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TEACHING REQUIREMENTS OF A DIGITISED PUBLIC ADMINISTRATION[1]

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The digitisation of public sector ICT is driven by a number of factors: Increased self-service via the Internet, the Internet of Things (IoT), real-time business intelligence and the advent of integrated information systems as the "backbone" of organisational ICT. This is accentuated by the Covid-19 pandemic. The paper presents an implemented university level teaching programme that covers the topics of integrated information systems for the environment described above. The paper also deals with the research question of how to embed such a programme in a conventional, public sector-oriented university course programme. It details the didactic specificities and analyses the feedback from the roll out and the prior knowledge required from students and the changes in other elements of a public administration course programme necessitated by digitisation orientation. It finally summarises the experience made and illustrates the necessity for further research.

Keywords:
Public Sector Education, ERP, Covid-19, curricular development

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1. REAL-WORLD REQUIREMENTS

1.1. Technology drivers

ICT in the past two decades generally saw the advent of several technological innovations that have had a considerable impact on business information systems:

1. Web-based information systems for customer self-service, whether for ordering, booking services or banking, effectively eliminating whole industries that had acted as intermediaries before (cf. travel agencies).
2. A massive decrease in sensor prices which, together with cloud services, enabled the digitisation of infrastructure, both in manufacturing and in the city infrastructure.[2]
3. In the past few years, real-time business intelligence (BI) has become feasible due to in-memory[3] technology[4] that enables the analysis of unprecedentedly large data sets in sequential mode without building pre-defined aggregation structures.[5]

These innovations have also "arrived" in the public sector. Citizen-centric eGovernment enables citizens to quickly and time-independently process their requests and applications; however, it also means that citizens use self-service functions.[6] Sensor networks render a city infrastructure "intelligent" which then leads to the smart city concept,[7] whose data is input for real-time BI solutions. In this regard, public sector ICT has largely mimicked the evolution in the private sector.

1.2. Covid-19-compatible public administration

As of January 2021, "lockdown" has become a standard instrument of European governments in fighting the pandemic.[8] This typically involves home office. However,

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[2] A Prosser, 'What the Smart City in the Danube Region can Learn from Industry 4.0', in *Proceedings of the CEE e|Dem and e|Gov Days 2018,* ed. by H Hansen, R Müller-Török, A Nemeslaki, A Prosser, D Scola and T Szádeczky (Wien: Facultas, 2018), 191–201.

[3] "In-memory" means that even a multiple terabyte-sized database is loaded in main memory, not on disk any more. The difference in access time is milliseconds (disk) to nanoseconds (main memory), this is an acceleration by 10^6. Schematically speaking, a search task that can be done on disk in 11 days, will take 1 second in main memory. In Europe, particularly SAP has applied in-memory extensively in its product line, even for transactional systems.

[4] T Zhu, D Wang, H Hu, W Qian, X Wang and A Zhou, 'Interactive Transaction Processing for In-Memory Database System', *Database Systems for Advanced Applications,* ed. by J Pei, Y Manolopoulos, Sh Sadiq and J Li (DASFAA, 2018), 228–246.

[5] A Prosser and M-L Ossimitz, *Data Warehouse Management Using SAP® BW* (Stuttgart: UTB für Wissenschaft, 2001), Chapters 3.1, 6.1, 6.2.7.

[6] Useful when formatted data is collected via the web interface, not just free text, for example, via email.

[7] P Neirotti, A De Marco, A C Cagliano, G Mangano and F Scorrano, 'Current trends in Smart City initiatives: Some stylised facts', *Cities* 38 (2014), 25–36.

[8] For an updated overview of measures see https://en.wikipedia.org/wiki/COVID-19_pandemic_in_Europe

home office of clerical public administration staff involves several minimal infrastructural requirements:

1. an electronic workflow system for processing administrative cases including financial and logistics applications
2. VPN[9] for securely accessing the applications
3. a digital interface of submitting applications to the authority feeding the electronic workflow system for processing the cases
4. a digital ID and signature solution both for citizens submitting applications and for civil servants processing them in the workflow component

Ideally this is supplemented by a component for the electronic service to the citizens of the resulting documents produced by the electronic workflow. Covid-19 brutally exposed deficiencies in this regard. Here are some examples from the media:

1. Criminal suspects had to be released because the constitutional time of detention had expired and public prosecutors were unable to fulfil their duties from their lockdown home office for a lack of digital infrastructure.[10]
2. Building activity ceased not only due to Covid-19 but also because building permits were not processed when civil servants were in home office.[11]
3. Students were virtually left to their own resources, when remote schooling was impossible under lockdown conditions.[12]

It is obvious that a massive surge in public sector digitisation is sorely needed, but this not only involves systems and applications, but above all trained personnel able to design, plan, procure and use digital systems in public administration. What does this mean for public administration education, particularly on a university level educating the future leaders in public administration? This paper describes a teaching programme jointly developed by several universities of the Danube Region and already implemented that addresses the issues in the field of ERP systems.

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[9]   A Virtual Private Network (VPN) provides encrypted and authenticated access from remote workstations to central applications and data of an organisation.

[10] Online: www.welt.de/wirtschaft/article207481187/Ausgesetzte-Strafbefehle-Das-Corona-Paradies-fuer-Kriminelle.html

[11] Online: www.tagesspiegel.de/berlin/corona-stau-bei-baugenehmigungen-berliner-bauwirtschaft-klagt-ueber-neue-buerokratische-huerden/25757122.html

[12] Online: www.deutschlandfunk.de/unterricht-im-corona-lockdown-die-huerden-der.724.de.html?dram:article_id=490259

2. THE TEACHING PROGRAMME

2.1. Why focus on Enterprise Resource Planning software (ERP)?

Web applications, mobile apps and sensor networks are but an interface to the "outside world"; they need to be supplemented by a core backbone application landscape of which an ERP system is typically the core, covering financials and logistics, service management, case management and the associated electronic filing and workflows. Sensor data for remote monitoring of maintenance requirements, for instance, or Web/app-based self-service input by citizens and businesses, need to be processed somewhere and linked to existing data. An example: Sensor input indicating that a spare part or component somewhere in the smart city is about to fail, must trigger a service order in the support system, and probably also a procurement process. The costs of such a service order need to be calculated and there has to be a link to the budgeting system. In the absence of such systems, the sensor input and related information will end up nowhere. Digitisation hence organically requires system integration. This is done in an ERP system.[13] ERP systems also increasingly interact with real-time BI applications – both providing input for analyses and receiving analytical results. This works particularly well if BI and ERP systems work on the same (in-memory) data basis.[14] ERP systems are being used in public sector ICT, however, it is our observation that such systems are effectively used only for accounting purposes, and even within accounting, mainly for Budget Management and General Ledger (G/L) Accounting. This, of course, is not the point of an integrated information system. But it appears to be foreseeable that ERP systems already in place will also be used for other purposes, such as materials and service management or procurement.

These systems require the corresponding skills, most importantly (but not exhaustively):
1. thinking in processes as well as tools and methods for process management
2. understanding of process implementation in integrated and customisable information systems (a.k.a. ERP)
3. fundamental understanding of ICT technologies and their application including ICT risk assessment, such as cybersecurity
4. skills in Business Analytics

The universities participating in the programme development agreed on a detailed syllabus and a "storyline" of the case study in each lecture. This involved reconciliation of prior knowledge and the course programme environment of the participants. Each lecture was piloted at least once. The original language of development and piloting was English (for the very practical reason that English was the only language understood by all partners). Additionally, German and Romanian versions were also derived. At the end of each pilot,

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[13] A-W Scheer, *Wirtschaftsinformatik: Referenzmodelle für industrielle Geschäftsprozesse* (Berlin: Springer, 1997).
[14] A Schmitz, *Was ist eigentliche SAP HANA*.

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feedback meetings were held, which included attendees in the pilot lectures used to improve the lecture design. This did not only comprise didactic issues but also inconsistencies in the case or the storyline. Only after a stable state for the cases had been achieved, the book in English language was concluded[15] and the other language derivatives were written.[16]

Technically, the content is implemented in two master clients in SAP ECC, which are copied into the operational client systems, where the lectures are then held.

2.2. The content

The teaching programme consists of three subjects (two semester hours each), implementing a municipality *Civitas.* All subjects have already been rolled out:

A. Process and data modelling with Business Process Modelling Notation (BPMN) 2.0[17] and Entity-Relationship Modelling (ERM)[18] followed by public sector budgeting with SAP® ECC, including budget execution and auditing in the municipality.

