by buying a digital gadget, for instance. Thus, the structure of the digital divide appears to represent a non-linear phenomenon where the prospective user of the digital solutions might depart from any point to cover and mitigate the digital divide: either from digital skills, access or benefits

CONSUMER ADOPTION OF SMART CITY SOLUTIONS

Smart city solutions are primarily aimed at improving people's quality of life by offering a more convenient and efficient solution to the existing challenges comparing to the extant solutions, which makes them a one-step-forward innovations, namely, incremental [Heath et al., 2015]. The implementation of SCS entails large technology spending (Figure 6).

Hence, for effective investments the aspect of consumer adoption plays a pivotal role. The motivation to adopt the offered digital technology or data-based solutions might be their convenience, monetary and time efficiency, as well as contribution to environmental sustainability. The example of the latter could be no extra pollution of the environment due to the search for a parking area through a smart parking application, which provides all the required information on the vacant sites, price and time to the destination, compares the options to find the optimal alternative. Such factors are considered in various types of smart sustainable solutions: environmentally beneficial technology, such as solar panels [Bollinger, Gillingham, 2012], electric or alternative fuel automobiles [Hackbarth, Madlener, 2013; Tanaka et al., 2014], as well as other green technologies [Heidenreich, Spieth, Petschnig, 2017] and smart technologies [Ruhlandt, 2018].

The factor of environmental sustainability is implied in SCS which is based on digital and data-based technology, such as e-government [Okunola, Rowley, Johnson, 2017; Faulkner, Jorgensen, Koufariotis, 2019], which minimizes or eliminates the use of paper and need for commuting to receive any required service.

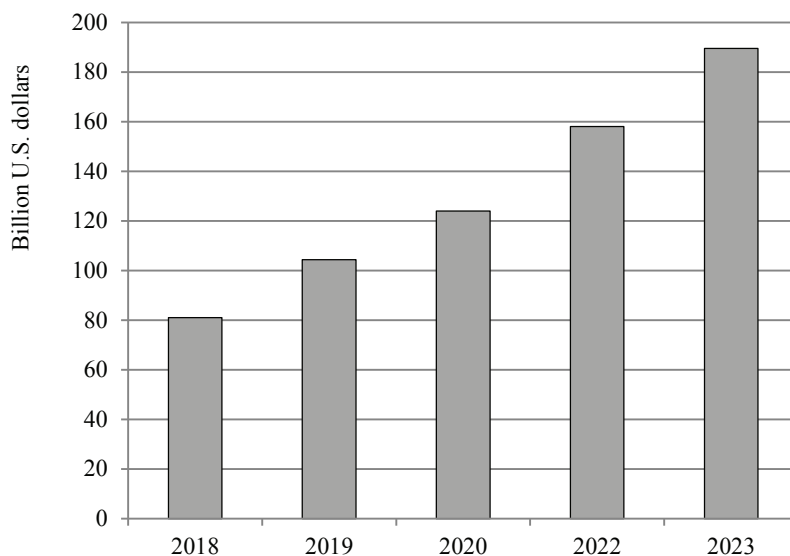


Figure 6. Technology spending into smart city initiatives worldwide, 2018–2023, billion US dollars

Source: statista.com. URL: <https://www.statista.com/statistics/884092/worldwide-spending-smart-city-initiatives/> (accessed: 05.06.2020).

Smart city solutions are commonplace in the context of smart cities. Extending the research by McKinsey Global Institute in 2018 [Woetzel, Kuznetsova, 2018] the determinants of SCS are a digital and/or data-based nature of the solution; aiming at addressing a public problem in a city; representing a step ahead compared to the extant services; implying the engagement of citizens into co-creation of services; a major role is played by cities in their adoption by providing access, among other things. Taking together, such yardsticks imply that smart city solutions are a special case of technological innovations which are aimed at improving the quality of life by providing the utility to the user as well as contributing to the sustainability and requiring active cities' and citizens' participation. Citizens' participation in such solutions entails the focus on citizens and their needs [Mueller et al., 2018], which is also called the citizen centricity [Lee, Lee, 2014]. The aspect of collaboration, in turn, might lead to more willing adoption of SCS on the consumers' part [Malchenko, Smirnova, 2019]. From the practitioner's perspective, the digital divide might be considered critical from the perspective of sustainable development goals [Hidalgo et al., 2020], such as goal No. 11 Sustainable cities and communities, No. 9 Industry, innovation and infrastructure, and No. 17 Partnership for the goals which are in turn part of SCS.