The prerequisites are knowledge in accounting, public sector budgeting, auditability principles and – like all the other subjects – a basic understanding of computing.

B. The "service yard" (of the municipality of Civitas) specifically for road cleaning as a case study, that covers cost accounting, materials management and procurement as well as service orders (operations management and execution); this section is also implemented in SAP® ECC.

The prerequisites are knowledge in accounting, materials management and basics of operations management. Lecture A is not a prerequisite.

C. Business Intelligence for formatted and unformatted data implementing analysis of voice clips of a hotline for the sentiment in which callers speak about various topics.

The prerequisites are general knowledge of the public sector. Lectures A and B are not a prerequisite.[19]

The development and rollout partners are: the University of Public Service (NKE) and the University of Technology and Economics (BME), both in Budapest, the National Public Administration Academy (AAP) in Chişinău (Moldova), the University for Public Administration and Finance (HVF) Ludwigsburg and the University of Economics and Business, Vienna (WU). These institutions engage – either exclusively (AAP, NKE, HVF) or at least also (WU) – in public administration education on a university level. Only BME

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15   R Müller-Török and A Prosser, *SAP® ECC in the Public Sector* (Wien: Facultas, 2019).
16   R Müller-Török and A Prosser, *SAP® ECC in der öffentlichen Verwaltung* (Wien: Facultas, 2019); R Müller-Török, A Prosser, I Cojocaru and I Cojocaru, *Sistemul de planificare a resurselor întreprinderii SAP în sectorul public,* 2019.
17   ISO/IEC 19510:2013.
18   P P Chen, 'The Entity-Relationship Model – Toward a Unified View of Data', *ACM Transactions on Database Systems* 1, no 1 (1976), 9–36.
19   A Prosser, D Bagnato and R Müller-Török, *Business Computing with SAP* (Wien: Facultas, 2021).

offers a technically-oriented education and will hence not be considered any further.[20] Parts of Lecture C are currently (January 2021) converted into an English-language web-based course to be rolled out in the Danube region.

Considering the programme in its entirety, the content covers 1. accounting/budgeting, cost accounting; 2. materials management/basics in operations management, 3. basics in ICT; 4. Business (or organisational) Analytics; and 5. process and data modelling/management. These elements are arguably not standard elements in public sector education.

The lectures are hands-on and every student implements the respective case study in his/her own virtual municipality. The ICT tools used are: 1. for process modelling Adonis˚ modeller; 2. for data modelling Visual Paradigm˚; 3. for natural language analysis IBM Watson˚ and RStudio˚; and 4. for the other elements SAP ECC˚ and HANA˚. There is a host of Web trainers for data and process modelling, screen cam shows of decisive or error-prone steps in the process implementation and a text book detailing the implementation steps and which can also serve as a reference later on when students again encounter such topics.[21] The materials are available in English and (for Lectures A and B) in German and Romanian.

2.3. The technical lecture cycle

In terms of hosting, the tools used impose vastly different technical requirements.

Adonis and Visual Paradigm are PC-based tools and are available in community editions. Also RStudio is a PC-based system and is available under a GNU AGPL licence.[22] They simply have to be installed in the PC labs used, no central server component is needed.

SAP ECC used for Lectures A and B is hosted centrally at WU. Both for the English and German language versions there is a master client, which is copied into the teaching client for a lecture. The administrative requirements include a change of the financial year at the beginning of each calendar (=financial) year. The GUI itself is rather easy to install and works both in MAC and Windows 10 environments. This facilitates remote teaching under lockdown conditions as each student can download the GUI from a university server, install and use it according to the server connection parameters given by the lecturer.

The software stack for HANA is a lot more complex as HANA uses Eclipse˚ and a number of plug-ins instead of the "classical" SAP GUI. This software stack is simply too complex to install for students, hence a viable solution is a remote desktop login to PCs in a lab to remotely work with the PCs as if students were sitting in front of the PC. This of course requires a VPN connection. WU actually went one step further: After an excellent

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[20] Coming from the IT side, the issue at BME is the exact inverse of the issue discussed in the paper; at least one course that requires strong public sector knowledge (that is Course A) is offered to students who are not trained in this direction.

[21] Online: www.wu.ac.at/erp

[22] Online: www.gnu.org/licenses/agpl-3.0.de.html

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experience of the remote desktop solution with remote online teaching in the first Covid-19 semester in spring 2020, WU installed virtual PCs on its central infrastructure that do not correspond to any physical "real" PC any more and only exist virtually for remote desktop solutions. These virtual PC labs can be booked under online teaching conditions like physical PC labs[23] and can be accessed with remote desktop service. The physical PCs are therefore no longer a bottleneck. As an alleviating factor in managing the infrastructure, the BI component of SAP HANA does not need a year change and from its content is virtually maintenance free given an existing lecture. The HANA BI system, however, is not client capable. Therefore, unlike ECC, the "master client" is a state of the system on backup media and the entire system needs to be reset after a lecture.[24]

2.4. The challenge of multi-country content

The course programme, from its very inception, was designed to be usable throughout the Danube region. The obvious issue in this regard is the topic of language. However, other topics at least equally significant include:

1. Currencies and national calendars (the latter quite a common entry in logistics as it determines the factory calendar for scheduling): Our solution was to choose EUR, even though two of the original partner countries do not have EUR as currency; the Austrian industrial calendar was chosen as a default.
2. Naming; each case study needs actors in the storyline including actors already created in the system: Our solution was to choose Latin names as this is some kind of common denominator in Europe.
3. VAT treatment of invoices, that is, whether VAT is deductible or not for public sector entities (key in accounting/budgeting, not so relevant for logistics); rates also vary, of course: Our solution was to show and prepare both variants in the system and let the lecturer choose, the VAT rate chosen was 20 per cent (Austria and Moldova).
4. General legal provisions about how a municipality works, which units it comprises; as an example, municipalities in some countries have police units, others do not, some maintain their own cadastres, and so on; also the fiscal transfer is organised in vastly different ways: Here we ran the very real risk of being confronted with criticism that the case study to be implemented is not "correct". We countered the risk by picking areas as neutral as possible and by pointing this issue out prominently.

Issues 3 and 4 are the most stringent. They, however, mainly apply to Lecture A. Lectures B and C are more generic and less driven by legal provisions than the Accounting content

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[23]   Online: https://learn.wu.ac.at/open/distanzlehre/virtuellpc
[24]   The technical reason for this, in brief, is that an ERP system uses a given database structure and populates it with data; a data warehouse/BI system creates tables in a database, hence client capability is a lot more complex to realise.

in A. Best practice business processes in cost accounting, logistics and BI are the same or very similar everywhere. For instance, consumption-based materials management is the same whether done in Stuttgart, Vienna, Budapest or Chişinău. Budgeting and Financial Accounting but also the design of public sector workflows, however, very closely follow the national legislation.

2.5. Rollout

A core issue with any curricular development project is sustainability. To achieve this, local teaching personnel must be found and educated that 1. has a long-term perspective in the respective teaching institution; 2. has the necessary pre-requisites; and 3. is intrinsically motivated to absorb the knowledge necessary to effectively teach the subjects.

The dissemination approach we chose and which proved itself was to hold a first – pilot – lecture with our staff and the prospective lecturer/s attending as students. Lecturers could also go through the subjects and practice by themselves after the lecture, thus familiarising themselves with the content. The second lecture of each type was then held by the local lecturers with one of the developing staff in attendance. From the third "run" on, lecturers hold the subjects themselves. They are also free to adapt the transparencies to their specific needs.

This is supplemented by a lecturers' guide. This guide informs lecturers about typical issues during the subjects and how to solve them. When for instance, a cost allocation in cost accounting does not work, there are four or five standard mistakes, why this may happen. They are listed in the guide, which also shows how to discern and fix them. The guide also informs the lecturer about additional content that may be taught, as well as additional exercises.

3. DIDACTICS OF REMOTE TEACHING

The teaching programme was originally designed for classroom teaching. Also the pilot lectures and the rollout of Lectures A and B was entirely in-class. The classroom was of course supplemented by blended learning[25] and self-study. A typical blended design in ERP teaching would, for instance, encompass:[26]
1. web trainers for teaching and practicing process and data modelling before class
2. implementing an ERP case study in class using the modelling methods
3. implementing an extended case in homework
4. discussing the extended case in class and building on it

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[25] N Friesen, *Report: Defining Blended Learning.* 2012; K Lothridge, J Fox and EFynan, 'Blended learning: efficient, timely and cost effective', *Australian Journal of Forensic Sciences* 45, no 4 (2013), 407–416.
[26] See for an example www.wu.ac.at/erp

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5. providing supplementary material for self-study and review, such as screen cam shows for the ERP content

However, in remote teaching under Covid-19 conditions, the challenges increased. There was no physical contact between lecturer and students, but also no direct interaction among students, which would typically be fostered in a classroom environment.[27] The out-of-classroom interaction in both cases strongly depends on the infrastructure provided by the university. At WU for instance, the university learning support application learn@wu provides such interactive tools in a closed, lecture-specific user group that also offers chat and workgroup functionalities.[28] Otherwise students are left to organise themselves via general social media, which has many issues in terms of user access and dissemination of materials. However, the interaction between lecturers is also impeded. Experience would usually be shared by mentoring and in-lecture coaching as described above in the rollout approach. This is a lot less practical in video-based lecture formats.[29]

It is, however, also the experience of the authors that teaching with complex ICT systems via video lectures has massive drawbacks in general. In classroom teaching, an experienced lecturer immediately recognises when students have software issues and fall behind. The lecturer may then immediately approach the student and directly offer help at the student's PC. In a video format, when student video streams are switched off resulting in an essentially one-way communication, lecturers do not get any immediate feedback on how students fare. Some students may not be active enough to interrupt the lecturer when they have issues and hence the lecturer has to regularly poll students for issues. The "hand" function offered by video conferencing tools may help here, but in the view of the authors it cannot replace direct interaction with students. Hence, the more technically complex the system environment becomes, the less a remote video format appears to be appropriate for teaching.

4. CONTENT SPECIFICS AND REQUIREMENTS

4.1. The process view

In many cases, public sector education appears to be legally oriented and focused on structures and cases. A procedural view of the Law in general and of administrative regulations in particular is not standard. However, a legal regulation can always be seen as

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[27] P Sendall, W Ceccucci and A R Peslak, 'Web 2.0 Matters: An Analysis of Implementing Web 2.0 in the Classroom', *Information Systems Education Journal* 6, no 64 (2008).

[28] M Andergassen, F Mödritscher and G Neumann, 'Practice and Repetition during Exam Preparation in Blended Learning Courses: Correlations with Learning Results', *Journal of Learning Analytics* 1, no 1 (2014).

[29] G Salmon, J Gregory, D K Lokuge and B Ross, 'Experiential online development for educators: The example of the Carpe Diem MOOC', *British Journal of Educational Technology* 46, no 3 (2015), 542–556.

a process – and it arguably helps to see it as a process.[30] For students of Business, process modelling and process management have become a standard feature. At WU, for instance, every student of whatever course programme has to pass "Business Information Systems I" very early on in the respective course programmes, where event-driven process chains[31] are taught. In public sector-oriented education, a process view on activities is often missing, where the lectures introduce not only a new topic but also a radically different view on the entire discipline.

4.2. The ICT view

"eGovernment" has become a buzzword in public administration, however, many pertinent education programmes do little to prepare students in this regard. We maintain that a profound ICT education is an *essential and integral* part of any public administration course programme. This not only concerns an introduction to web applications and digital signatures/eID/registers behind the eID, but also to topics, such as data protection, cybersecurity and intellectual property rights in cyber; the latter three could be considered part of IT management, which of course also encompasses more traditional items, such as life cycle cost assessment for IT projects, IT project management and IT procurement. Also base technologies, such as the Internet of Things (IoT), should be understood. Some methods, such as process modelling, often associated with ICT, are in fact general business/ organisational methods that can be disassociated from any ICT application, for instance depicting a legal process as such to better analyse it.

Hence, integrated information systems are only one of many topics, but may serve as an introductory initiative, much like a "feeder", to introduce a broader technology orientation into the curriculum. This leads to an ICT common body of knowledge, which as we believe should be defined for each public sector-oriented course programme ranging from the "basics" of web/IoT technology, registers and eID to IT management in a broader sense.

4.3. Accounting

In our experience, accounting knowledge is quite broadly taught in public sector education course programmes and hence accruals accounting and budgeting can be pre-supposed

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[30] See for example A Prosser, R Müller-Török and A Pautsch, 'Legal Aspects of Cross-Border Delivery of Voting Documents: a Neglected Issue?', in *Proceedings of the 2015 2nd International Conference on Electronic Governance and Open Society: Challenges in Eurasia,* ed. by Y Misnikov and D Trutnev (New York: Association for Computing Machinery, 2015), 123–128; A Balthasar and A Prosser, 'Die Europäische Bürgerinitiative – Gefährdung der Glaubwürdigkeit eines direktdemokratischen Instruments?', *Journal für Rechtspolitik* 18, no 3 (2010), 122–132.
[31] G Keller, M Nüttgens and A-W Scheer, *Semantische Prozeßmodellierung auf der Grundlage „Ereignisgesteuerter Prozeßketten (EPK)"* (University of the Saarland, 1992).

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as common knowledge. This applies less to cost accounting, which may be offered in a preparatory course. It should be noted that – completely in line with private sector accounting practices – also the public sector is moving to the triad of cash-based accounting (classical "cameralistics" budgeting) – accruals accounting with periodicity – cost accounting; cf. as an example the Austrian Bundeshaushaltsgesetz BHG 2013,[32] which obliges all federal agencies to provide this triad.

4.4. Logistics

Logistics is an area where organisations may gain or lose substantial amounts of money.[33] The more ICT-based systems are used to manage logistics the more advanced concepts of materials and operations planning may be implemented. Methods which on a paper or near-paper basis (think MS Excel) are not viable, become viable in state-of-the-art ICT-based logistics systems.

We observed that classical public administration course programmes provide little to no introduction to these concepts. Here a lot of future optimisation potential is lost due to the fact that next generation public administration leaders simply are not aware of the potentials to optimally organise and run their logistics and operations.

4.5. Business analytics and artificial intelligence

Commercial entities perform analytics of their business on a routine basis. Public sector organisations may find it a relatively new idea. However, process mining[34] may be an area to discover ways to improve one's service delivery to citizens. Also, the systematic semantic analysis of social media posts on the organisation or specific topics can yield valuable insights. Specifically, the combination of Analytics and Artificial Intelligence can be incorporated in service delivery itself, for instance the usage in pre-filtering interesting cases in an analysis for fraudulent behaviour of any kind. However, the application potential is pervasive as may be demonstrated by an example: To register a dog at the authorities via an app, the holder uploads a smart phone photo, which is analysed by an AI component that discerns problematic dog breeds. If no such breed is discerned by the AI component, the registration process can be concluded purely online; otherwise, the dog must be inspected.[35] This example in its complete mundanity shows how pervasive

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[32]   Bundeshaushaltsgesetz 2013. Online: www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage= Bundesnormen&Gesetzesnummer=20006632

[33]   Cf. S Chopra and P Meindl, *Supply Chain Management* (Pearson, 2014), Chapter 1.6 and 6.4 with examples.

[34]   W vd Aalst, *Process Mining. Discovery, Conformance and Enhancement of Business Processes* (Berlin: Springer, 2011).

[35]   Online: https://news.sap.com/germany/2019/08/cloud-oeffentliche-verwaltung

AI components are about to become in public sector applications. Future leaders in public service should understand the technology, its potential, but also its limitations.

5. FINDINGS AND FURTHER WORK

From the above discussion we may derive the following refutable hypotheses:

H1: Covid-19 accelerated the need for ICT-related training in public sector education.

H2: Public sector education, while still being distinctly different from business education, approaches the latter in some key aspects.

H3: ERP-related subjects serve as a catalyst for curricular change in non-ICT-related areas.

In Section 1 we discussed the technology drivers for strengthening the ICT component in public sector university training. Covid-19 arguably plays an important role in this transformation and it is a safe bet to say that the pandemic has played an essential part in the digital transformation.

Section 2 presented the content of the lecture series showing the inter-relationship between this new type of public sector education and ICT training for the private sector. Specifically, we identified at least four areas where ERP-based teaching content requires or at least promotes non-conventional content for public sector education: Process management, ICT common body of knowledge, logistics and Business Intelligence. Section 3 discussed some didactic issues in teaching such content, which shows little difference between private and public sector-oriented ICT education strengthening the case for H2.