By definition SCS are provided by smart cities, that is why there is no gap in their accessibility. Indeed, smart city solutions are part of smart cities, hence, the access to such solutions is already granted, which eliminates the first level digital divide. This

assumption holds considering there is a technical access on the citizens' (consumers') part. Due to the nascent nature of smart city, its "strategic vision [is] to reach sustainable futures, rather than a description of reality in a current context" [Kummitha, Crutzen, 2017, p. 44], the focus on digital native is recommended primarily as target audience in the ubiquitous information systems [Vodanovich, Sundaram, Myers, 2010], such as SCS. We assume digital natives all have the technical access to SCS (gadgets and the Internet). Given the same assumption we proceed with the idea of digital skills and competence have been acquired by the digital natives as they demand digital solutions as such [Prensky, 2001; Vodanovich, Sundaram, Myers, 2010]. This is in line with the recent statistics as a result of a survey of 1 600 respondents in Russia showing that Russians with a high level of digital literacy were aged 36 years on average as of April 2020¹.

However, the skills of using the predecessors of SCS might or might not be obtained. Such skills are mostly developed via personal experience, however, according to Social Cognitive Theory they might also be acquired via observations [Bandura, 1986]. Hence, SCS skills acquisition is related to cognition and further competence as the result of such cognition. The next level represents the envisaged benefits for adoption of SCS solution. Intuitively, citizens in the same smart city might be divided into those who use SCS and who do not. Experience of SCS or their predecessors yield the skills pertaining to SCS and the level of satisfaction might be aligned with the second level digital divide. The third level digital divide might be regarded as the relevance of SC solutions with regard to their perceived usefulness and attitude to them. Cognition and competence is related to innovativeness and willingness to deal with SC solutions.

The model represented in Figure 7 is in line with the MOA framework, where motivation is benefits; opportunity is the provided access which goes without saying within the context of smart cities; ability is cognition and competence.

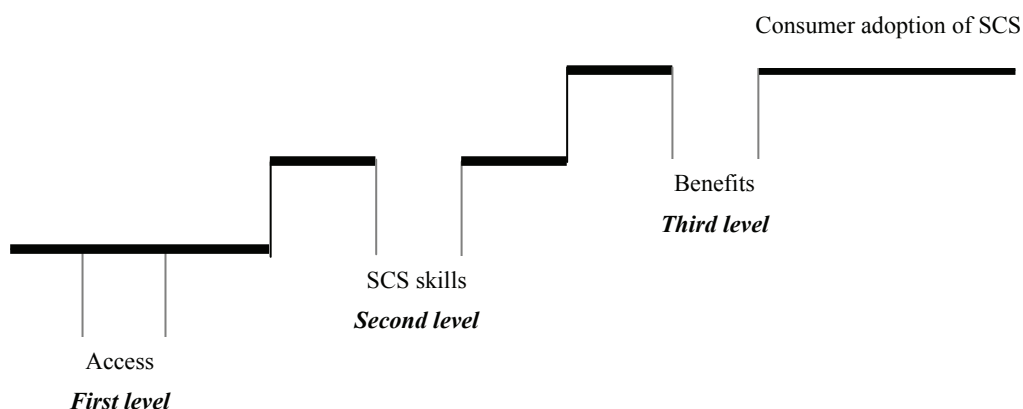


Figure 7. Three levels of digital divide pertaining to smart city solutions

¹ See: statista.com. URL: <https://www.statista.com/statistics/1120121/average-age-digital-literacy-level-russia/> (accessed: 05.06.2020).

The digital divide is regarded not as a challenge of access but rather a challenge of engagement [Hennessy, Lapple, Moran, 2016]. Thus, the factors of consumer adoption of SCS embrace motivation, cognition, and competence. Interestingly, cognition represents continuum whilst competence is the outcome of such cognition or experience. Similarly, to the corporate push to innovate and improve through learning [Iansiti, Richards, 2020], consumers might have the cognition drive for their own benefit which motivates them to augment their competence. Such a drive appears to have a relationship with personal innovativeness [Yeh, 2017]. It is worth noting that similarly to the digital divide, SCS divide might be regarded starting first from the benefits point of view and proceeding to the consideration of SCS skills required to it or vice versa. In case of lack of any experience related to SCS, cognition plays a role instigating to acquire the skills. This competence might be obtained merely on the basis of digital skills, which by default are there in digital natives, and based on the exposure to similar solutions.