Section 4 discussed the requirements from the non-ICT parts of the university training in order to embed the content of the lecture series. We also hold that these items, which are standard curricular items[36] in business education, will also become standard features in public sector education. This will not negate the specificities of public sector education. However, it will tend to bring both strands of administration education – business and public administration – closer together.

It will be an interesting and worthwhile task to test the hypotheses once a sufficient sample of educational programmes has embedded them or similar content. Particularly if H3 proves to be valid, ERP-related teaching would then have essentially contributed to move public sector university level education into the 21st century.

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[36] P Mertens, 'Lehre und Lehrinnovationen', in *Verband der Hochschullehrer für Betriebswirtschaft e.V., Der Verband der Hochschullehrer für Betriebswirtschaft – Geschichte des VHB und Geschichten zum VHB,* ed. by W Burr and W Wagenhofer (Wiesbaden: Gabler, 2012), Chapter 13, 282ff.

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Mihai Grecu – Ion Dicusar

INFLUENCE OF THE ECONOMIC GAP ON THE LEVEL OF E-GOVERNMENT IN THE DEVELOPING COUNTRIES – REPUBLIC OF MOLDOVA

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The digital divide of developing countries vis-à-vis developed countries is also reflected in the level of e-Government development. Developing countries face the challenges of e-Government with reduced capacities and resources but also strong incentives for growth prospects.

Developing e-Government as a complex phenomenon involves multidisciplinary efforts: the development of electronic communications infrastructures and data infrastructures, the transformation of internal business processes of government, increased democracy, education, as well as a sustained economic level, and so on.

The research analyses the level of e-Government development in the Republic of Moldova in a regional context of a group of developing countries. It is an attempt to find particularities and similarities in the evolution of e-Government in this space and to identify the development potential and opportunities and to overcome the gap in this area.

The study also addresses the prospect of alignment with European standards on e-Government development, especially with regard to the single digital market, the European Interoperability Framework and others, as levers and drivers for increasing the socio-economic level of Moldova, and building an open, participative and performing government.

1. INTRODUCTION

Electronic government is a great challenge for the traditional model of public administration. It has an overwhelming influence on how to organise internal government processes and on the services provided by citizenship and business governance.

Over the years, the issue of implementing e-Government in developing countries and especially in transition countries[1] has been the subject of numerous studies.[2] Research has focused on the specificities of e-Government development in these countries, on the causes of failure of e-Government projects, barriers to e-Government implementation and on issues such as government policies in the field, ICT infrastructure, education, research, culture, democratic freedoms, and so on.

The purpose of this paper is to examine the situation regarding e-Government development in the Republic of Moldova in an attempt to understand to what extent this process takes place in line with the general trends in the digitisation of government, but also to help identify development opportunities.

In our study, we have been particularly interested in how the level of economic development of the country influences the phenomenon of e-Government and whether there are specific characteristics for developing countries in comparison to developed countries.

2. REASON OF RESEARCH

Several studies highlight factors with an essential influence on the implementation process of e-Government.[3] These include, for example, lack of awareness of the role and

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[1] According to the World Economic Situation and Prospects classification of the countries of the world: developed economies, economies in transition and developing economies, depending on the basic economic conditions of each country. World Economic Situation and Prospects 2020. UN, 2020, 163, 165.

[2] United Nations E-Government Survey 2020. Digital Government in the Decade of Action for Sustainable Development; Suha AlAwadhi and Anne Morris, 'Factors Influencing the Adoption of E-government Services', *Journal of Software* 4, no 6 (2009); Kazeem Oluwakemi Oseni, Kate Dingley and Penny Hart, 'Barriers Facing E-Service Technology in Developing Countries: A Structured Literature Review with Nigeria as a Case Study', *2015 International Conference on Information Society (i-Society),* November 2015; Richard Heeks, 'Information Systems and Developing Countries: Failure, Success, and Local Improvisations', *The Information Society* 18, no 2 (2002), 101–112; Mayumi Miyata, 'Measuring Impacts of e-Government Support in Least Developed Countries: a Case Study of the Vehicle Registration Service in Bhutan', *Information Technology for Development* 17, no 2 (2011), 133–152; Richard Heeks, 'Most e-Government-for-Development Projects Fail. How Can Risks be Reduced?', *iGovernment Working Paper* no 14, 2003; Danish Dada, 'The Failure of E-Government in Developing Countries', *The Electronic Journal on Information Systems in Developing Countries* 26, no 1 (2006), 7.

[3] AlAwadhi and Morris, 'Factors Influencing'; Dada, 'The Failure of E-Government'; Strategic Programme for Technological Modernisation of Governance (e-Transformation), 2011; Ngo Tan Vu Khanh, 'The critical Factors Affecting E-Government Adoption: A Conceptual Framework in Vietnam', s. a.; Ali M Al-Naimat, Mohd Syazwan Abdullah and Mohd Khairie Ahmad, 'The Critical Success Factors for E-Government Implementation in Jordan', 2013; Princely Ifinedo, 'Examining Influences on eGovernment Growth in the Transition Economies of Central and Eastern Europe: Evidence from Panel Data', *11th European Conference on eGovernment (ECEG),* 2011; The Global Competitiveness Report 2019; Spyridoula Lakka, Teta Stamati,

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opportunities of e-Government,[4] funding of e-Government projects, political and legal issues, political support, resilience to change, vision and implementation strategy,[5] lack of infrastructure.[6]

The most frequently mentioned and considered critical factors in the effort to implement e-Government are financing, IT infrastructure, legal issues, awareness and political support.[7] For example, in case of developing countries, funding for e-Government projects is much more critical because they have limited resources.[8] As a rule, e-Government projects in these countries are largely funded by external donors and, once these grants are completed, the sustainability of the projects can no longer be ensured. On the other hand, projects financed in this way often do not offer an approach that leads to incremental improvements in which functionalities are improved over time, so that efforts are not wasted if funding is reduced.

In our research we considered the economic aspect of the problem; the level of economic development being the basic criterion according to which countries are classified in different categories of development. We set out to examine the situation in a group of developing countries, according to the International Monetary Fund classification[9] in regions that were formerly ruled by communist governments, a group that also includes the Republic of Moldova. Countries that are or have been in transition, the idea that these countries have a somewhat common past, certain economic and social characteristics, common cultural and mental features, and so on, allowed us to identify certain regularities in the process of implementing e-Government.

We also wanted to study the dependence between the level of economic development and the level of e-Government in an extended context, at the level of countries across the European continent. On the one hand, we were interested in having a broader vision of the relationship between the level of development of e-Government and that of economic development and, on the other hand, we wanted to see what are, in general, the particularities of countries like the Republic of Moldova, where relations between e-Government and economic development are under development.

The Republic of Moldova is a country increasingly closely linked to European practices in all areas of economic and social life both in geographical proximity and especially through the association agreement. The Moldovan e-Government model will have to take this link

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Christos Michalakelis and Draculis Martakos, 'What Drives eGovernment Growth? An Econometric Analysis on the Impacting Factors', *IJEG* 6, no 1 (2013), 20–36; Spyridoula Lakka, Teta Stamati, Christos Michalakelis and Dimosthenis Anagnostopoulos, 'Cross National Analysis of the Relation of eGovernment Maturity and OSS growth', *Technological Forecasting & Social Change* 99 (2015), 132–147.

[4] AlAwadhi and Morris, 'Factors Influencing'.

[5] Al-Naimat et al., 'The Critical'.

[6] Dada, 'The Failure of E-Government'.

[7] Ibid.

[8] Dada, 'The Failure of E-Government'.

[9] World Economic Outlook 2018, 134–135; World Economic Outlook, Database – WEO Groups and Aggregates Information, 2018.

into account, and technological and other solutions for transforming governance will have to develop into an information space increasingly integrated with the European one, by harmonising the regulatory framework and aligning to European practices and norms. This must be one of the most important issues on the e-Government development agenda in Moldova.

3. E-GOVERNMENT IN MOLDOVA

The Republic of Moldova is a developing country, a country in transition, detached from the former Soviet Union in 1991. At the end of the Soviet period, there were a significant number of local technological institutions and enterprises. They had been activated in the Soviet industry, especially in the military industry. For example, more than 35,000 specialists were employed in the electronics industry at the end of the 1980s[10] (for comparison, in 2018, the ICT sector employed 20,000 specialists[11]). During this time, human potential with experience and culture in the field of ICT was created. The achievements of the Republic of Moldova in the field of ICT, especially in the electronic communications infrastructure, are largely due to this potential. The export of IT services made up a share of 13.1 per cent of total services exported in 2019, exceeding exports of (traditional) alcoholic beverages, as well as exports of other business services, according to the National Bank of Moldova (www.bnm.md).

Moldova is part of the group of countries with a high level of EGDI, between 0.50 and 0.75, with an e-Government Development Index of 0.6881. Also, Moldova, being a lower middle-income country (GDP per capita PPP IC$ 2019– 13627 US dollars), records very high values of the Online Services Index (0.7529) and the e-Participation Index (0.7619, global position – 55) and is one of 10 countries of this category, which have values of the e-Government Development Index above the global average.[12]

Table 1 • *E-Government Development Index in Moldova, 2020*
(Source: UN E-Government Survey 2020)

	EGDI	Online Service	Telecomm. Infrastructure	Human Capital
Republic of Moldova	**0.6881**	**0.7529**	**0.7432**	**0.5683**
Eastern Partnership Countries (EaP)	*0.7249*	*0.6892*	*0.8206*	*0.6649*
EU	*0.8494*	*0.8157*	*0.8895*	*0.8430*
Europe	*0.8170*	*0.7802*	*0.8674*	*0.8033*
World	0.5988	0.5620	0.6880	0.5464

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[10]   Ion Bostan, *Ştiinţele inginereşti şi cooperarea cu industria în Republica Moldova* [Engineering Sciences and Cooperation with the Industry in the Republic of Moldova] (Bucureşti: AGIR, 2016).
[11]   Strategy for the Development of the Information Technology and Eco-System for Digital Innovation for the Years 2018–2023.
[12]   UN E-Government Survey 2020.

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An important feature at this stage is that the means of communication and use of information applications are becoming more accessible. This especially refers to mobile telephone use, which has a coverage of about 125 per cent, and the penetration rate of broadband mobile internet use of 85 per cent (http://www.anrceti.md/). This makes it possible to capitalise on great opportunities for development and better provision of online public services.

Even if the progress made so far by the Republic of Moldova in implementing e-Government is obvious, there are still fears that the situation is not so good, the reasons for this being several factors limiting development. The World Economic Forum highlights the most problematic factors for doing business in Moldova. These include, first and foremost, corruption, political instability, government instability, inefficient government bureaucracy and access to finance.

The reports E-Government Developing Index[13] and Network Readiness Index 2020[14] place the Republic of Moldova in the last position among Eastern Partnership countries (Table 2, Table 3):

Table 2 • *Network Readiness Index, EaP countries, 2020*
(Source: The Network Readiness Index 2020)

Country	NRI Rank	NRI Score
Armenia	55	51.91
Ukraine	64	49.43
Belarus	65	49.16
Azerbaijan	66	48.76
Georgia	68	47.95
Moldova	**71**	**47.09**

Table 3 • *E-Government Developing Index, EaP countries, 2020*
(Source: UN E-Government Survey 2020)

Country	EGDI Rank	EEGDI Index
Belarus	40	0.8084
Georgia	65	0.7174
Armenia	68	0.7136
Ukraine	69	0.7119
Azerbaijan	70	0.7100
Moldova	**79**	**0.6881**

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[13]   Ibid.
[14]   The Network Readiness Index 2020. Accelerating Digital Transformation in a post-COVID Global Economy.

Moldova has characteristics specific for developing countries:[15]
- Reduced funding opportunities for e-Government projects. The most important program of e-Government, Strategic Program for technological modernisation of governance (e-Transformation)[16] adopted in 2011, was supported by the International Development Association (IDA) in a rate of over 85 per cent, and, for example, expenditure on computerisation of government, defence and compulsory insurance is just over 0.2 per cent of GDP.[17]
- Demographic and territorial disparities.[18] Over half of the country's population, 57 per cent, live in rural areas. About 89 per cent of the total IT expenditure of legal entities in 2019 are made in Chisinau. The expenditures for the purchase of computer equipment were in proportion of 82 per cent/18 per cent, the purchase of software products – 95 per cent/5 per cent, designs and elaborations of computer systems – 98 per cent/2 per cent, according to www.statistica.md.
- Sporadic and uncoordinated use of electronic services.[19]
- A poorly developed ICT market, in particular the IT market and low ICT absorption by companies.[20]
- Low level of government procurement of advanced technologies (136th place from 138 countries).[21]
- Digitising front-office processes, while back-office is still out of digitisation.[9]

4. DATA SOURCES

In order to establish a functional relationship between the economic development level and the level of development of e-Government in the group of countries that make up the research sample, current data with free access were used, namely:
- e-Government Development Index (EGDI), according to the United Nations[22]
- GDP per capita, according to the World Bank (http://api.worldbank.org)
- Global Competitiveness Index (GCI), according to the World Economic Forum[23]

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[15]   Heeks, 'Information Systems'; Heeks, 'Most e-Government'; Dada, 'The Failure of E-Government'.
[16]   Strategic Programme.
[17]   Mihai Grecu, Igor Cojocaru and Ion Coşuleanu, 'On e-Governance Development Opportunities in the Republic of Moldova', *Proceeding of the 'CEE eDem and eGov Days 2018' conference,* Budapest, 3–4 May 2018, 327–336.
[18]   Mihai Grecu, Ilie Costaş and Artus Reaboi, 'E-Government Services in Moldova: Value and Opportunities', *Proceedings of the Central and Eastern European e|Dem and e|Gov Days 2017,* Budapest.
[19]   Ibid.
[20]   The Global Competitiveness Report 2016–2017.
[21]   Ibid.
[22]   UN E-Government Survey 2020.
[23]   World Economic Outlook 2018.

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– The Network Readiness Index 2020. Accelerating Digital Transformation in a post-COVID Global Economy (https://networkreadinessindex.org)
– Population structure of the Republic of Moldova, 2019 (www.staistica.md)
– Expenditure of legal entities for IT, in territorial profile, 2019 (www.statistica.md)

5. DATA ANALYSIS AND MODEL ESTIMATION

We understand the notion of the level of e-Government development in a particular country, as defined in E-Government Reports,[24] as the availability and capacity of national institutions to use ICT to provide public services, and the E-Government Development Index (EGDI) as a measure, which is used by government officials, policy makers, researchers and representatives of civil society and business to better understand the relative position of a country in using e-Government to deliver public services.

As an indicator of the level of development of e-Government, the composite E-Government Development Index (EGDI) indicator was taken, and as an independent variable and indicator attesting to the level of economic development, GDP per capita of the countries was taken into account.
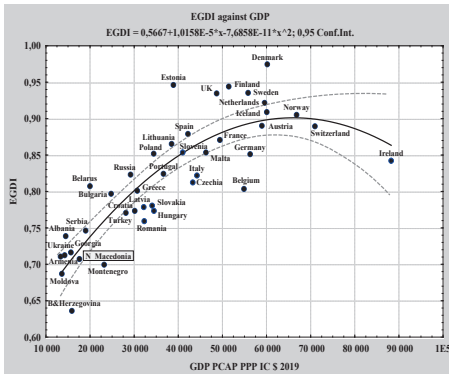

Figure 1a • *EGDI 2020 against GDP PCAP. European countries (Source: Compiled by the authors.)*
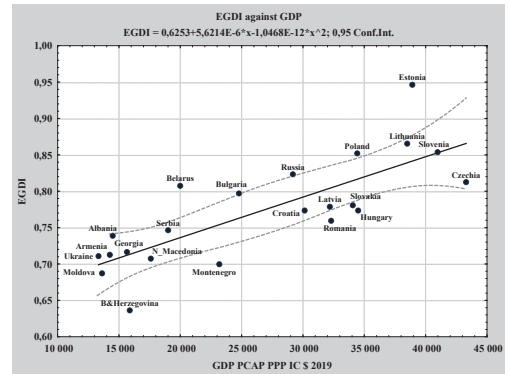
Figure 1b • *EGDI 2020 against GDP PCAP. former or current European countries in transition (Source: Compiled by the authors.)*

In the analysis process we also used another development indicator – the Global Competitiveness Index, calculated and maintained in the global competitiveness reports of the World Economic Forum. The idea of analysing the relationship between EGDI and GCI comes from the belief that this indicator would reflect a more complex and nuanced level of development in its calculation. Many more factors than the level of economic

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[24]   UN E-Government Survey 2020.

development were taken into account, the weight of which becomes more and more visible with the evolution of e-Government phenomena.