Following the recent research by [Bartikowski et al., 2018] who distinguished the type of internet access (mobile or computer) as a new and underexplored form of digital divide, it is considered feasible to distinguish the adoption vs. non-adoption of SCS as another type of digital divide — a perspective embracing the second and the third level of digital divide. Citizens who have already used one of SCS have acquired SCS skills and may well be willing to continue using such solutions further. This leads to the second level digital divide which distinguishes digital skills as a factor hindering further consumer adoption of novel solutions. The perception of utility from the use of SCS is in line with the third level digital divide [Scheerder, Van Deursen, Van Dijk, 2017].

The usage-related outcomes [Van Dijk, 2006; Sánchez-Torres, 2019] as the factors of digital divide in the context of smart cities appear to be related to the usage or experience with the SCS predecessor. Primary experience (either by the prospective consumers themselves or through the observation from others) with the predecessor of SCS or a similar solution plays a role in consumer adoption of the novel SCS. Thus, while measuring the acceptance of the novel SCS studies should consider previous experience.

The aforesaid factors related to motivation, cognition and competence including the experience with the predecessor of SCS are further elaborated in the propositions which are enriched with the perspectives found in literature.

PROPOSITIONS FOR FUTURE RESEARCH

Research on the second-level digital divide pertaining to the Internet in general regards skills as one of the factors influencing adoption. The Internet skill is related to the ability to manage online privacy. Motivation and cognitive ability could also play a paramount role in predicting Internet news use [Beam, Hmielowski, Hutchens, 2018]. Consumers have to weigh up the opportunities they obtain with the adoption of SCS, in other words, their usefulness or utility. Further, consumers may need to learn which SCS are relevant to them, therefore, the ability to identify and prioritise the SCS which are crucial for them is also required. Thus, since the opportunity is provided in the form of

SCS, motivation, cognition and competence (skills) are considered factors determining adoption. Ability is basically referred to cognitive ability. What is important is not only to take into consideration the effects of cognitive ability and motivation separately but also to combine them with digital skills [Beam, Hmielowski, Hutchens, 2018], which yields motivation, cognition and competence as the factors influencing consumer adoption of SCS. Research has discovered that proficiency in digital privacy skills plays a positive and direct role in influencing levels of literacy, for instance of eHealth literacy [Li, 2018].

Proposition 1. Motivation, cognition, digital skills and competence influence the intention to adopt smart city solutions.

Proposition 2. Privacy concerns impact cognition and competence, which in turn influences the willingness to adopt smart city solutions.

Similar to the previous research where motivation towards online news reading and sharing was determined by such factors as individual levels of political interest [Beam, Hmielowski, Hutchens, 2018], prospective consumers' willingness to contribute to the comfort and sustainability of the city might motivate them to adopt SCS. Following the idea of relevance of the context in the digital divide [Sánchez-Torres, 2019] and considering affective commitment related to joy, love [Bergami, Bagozzi, 2000] and social attachment to the city [Yeh, 2017] might play a role. S. J. Levy [Levy, 1959] indicated that consumers use smartphones not only for what they can do but also for what these possessions mean to them. We would like to apply the same logic to the use of services which are relevant to smart cities, therefore, through the engagement and participation in creating and adjusting SCS they signal their identity and attitude to the place they live. Hence, the assumption related to the attitude to the city which influences consumer adoption of SCS is given below.

Proposition 3. Commitment, attitude to the city, participation in the city's life and envisaged joy predetermine the consumer willingness to adopt smart city solutions.

The research regarding digital divide at individual level proposes behavioural factors as antecedents of closing the divide. B. Bartikowski with coauthors argue that "each person idiosyncratically perceives how internet use affects his or her life" [Bartikowski et al., 2018, p. 376], which requires theories investigating this aspect, such as Theory of Planned Behavior, which posits that the factors influencing intention to adopt are attitude, subjective norm, perceived behavioural control [Ajzen, 1991]. The attitude to SCS in general and individual SCS in particular could determine further consumer adoption or rejection of SCS. Subjective norm is in line with social influence being part of Unified Theory of Acceptance and Use of Technology [Venkatesh et al., 2003].

Proposition 4. Attitude, subjective norm, perceived behavioural control towards the use of smart city solutions influence the intention to adopt them.

B. Bartikowski, M. Laroche, A. Jamal, Zh. Yang [Bartikowski et al., 2018] proposed that further studies should measure the intensity of internet usage, which leads to the necessity to regard intensity of usage of predecessors of SCS and satisfaction from such usage in the research related to SCS adoption. Another study confirms that satisfaction

is relevant [Pénard, Poussing, Suire, 2013]. The matter is that unlike internet, SCS usually are based on the previous solution with certain step forward, which makes them an incremental innovation. Based on that, it is crucial to consider satisfaction with the predecessor to understand the prospective consumer perception of the novel SCS. The idea of the experience with the predecessor of the solution is in line with the research by [Okunola, Rowley, Johnson, 2017] who outline previous Internet experience and previous e-government experience as the dimensions of digital divide. Taking into account a proposed [Bartikowski et al., 2018] avenue for future research regarding grasping the extent of the Internet usage intensity on different devices to gain an overwhelming picture we propose to take into account the previous usage of the predecessor of SCS to capture the interest and motivation to update it to the next level — SCS.

Proposition 5. Previous experience, namely satisfaction vs. dissatisfaction, intensity of usage of the predecessor of the smart city solutions influence the acceptance of novel smart city solutions.

Proposition 6. Acceptance of smart city solutions is related to the requirement in advanced smart city solutions.

Due to the fact that satisfaction relates to specific incidents, while quality is related to relationship, incident-level and relationship-level assessments should be considered as complementary measurements [Bartikowski et al., 2018]. The user-friendliness of SCS usually is an attribute of SCS, which is referred to their quality. B. Sapio with coauthors [Sapio et al., 2010] considered perceived ease of use being part of TAM model [Davis, 1989; Song, Parry, Kawakami, 2009] as an important aspect of usability. An intuitive aspect of usability of ubiquitous information systems was outlined by [Vodanovich, Sundaram, Myers, 2010]. As technology becomes more and more user-friendly, it yields an improvement in the performance of its use [Sánchez-Torres, 2019]. Findings by [Hakkarainen, 2012] show that those who do not see any utility of information technology in their life choose to be non-adopters. Nevertheless, if a predecessor solution is mandatory (for instance, e-governmental portal without any brick-and-mortar governmental offices for receiving services) and there is a more advanced version of such a service, then the question of the relevance and adoption rises. Another important fact is that SCS usually offer the utility which was proven to be relevant to citizens. Practical researchers and market specialists organise polls and surveys to discover the demand for a certain SCS (for instance, a poll of Saint Petersburg citizens on adoption of smart city technologies in 2017 conducted by Information Technologies, Mechanics and Optics University, Russia). Utility or perceived usefulness, the other aspect of Technology Acceptance Model (TAM) [Davis, 1993] and practicality are the factors which influence adoption of such a digital solution. According to prior research mentioned by [Sánchez-Torres, 2019], the factor influencing e-commerce acceptance is enjoyment. Attractiveness plays a role in adoption of technology [Sapio et al., 2010]. This is in line with the research pertaining to digital natives for whom attractiveness is one of the main characteristics of usability [Vodanovich, Sundaram, Myers, 2010].

Proposition 7. Perceived ease of use, perceived quality, and perceived benefit motivate the willingness to adopt smart city solutions.

Proposition 8. Enjoyment and attractiveness motivate the willingness to adopt smart city solutions.

Among other factors, A. Habib, D. Alsmadi, V. Prybutok [Habib, Alsmadi, Prybutok, 2019] highlighted trust in technology and trust in government as an antecedent of subsequent adoption of SCS. We would propose to extend the frontiers of such a definition to the civil trust concept, at the same time removing trust in the government variable due to the fact that solutions offered are encouraged to be offered from the bottom-up perspective [Lee, Lee, 2014].

Proposition 9. Civic trust correlates with the motivation to adopt smart city solutions.

According to Diffusion of Innovations Theory [Rogers, 1995] innovativeness in trying novel products relates to the willingness to adopt such products. This is in line with the study by [Ferro, Helbig, Gil-Garcia, 2011] which metaphorically represented the IT skills acquisition levels as the athletes (related to innovators), the laidback (related to early and late majority) and the needy (related to laggards). Individuals with various attitudes to innovation and risk embodied in security and privacy as well as skill acquisition will have different levels of willingness to adopt SCS.