From a mathematical point of view, EGDI, like many similar composite indicators, is a weighted average, in this case, of three sub-indices: the Online Service Index (OSI), the Telecommunication Infrastructure Index (TII) and the Human Capital Index (HCI). The preference for EGDI came from the fact that it is established as a result of complex questionnaires (140 questions), in which the emphasis is on the identification of multiple aspects of the e-Government concept, in close connection with the Sustainable Development Objectives.

The level of economic development is primarily represented by the broad general indicator used in development process research such as Gross Domestic Product (GDP) per capita, and secondly by the composite Global Competitiveness Index as a measure of the level of the competitiveness of national economies, which in turn determines the productive level of these economies. Built on 98 variables that describe different aspects of country economies, GCI highlights the determinants of long-term development.

To identify the relationship between the e-Government Development Index and Gross Domestic Product (GDP per capita), as well as between the EGDI and the Global Competitiveness Index and to verify the results, we used data from 2010–2019 for GDP and GCI and 2010–2020 for EGDI.

Figure 2a • *EGDI 2020 against GCI 2019 European countries (Source: Compiled by the authors.)*
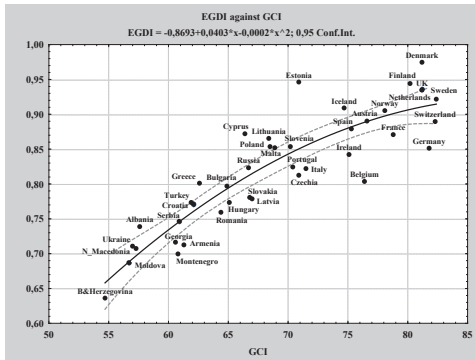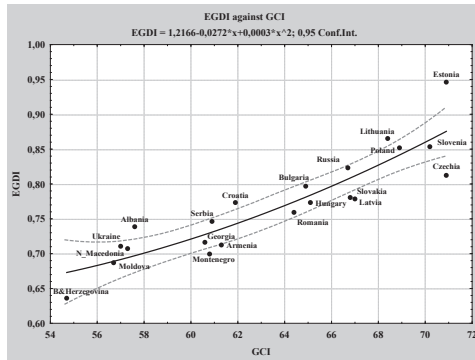
Figure 2b • *EGDI 2020 against GCI 2019 European countries that were or are still in transition (Source: Compiled by the authors.)*

The data analysis showed that there is a direct relationship between the level of economic development of the country and the level of development of e-Government. The nature of the relationship between EGDI and GDP (Figure 1a) is somewhat similar during that period. Also, the condition of the relationship between EGDI and GCI (Figure 2a) is the same throughout this period. These relations are stronger when the economic level and competitiveness of the country is at a lower level and the economic factor is a critical one. In case of countries with strong economic potential and a high level of global

competitiveness, the EGDI–GDP and EGDI–GCI relations become less pronounced. Our research shows that in these conditions the role of social, cultural, management factors, and so on, increases. This phenomenon is to be investigated in more depth.

Over the years, the level of development of e-Government is increasing in all countries. Thus, in Europe, the average value per country of the e-Government development index increased by 31 per cent from 2010 to 2020. The increase, in the same period, of the EDGI value at the EU level was of 35 per cent, in the Eastern Partnership countries – EaP (Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine) the index increased by 58 per cent, and in Moldova by 49 per cent.

Developing countries have registered a higher pace in the development of e-Government (Figure 1b, Figure 2b). In our opinion, this growth was based on and supported by the increase in the economic level. Gross Domestic Product per capita at purchasing power parity increased in Europe by 45 per cent, in the EU by 47 per cent, in EaP by 53 per cent, and in Moldova by 113 per cent. The faster rise in EGDI levels in developing countries could also suggest that they are much more motivated at this stage to develop their own e-Government systems.

For countries in transition, the implementation of e-Government is an even greater challenge as these countries are still in the process of building economic and social mechanisms and even states and nations.[25] These countries have neither sufficient governance experience nor the resources necessary for good governance in the modern vision of this concept such as democratic practices, accountability, transparency and the participation of citizens and business in the act of governing. On the other hand, this challenge can also be seen as an opportunity to implement new social and economic models and mechanisms based on digital technologies that allow them to develop.

An eloquent example of this is, in our view, Estonia, which has made amazing progress in digital development in a short time. The e-Government solution developed in this country is a remarkably successful one, and the United Nations E-Government Survey 2020 Report ranks it 3rd in the world and second in Europe in the e-Government Development Index. Estonia has thus surpassed countries such as the Netherlands (Figure 3b), for example, a country that has always been at the top of this ranking with a much higher economic potential than Estonia (Figure 3a).

In the case of the Netherlands, for example, inconsistencies and shortcomings in the management of the public sector IT process led to unjustified costs and inefficiencies in the implementation of e-Government,[26] in Estonia, on the contrary, an innovative systemic approach has ensured progress and efficiency.[27] Estonia has shown that e-Government can be built in a small country, a country in transition, just as the Republic of Moldova is,

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[25] Mihai Grecu, 'Provocări privind e-Guvernarea în Europa de Est: Cazul Republicii Moldova' [E-Governance Challenges in Eastern Europe: The Case of the Republic of Moldova], *Intellectus* no 1–2 (2020), 139–147.

[26] Dada, 'The Failure of E-Government'.

[27] Miguel Goede, 'E-Estonia: The e-Government Cases of Estonia, Singapore and Curaçao', *Archives of Business Research* 7, no 2 (2019).

and the economic power of the country, even if it is especially important, is not the only factor on which the identification and successful realisation of innovative and efficient e-Government solutions depends.
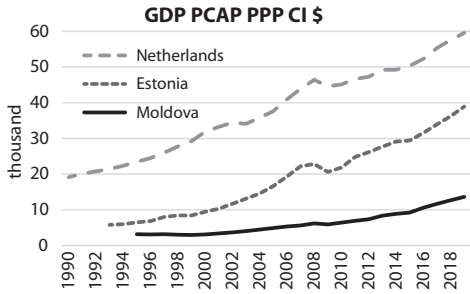

Figure 3a • *GDP per capita evolution (Netherlands, Estonia, Moldova, 1990–2019) (Source: Compiled by the authors.)*
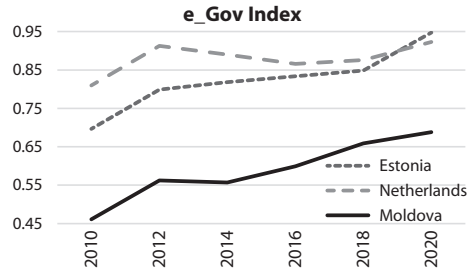
Figure 3b • *EGDI evolution (Netherlands, Estonia, Moldova, 2010–2020) (Source: Compiled by the authors.)*

6. OBSERVATIONS AND CONCLUSIONS

The study aimed to investigate the dependence between the level of economic development of the Republic of Moldova and the level of development of e-Government in the context of a group of developing countries that were formerly communist. The choice of this group of countries is not coincidental, with several common features between these countries, such as the economic model, social relations, similarities in how to organise, how governance is perceived, and so on. On the other hand, it has been interesting to see how these countries are positioned in relation to economically advanced countries. Some of the European countries, which are now developed countries, have already gone through a transition from a planned economy to a market economy.

In parallel with the dependence between e-Government development and the level of revenues, another dependence was considered, the level of e-Government and the level of economic competitiveness. The reason for choosing to include GCI in research is that it is a much more complex variable that takes into account several aspects of economic development, some of which, in our opinion, may give us a slightly more appropriate picture of the essence of the economic factor.

Research finds a clear dependence of e-Government on the level of economic development, which is in line with studies in the field.[28] At the same time, there is a visible distinction

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[28]   AlAwadhi and Morris, 'Factors Influencing'; Heeks, 'Information Systems'; Heeks, 'Most e-Government'; Dada, 'The Failure of E-Government'; Al-Naimat et al., 'The Critical'; Ifinedo, 'Examining'.

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between the level of e-Government and the level of income between developing countries and developed countries. This finding suggests that, although there are a variety of other influences about the level of e-Government development, income levels are decisive. The studies did not find significant quantitative influences between the level of development of e-Government and specific components of GCI such as Public-sector performance, Entrepreneurship, Digital skills among the population, Government policy stability policy, Government's long-term vision, Government's responsiveness to change, except for the E-Participation Index, the influence of composite factor Global Competitiveness Index 4.0, which is a significant factor.

The challenge for the Republic of Moldova in this respect is both the gap with other countries and the internal disparities of economic and social development that will not be overcome very soon. This can be significant in the context of the global development competition that will be largely devoted to the digitisation of social activities both within the government and in the private space. IT investments in the government sector and businesses are far too limited.

The Republic of Moldova is a country more closely linked to European practices in all areas of economic and social life both in geographical proximity and especially through the Association Agreement and the Eastern Partnership – a regional and multilateral initiative that includes the European Community and its six Eastern Partners: Armenia, Azerbaijan, Belarus, Georgia, the Republic of Moldova and Ukraine, and which aims to support and provide assistance for reforms in the region in various fields in order to bring the six neighbouring countries closer to the European Union. The EaP's digital agenda provides support for creating a better digital environment in partner countries, developing e-services for citizens and business, and establishing a policy framework for e-services. This involves harmonising digital markets in partner countries and extending the European, digital single market to the Eastern Neighbourhood, aiming at developing digital potential and growth through the adoption of European rules and practices.

The research was carried out using current data from the countries in the sample. We consider it of interest to investigate the evolution of the level of development of e-Government, both depending on the level of economic development and on various other aspects, taking into consideration, for example, the temporal aspect of the phenomenon, but also a broader context of research subjects, which we hope to be able to achieve further.

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INTERPRETING THE CONCEPTS OF TECHNOLOGY-SOCIETY TO PUBLIC POLICY: THE POTENTIALS OF SYSTEM DYNAMICS AND COMPUTER GAMES

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Extended abstract

In this paper, we explore how Civilization, and – in a more general approach – computer games can enhance public administration (PA) education for interpreting technology-society concepts (or Science Technology Studies). We pose the research question, how computer games at the early stage of PA studies aligned with systematic curriculum design make educational experiences and the learning process more sensitised to system complexity, creativity and understanding the role of technology.

The paper shows an educational experiment where Sid Meier's Civilization series is used at the University of Public Service in Budapest. Civilization is one of the most famous turn-based strategy games, illustrating the complex causalities of economic development, geographical expansion, technology innovation, government structure and warfare. The players experience historical development through the ages of human Civilization – starting to build simple ancient huts to modern space exploration – and choosing different strategies to guide their Civilization through the challenges of allocating resources, managing conflicts, or deploying technological innovations. Civilization has been used in several classroom experiences for teaching history and complex system analysis.

Methodologically, we present an experiment ran at the University of Public Service in Budapest during the academic year of 2017–2018 written in a case study format. Our findings suggest promising results using computer games in four aspects of PA:

a) *Effectiveness and efficiency of learning*
   We show that students have acquired the learning objectives – knowledge and skills – of technology-society relationships and system thinking effectively and efficiently. We show that the concept of Civilization has proven an effective method to demonstrate the comprehensive approach in PA – showing how the interplay of event, structure, and behaviour works on a grand scale.

b) *Implications of advanced technologies in public administration studies*
   Our experiment has revealed that if students are presented with the historical contexts of technology and society relationship, their aptitude for the technology-society relationship becomes creative, sensitive, and opens up for appreciating the importance of public policies in the better functioning of governments.

c) *Further applications of computer games (different uses of Civilization and others)*
   Based on the experiment, we developed recommendations on how computer and video games can be used in PA education. This is essential given our students' feedback, given the fact that the genre of PA education needs to be modernised for retaining astute talents for improving the future staffing of PA experts.

d) *PA problems that can be solved by games: the reception of the idea*
   Finally, we have suggested ideas beyond the classroom learning for understanding complex PA problems by using simulation games based on our observations. 'Games' are the popularised versions of complex dynamic simulations of cause-effect relations that often reveal non-intuitive behaviour of systems, understanding of which is essential for future public leaders.

1. INTRODUCTION

The broad church of Science-Technology Studies (STS) has investigated the complex duality of how technology shapes society and how social development either limits or triggers innovations. While a large amount of research contribution has shown the relevance of STS to conceptualise public policy challenges regarding technology innovations, such as in the cases of smart cities, e-participation, or the use of information communication technologies (ICT) in public services, it seems to be much more challenging to interpret STS constructs to actual policy planning and execution. Our research argues that a potential bridge connecting this theory-policy gap is the use of system dynamics and computer games – in part for modelling technology-society complexity and engaging future generations of public managers.

By putting system dynamics and computer games into the centre of our problem statement, we intend to investigate another challenge in public administration. That is the education of the present generation in colleges who will be employees, managers, decision-makers of administrative institutions – and beyond that – politicians, government members, representatives of collectives facing complex problems of our societies. The unique situation in STS is that they view the whole complexity through technology. Their perception of the world, access to information, processing experience, cognition and understanding is mediated in ubiquitous ICT, social media, and data abundance. However, very significantly, it is influenced by computer and video games of all kinds.

The conceptual – or theoretical – tension in public administration, especially in the Central Eastern European environment, is the conservative legal and political science tradition in practice and education. Even though ICT has been recognised and is even dealt with achieving progress in transforming administrative processes with ICT, future employees' philosophical mind setting is indoctrinated within traditional law, political science, or economics. System thinking, modelling and creative learning through the most familiar and comfortable media for the millennium generation is rare.

In this paper, we focus on this second issue by exploring how the application of computer games combined with system thinking and science-technology studies can enhance PA education and contribute to solving these educational challenges. We pose four research questions regarding how computer games at the early stage of PA studies aligned with systematic curriculum design make educational experiences and the learning process more successful than standard teaching and sensitise the millennium generation to the complexity of public policy decisions.

Firstly, we explore the effectiveness and efficiency of the learning process by applying a computer game. Secondly, we assess the implications of advanced technologies in public administration studies, especially how aptitude for the technology-society relationship becomes creative and opens up new approaches to public policies. Thirdly, we show how the existing genre of computer games can be used in PA education, and finally, we give an initial summary of what type of problems can be solved by games.

2. THE ROLE OF SCIENCE TECHNOLOGY STUDIES AND SYSTEM THINKING IN PA EDUCATION – A THEORETICAL AND CONCEPTUAL REVIEW

As a curriculum design experience at the University of Public Services in Budapest, two courses have been investigated. The University of Public Service (UPS) is responsible for educating the Hungarian public sector's future leaders and managers. UPS launched a five-year master program in Government Studies with the following objectives:

- educating its participants of the complex knowledge involving the tasks, organisation and operation of the state
- to provide skills and knowledge for systematically handling human capital and performing high-level planning, strategic analysis and leadership tasks
- to introduce the concept of strategic planning of public policy and analysis
- to make students capable of creating government models and understand the techniques, necessary legal and public service frameworks
- to familiarise students with the techniques of efficient management of the changes in state structure and governance
- to educate students on how to organise government activities using comparative methods and international models
- to introduce the societal, political, economic and human elements that define and influence government function

Technology and society-related questions are included in two courses within the program. An Information Society course introduces the cultural, political and economic issues of the information society and the Internet, reviewing the state responses to this challenge by analysing some information strategies. The course's strategic approach is emphasised by presenting the strategic incentives of the ICT companies, so it deals with network and microeconomic issues, as well as the macroeconomic impacts by which the information economy has an impact on national competitiveness.

Secondly, a 'Systems Theory and Analysis course' familiarises students with the basic terms of cause-effect relations, system thinking elements, and modelling complex legal, organisational and technological problems (positive and negative feedback, effects of delays and externalities, dynamic models, cause-effect diagrams). Students are supposed to acquire skills in exploring, analysing and evaluating basic system archetypes.

To methodologically enhance the two courses, we initiated a well-known turn-based strategy game series – Sid Meier's Civilization. Games, especially strategy simulation games, such as Civilization, are great tools to illustrate system complexity, how and why leaders allocate their resources, and, importantly, the impact of technology on social development and vice versa. During the gameplay of Civilization, we can observe how nations expand from ancient times due to economic development (see Figure 1), geographical expansion, warfare, and, most importantly, technology evolution.

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Figure 1 • *Screenshot of Civilization VI – a modern city with special building and wonders (Source: Compiled by the authors.)*

In the case of the Information Society course, Civilization was used primarily to show the dynamic perspective of socio-technical evolution. In contrast, during the Systems Theory course, the game was applied for modelling and analysis.