Proposition 10. Innovativeness and risk attitude influence the intention to adopt novel smart city solutions.

Studies have identified the necessity to envisage consumers heterogeneously [Connolly, Lee, Tan, 2016] paying attention to the education and gender [Quibria et al., 2003; Afshar, Alam, Taylor, 2019; Badran, 2014], employment status [Campos, Arrazola, de Hevia, 2017], age [Okunola, Rowley, Johnson, 2017] which was referred to “grey divide” [Quan-Haase et al., 2018], location, and income [Okunola, Rowley, Johnson, 2017]. Since SCS are usually offered free of charge and within the smart city, location and income might be disregarded. Studies suggest that “consumer innovators and early adopters tend to be younger, have higher levels of income, and are more educated” [Stump, Gong, Li, 2008, p. 399]

Proposition 11. Age, gender, employment status and level of education influence the willingness to adopt smart city solutions.

CONCLUSION

The topic of digital divide has been broadly discussed from various angles: from the cross-country and country to the individual levels. With the increase of accessibility and availability of digital solutions the relevance of studying the individual level of digital divide augments. In other words, the question of what factors lie in the individual's acceptance of digital solutions has gathered pace. This is in line with citizen-centricity trend [Lee, Lee, 2014] aimed at satisfying consumer requirements in services and products. This paper has explored the antecedents of consumer adoption on the special case

of digital solutions — smart city solutions represented the interest among academia [Habib, Alsmadi, Prybutok, 2019] and practical researchers [Woetzel, Kuznetsova, 2018]. SCS are defined in this research as the incremental innovations based on digital and data-based technology and the existing solutions of urban problems, which are aimed to improve citizens' quality of life, contribute to environmental sustainability, in adoption of which cities play a role (by providing infrastructure and access) and which imply citizens' participation, for instance, in the process of co-creation or adjustment of SCS and voting for their necessity. The case of consumer adoption of SCS is particularly interesting due to its infancy and multifaceted nature [Malchenko, Smirnova, 2019], which makes it rather a comprehensive topic with a large array of constructs.

The present research has investigated the question of consumer adoption of smart city solutions from the digital divide point of view via two steps. First, the article has scrutinised a large scope of papers pertaining to digital divide, analysed the three levels of digital divide from the bird's-eye view and identified the MOA theoretical framework underlying it. Secondly, the article has delved into adapting the MOA framework to the SCS from the digital natives' perspective, which resulted in motivation, cognition, competence as factors playing a role in the consumer adoption of SCS. The paper proceeded to the propositions related to each of the factor based on the extant research. Theoretically, the study has proposed a novel framework which can be used in research pertaining to SCS as well as sustainable solutions based on digital or data-based technology. Further, the research has proposed the factors which are to be considered when studying the potential consumer adoption of novel SCS, data-based or digital solutions, which can be a roadmap for the policy makers and digital service/product providers who are considering the launch of such solutions or adjusting the existing ones for facilitating consumer adoption. Despite the abovementioned contributions to academic and practical fields, this study has limitations. The focus on digital natives who have the access to digital resources and use them actively as prospective adopters of SCS, although having been recommended by the extant studies [Vodanovich, Sundaram, Myers, 2010] might overlook the factors which could be relevant to digital immigrants as consumers of SCS. This aspect might represent an interesting avenue for future research.

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References

- Ajzen I. 1991. The theory of planned behavior. *Organizational Behavior and Human Decision Processes* **50** (2): 179–211.
- Afshar A. M., Alam K., Taylor B. 2020. Do social exclusion and remoteness explain the digital divide in Australia? Evidence from a panel data estimation approach. *Economics of Innovation and New Technology* **29** (6): 643–659.

- Badran M. F. 2014. Young people and the digital divide in Egypt: An empirical study. *Eurasian Economic Review* 4 (2): 223–250.
- Bandura A. 1986. *Social Foundations of Thought and Action: A Social Cognitive Theory*. Englewood Cliffs, NJ: Prentice-Hall.
- Bartikowski B., Laroche M., Jamal A., Yang Zh. 2018. The type-of-internet- access digital divide and the well-being of ethnic minority and majority consumers: A multi-country investigation. *Journal of Business Research* 82: 373–380.
- Bartolacci F., Caputo A., Soverchia M. 2020. Sustainability and financial performance of small and medium sized enterprises: A bibliometric and systematic literature review. *Business Strategy and the Environment* 29 (3): 1297–1309.
- Beam M. A., Hmielowski J. D., Hutchens M. J. 2018. Democratic digital inequalities: Threat and opportunity in online citizenship from motivation and ability. *American Behavioral Scientist* 62 (8): 1079–1096.
- Bergami M., Bagozzi R. P. 2000. Self-categorization, affective commitment and group self-esteem as distinct aspects of social identity in the organization. *British Journal of Social Psychology* 39: 555–577.
- Billon M., Lera-Lopez F., Marco R. 2010. Differences in digitalization levels: A multivariate analysis studying the global digital divide. *Review of World Economics* 146 (1): 39–73.
- Bollinger B., Gillingham K. 2012. Peer effects in the diffusion of solar photovoltaic panels. *Marketing Science* 31 (6): 900–912.
- Campos R., Arrazola M., de Hevia J. 2017. Economic crisis and benefits of the Internet: Differentiated Internet usage by employment status. *Economics of Innovation and New Technology* 26 (3): 269–294.
- Chipeva P., Cruz-Jesus F., Oliveira T., Irani Z. 2018. Digital divide at individual level: Evidence for Eastern and Western European countries. *Government Information Quarterly* 35: 460–479.
- Connolly M., Lee C., Tan R. 2016. The digital divide and other economic considerations for network neutrality. *Review of Industrial Organization* 50 (4): 537–554.
- Davis F. D. 1989. Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly* 13 (3): 319–339.
- Donthu N., Kumar S., Pattnaik D. 2020. Forty-five years of journal of business research: A bibliometric analysis. *Journal of Business Research* 109: 1–14.
- Faulkner N., Jorgensen B., Koufariotis G. 2019. Can behavioural interventions increase citizens' use of e-government? Evidence from a quasi-experimental trial. *Government Information Quarterly* 36 (1): 61–68.
- Ferro E., Helbig N. C., Gil-Garcia J. R. 2011. The role of IT literacy in defining digital divide policy needs. *Government Information Quarterly* 28 (1): 3–10.
- Goncalves G., Oliveira T., Cruz-Jesus F. 2018. Understanding individual-level digital divide: Evidence of an African country. *Computers in Human Behaviour* 87: 276–291.
- Habib A., Alsmadi D., Prybutok V. R. 2019. Factors that determine residents' acceptance of smart city technologies. *Behaviour and Information Technology* 39 (6): 610–623.
- Hackbarth A., Madlener R. 2013. Consumer preferences for alternative fuel vehicles: A discrete choice analysis. *Transportation Research Part D: Transport and Environment* 25: 5–17.
- Hakkarainen P. 2012. 'No good for shovelling snow and carrying firewood': Social representations of computers and the internet by elderly Finnish non-users. *New Media and Society* 14 (7): 1198–1215.
- Hargittai E., Hinnant A. 2008. Digital inequality differences in young adults' use of the Internet. *Communication Research* 35 (5): 602–621.
- Hawash R., Lang G. 2019. Does the digital gap matter? Estimating the impact of ICT on productivity in developing countries. *Eurasian Economic Review* 10 (2): 189–209.

- Heath T. B., Chatterjee S., Basuroy S., Hennig-Thurau T., Kocher B. 2015. Innovation sequences over iterated offerings: A relative innovation, comfort, and stimulation framework of consumer responses. *Journal of Marketing* **79**: 71–93.
- Heidenreich S., Spieth P., Petschnig M. 2017. Ready, steady, green: Examining the effectiveness of external policies to enhance the adoption of eco-friendly innovations. *Journal of Product Innovation Management* **34** (3): 343–359.
- Helbig N. C., Gil-Garcia J. R., Ferro E. 2009. Understanding the complexity of electronic government: Implications from the digital divide literature. *Government Information Quarterly* **26** (1): 89–97.
- Hennessy T., Läßle D., Moran B. 2016. The digital divide in farming: A problem of access or engagement? *Applied Economic Perspectives and Policy* **38** (3): 474–491.
- Hidalgo A., Gabaly S., Morales-Alonso G., Urueña A. 2020. The digital divide in light of sustainable development: An approach through advanced machine learning techniques. *Technological Forecasting and Social Change* **150** (C): 119754.
- Hill R. P., Dhanda K. K. 2004. Globalization and technological achievement: Implications for macro-marketing and the digital divide. *Journal of Macromarketing* **24** (2): 147–155.
- Iansiti M., Richards G. 2020. Coronavirus is widening the corporate digital divide. URL: <https://hbr.org/2020/03/coronavirus-is-widening-the-corporate-digital-divide> (accessed: 14.04.2020).
- Kummitha R. K. R., Crutzen N. 2017. How do we understand smart cities? An evolutionary perspective. *Cities* **67**: 43–52.
- Lee J., Lee H. 2014. Developing and validating a citizen-centric typology for smart city services. *Government Information Quarterly* **31** (1): 93–105.
- Levy S. J. 1959. Symbols for sale. *Harvard Business Review* **37** (4): 117–124.
- Li X. 2018. Understanding eHealth literacy from a privacy perspective: eHealth literacy and digital privacy skills in American disadvantaged communities. *American Behavioral Scientist* **62** (10): 1431–1449.
- Lissitsa S., Kol O. 2016. Generation X vs. generation Y — A decade of online shopping. *Journal of Retailing and Consumer Services* **31**: 304–312.
- Malchenko Yu. A., Smirnova M. M. 2019. What drives consumers smart? The challenge of adoption of smart city solutions. *Russian Management Journal* **17** (3): 387–410.
- Milanesi C. 2020. Digital transformation and digital divide post COVID-19. URL: <https://www.forbes.com/sites/carolinamilanesi/2020/05/11/digital-transformation-and-digital-divide-post-covid-19/#1736a7191656> (accessed: 08.04.2020).
- Mueller J., Lu H., Chirkin A., Klein B., Schmitt G. 2018. Citizen Design Science: A strategy for crowd-creative urban design. *Cities* **72**: 181–188.
- Nedungadi P. P., Menon R., Gutjahr G., Erickson L., Raman R. 2018. Towards an inclusive digital literacy framework for digital India. *Education and Training* **60** (6): 516–528.
- Okunola O. M., Rowley J., Johnson F. 2017. The multi-dimensional digital divide: Perspectives from an e-government portal in Nigeria. *Government Information Quarterly* **34** (2): 329–339.
- Oni A. O. 2013. Digital divide — a challenge to the real estate practice in Nigeria? *Property Management* **31** (1): 22–38.
- Pénard T., Poussing N., Suire R. 2013. Does the Internet make people happier? *Journal of Socio-Economics* **46**: 105–116.
- Prensky M. 2001. Digital natives, digital immigrants. *On Horizon* **9** (5): 1–15.
- Quan-Haase A., Williams C., Kicevski M., Elueze I., Wellman B. 2018. Dividing the grey divide: Deconstructing myths about older adults' online activities, skills, and attitudes. *American Behavioral Scientist* **62** (9): 1207–1228.
- Quibria M. G., Ahmed S. N., Tschang T., Reyes-Macasaquit M.-L. 2003. Digital divide: Determinants and policies with special reference to Asia. *Journal of Asian Economics* **13** (6): 811–825.

- Reisdorf B. C., Rikard R. V. 2018. Digital rehabilitation: A model of reentry into the digital age. *American Behavioral Scientist* **62** (9): 1273–1290.
- Rogers E. M. 1995. *Diffusion of Innovations*. 4th ed. New York: Free Press.
- Rogers E. M. 2003. *Diffusion of Innovations*. 5th ed. New York: Free Press.
- Ruhlandt R. W. S. 2018. The governance of smart cities: A systematic literature review. *Cities* (81): 1–23.
- Salemink K., Strijker D., Bosworth G. 2015. Rural development in the digital age: A systematic literature review on unequal ICT availability, adoption, and use in rural areas. *Journal of Rural Studies* **54**: 360–371.
- Sánchez-Torres J. A. 2019. Moderating effect of the digital divide of e-commerce. *International Journal of Social Economics* **46** (12): 1387–1400.
- Sapio B., Turk T., Cornacchi M., Papa F., Nicolò E., Livi S. 2010. Building scenarios of digital television adoption: A pilot study. *Technology Analysis and Strategic Management* **22** (1): 43–63.
- Scheerder A., Van Deursen A., Van Dijk J. 2017. Determinants of Internet skills, uses and outcomes: A systematic review of the second- and third-level digital divide. *Telematics and Informatics* **34**: 1607–1624.
- Song M., Parry M. E., Kawakami T. 2009. Incorporating network externalities into the technology acceptance model. *Journal of Product Innovation Management* (26): 291–307.
- Stump R. L., Gong W., Li Zh. 2008. Exploring the digital divide in mobile-phone adoption levels across countries: Do population socioeconomic traits operate in the same manner as their individual-level demographic counterparts? *Journal of Macromarketing* **28**: 397–412.
- Tanaka M., Ida T., Murakami K., Friedman L. 2014. Consumers' willingness to pay for alternative fuel vehicles: A comparative discrete choice analysis between the US and Japan. *Transportation Research Part A: Policy and Practice* **70**: 194–209.
- Thomas I. B., Flavin F. E. 1970. Intelligibility of speech transposed downward in frequency by one octave. *Journal of the Audio Engineering Society* **18** (1): 56–62.
- Understanding the Digital Divide*. 2001. Paris: OECD.
- Van Dijk J., Hacker K. 2003. The digital divide as a complex and dynamic phenomenon. *The Information Society* **19**: 315–326.
- Van Dijk J. A. G. M. 2006. Digital divide research, achievements and shortcomings. *Poetics* **34** (4–5): 221–235.
- Venkatesh V., Morris M. G., Davis G. B., Davis F. D. 2003. User acceptance of information technology: Toward a unified view. *MIS Quarterly* **27**: 425–478.
- Vodanovich Sh., Sundaram D., Myers M. 2010. Digital natives and ubiquitous information systems. *Information Systems Research* **21** (4): 711–723.
- Woetzel J., Kuznetsova E. 2018. *Smart City Solutions: What Drives Citizen Adoption around the Globe?* McKinsey Center for Government. McKinsey & Company.
- Yeh H. 2017. The effects of successful ICT-based smart city services: From citizens' perspectives. *Government Information Quarterly* **34**: 556–565.
- Zickuhr K. Who's not online and why. 2013. *Pew Research Center*. URL: <https://www.pewresearch.org/internet/2013/09/25/whos-not-online-and-why/> (accessed: 17.05.2020).

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ОТ ЦИФРОВОГО БАРЬЕРА К НАМЕРЕНИЮ ИСПОЛЬЗОВАТЬ ТЕХНОЛОГИЧЕСКИЕ РЕШЕНИЯ УМНЫХ ГОРОДОВ: СИСТЕМАТИЧЕСКИЙ ОБЗОР ЛИТЕРАТУРЫ И БИБЛИОМЕТРИЧЕСКИЙ АНАЛИЗ

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На протяжении трех последних десятилетий интерес к проблематике цифрового барьера возрастает, однако малоизученным остается возникновение цифрового барьера у потребителей. Данная тенденция прослеживается в исследованиях, затрагивающих вопросы нежелания потребителей использовать цифровые инновации — технологии и сервисы умных городов, которые предназначены для улучшения качества жизни. Согласно исследованиям, возможность участия потребителей в разработке и модификации таких решений, а также развитие городской инфраструктуры и обеспечение доступа к ней увеличивают их ценность, а значит, и вероятность дальнейшего применения потребителями. В статье посредством библиометрического анализа и систематического обзора литературы исследуются факторы возникновения феномена цифрового барьера, которые связаны с принятием решения об использовании сервисов и технологий умных городов. Цель статьи — изучить предпосылки и факторы, влияющие на принятие решения использовать сервисы и технологии умных городов на уровне потребителей. В работе идентифицированы факторы возникновения цифрового барьера, связанные с мотивацией, познанием и компетенцией, которые следует рассматривать совместно. В связи с многогранностью решений умных городов мотивация использовать эти технологии обусловлена факторами, сформулированными в теории поведения потребителей и в теории принятия решений. Сервисы (технологии) умных городов основываются на существующих решениях городских проблем. Следовательно, компетенция зависит от предыдущего опыта, в то время как познание и инновационность относятся к намерению применять новые решения умных городов. В работе сформулированы предложения для эмпирических исследований по принятию потребителями решений использовать сервисы и технологии умных городов, а также определены факторы, которые необходимо учитывать перед их внедрением.

Ключевые слова: сервисы и технологии умных городов, цифровой барьер, решение использовать сервисы и технологии умных городов, поведение потребителей, модель «мотивация, возможность, способность», познание, компетенция.

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