3. SYSTEM DYNAMICS IN PUBLIC POLICY ESPECIALLY IN THE TECHNOLOGY-SOCIETY ANALYSIS: WHAT WE FIND IN SCOPUS

The two theoretical foundations of the experiment with students are Science-Technology Studies, or more precisely its interpretation of society-technology relationship, and system dynamics (SD) as a critical conceptualising and modelling framework. This second concept has originated from the groundbreaking work of Jay Forrester at MIT in the 1960s and still harnessing his heritage originating in 'urban and industrial dynamics' by his successors (for example, Donella Meadows, John Sterman, Peter Senge, and others), they expand the principles of SD into many different fields and applications from supply chain management, to sustainability and organisational development.

STS provides a rich platform to enhance the discourses of scientific and technological knowledge in socio-political contexts. Firstly, because STS has an operational standpoint, it is often referred to as an 'engaged program' assuming actions, creating conceptual and pragmatic positions.[1] Secondly, STS is inherently social and treats scientific and techno-logical development as a complex social process, and considers that solutions/products of

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[1]   E Hackett, O Amsterdamska, M Lynch and J Wajcman, *The Handbook of Science Technology Studies* (Cambridge, MA: MIT Press, 2008).

these developments are not 'natural' by themselves.[2] This is especially relevant with information technology and information system applications since they are all created, programmed, designed by humans, where the 'sciences of the artificial' apply.[3] Furthermore, the third reason to embed this work into the STS domain is the broader context of politics and the role of governance at high and low levels to address the new digital world.[4] Scholars in the STS program have developed clear arguments that not only science and technology form politics and government, but, and this is probably a more critical direction, in this case, the political neutrality of science and technology is also questionable[5] – several technological paradigm changes have happened thanks to government interventions or even high-level political influences (space programs, the trickling effects of military technology, or even the Internet).

In Appendix 1, 2 and 3 we summarised what can be found in Scopus, running three keyword searches related to our problem statement and research question. Then the hits had been filtered for academic papers. In the first Table of the Appendices, those 'illustrative' papers are summarised, which until 2019 have had more than 50 references – therefore considered highly relevant contributions. I have also presented the annual trend of appearance, which is indicative of the increase of interest to publish in the researched topics. Finally, in order to get a first and high-level insight into the content differences between the three search results and the whole corpus of the 401 papers identified by the search of 'system dynamics, public policy, technology and society, and gaming', a word keyness analysis has been run using the abstracts of the papers. High-frequency words with a 95 per cent significance level ($p < 0.05$) of keyness are presented in the Appendices.

Appendix 1 contains the summary of 'system dynamics and public policy'; in the first Table showing the 17 most highly cited papers in SCOPUS out of the total 170 search results; scientific fields where most publications have found are sustainability, operations management, system thinking and energy. We can also see that the annual number of papers has grown from 2013 to an average of 10–15 papers from the earliest period of 5–7 papers in the 2000s showing interest in investigating how system dynamics is used in public policy.

Looking at the 'keyness' in the abstracts, we indicated the content and approach of these 170 articles. We got the confirmation that the main topics are environmental, sustainability and efficient energy utilisation. Interestingly, our problem is that we have not found significant key wording in policy analysis in administration, public affairs, or technology-society relationship. These publications seem to appear in the long tail of the 'public policy' search.

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[2]   D Howcroft, N Mitev and M Wilson, 'What We May Learn from the Social Shaping of Technology Approach', in *Social Theory and Philosophy for Information Systems,* ed. by J Mingers and L Willcocks (Chichester: John Wiley & Sons, 2004), 329–371.

[3]   H Simon, *The Sciences of the Artificial* (Cambridge, MA: MIT Press, 1996).

[4]   C Perez, 'Technological revolutions and techno-economic paradigms', *Cambridge Journal of Economics* 34, no 1 (2010), 185–202.

[5]   L Winner, 'Do artifacts have politics?' in *The Social Shaping of Technology,* ed. by D MacKenzie and J Wajcman (UK: Open University Press, 1999), 28–40.

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Appendix 2 summarises the keyword search combination 'system dynamics, technology and society'. We found nine papers out of the 156 with higher than 50 citations: naturally appearing in a different scientific field genre than the policy-oriented publications. However, sustainability and environmental orientation can be identified in this analysis as well. For instance, the Journal of Cleaner Production and the outlets in operations research and system dynamics seem to be highly relevant.

Keyness analysis of the 156 abstracts confirms the high dominance of environmentalist views in this search, as well. However, the words 'innovation' appearing 30 times and 'urban' 44 times indicate other directions as well in these papers.

We found the lowest number of results to search for 'system dynamics and gaming', summarised in Appendix 3. In this context, seven papers have over 50 references in SCOPUS out of the 75 total, and the main body of this literature has started to grow after 2005, yet this combination seems to be at its early stage. Keyness confirms this to some extent since these abstracts contain the highest number of significantly different wording (for brevity, we only included those words that appear more frequently than 10). It seems to be a convincing finding that amongst the highest and most significant wording, 'learning' is right in alignment with 'gaming', indicating that games go hand-in-hand with the individual, team and organisational learning. This research stream is being published in a different set of outlets than the previous two streams – simulation, management, modelling genres are much more frequent outlets in this group of papers.

Summarising the broad level exploratory keyword search in SCOPUS, we, therefore, can conclude that the system dynamics approach is a well-researched topic in the intersection of public policy, technology-society and gaming. By looking at the sheer number of articles and their timeliness, the interest and problem relevance is growing in these areas, and the theoretical background of the 'gaming and learning' – especially with computer games seems to be a promising direction for contributing to new findings in system dynamics application in technology-society areas. For exploring this, in the following section of the literature review, I turned to the questions of computer games and how Sid Meier's Civilization is used to learn system thinking.

The potential to use computer games in education has become relevant as its popularity and availability has grown. As the advancements in using video games and simulations for educational purposes in the corporate, government, and military worlds have grown, a similar change in the world of schools has raised.[6] With the appearance of serious games – games used for purposes outside of entertainment – a vast variety of opportunities have risen.[7] For instance, Squire (2008) uses an overview of two games-based research programs in education to make a case for a gaming-based future of education through the specific use of commercial games or gamification and gaming techniques.

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6   D W Schaffer, K R Squire, R Halverson and J P Gee, 'Video Games and the Future of Learning', *Phi Delta Kappan* 87, no 2 (2005), 105–111.

7   T Susi, M Johannesson and P Backlund, *Serious Games – An Overview.* Technical Report HS- IKI -TR-07-001, 28, 2007.

Another literature review summarises the effect of video games on students at the age of 14 years, finding links of numerous cognitive and other outcomes; the most common of which was the acquisition of knowledge and motivational outcomes.[8]

Civilization is one of the oldest and most widely known turned-based strategy games in the gaming industry. Its use in classrooms has been explored mainly in history education, for instance, discussing how good the game is to effectively study alternate historical events.[9] Pagnotti and Russell III (2012) explore the use of a specific lesson plan using Civilization IV to teach world history to ninth-grade students in the hope of encouraging high-order thinking. As Wainwright (2014) reports after experimenting with the 4th edition of the game series, student feedback indicates that the methods used allow many undergraduates to better understand complex historical concepts and form assumptions based on critical analysis of the historical context of the game. It also helps children learn visual conceptualisation.[10] Using Civilization in the classroom is fun; research proves that the enjoyment factor overrules the conceptual scaffolding, indicating that free flow and creativity are essential when video games are deployed in education.[11]

Computer games are also used in PA and related fields. For instance, noteworthy applications are documented by Kolson (1996) using SIM CITY or Mayer (2009) to use games in politics. There are also proposals on how to conceptually integrate games in civil service education.[12] Civilization is used to learn about power games, and Valdre (2007) claims that players of Civilization through their play, get used to various theoretical tools, such as the concept of cultural, social and economic capital, and how they influence modern social practices and learning processes.

Methodologically, most research in the field uses case study based approaches similar to Watson et al. (2011), who also give a detailed guideline designing and executing research of this kind.

4. RESEARCH METHODOLOGY

Before starting the Information Society course at the first session, we surveyed students to form an image of their experience as gamers, their specific experience with strategy video games or the Civilization series in particular, and the level of their digital literacy in a general sense. Based on the information obtained, we organised the volunteers into groups of 3 or 4

8   T M Connolly, E A Boyle, E MacArthur, T Hainey and J M Boyle, 'A systematic literature review of empirical evidence on computer games and serious games', *Computers & Education* 59, no 2 (2012), 661–686.
9   A Burns, 'Civilization III: Digital game-based learning and macrohistory simulations', 2002.
10   C-C Liu, H S Chen, J-L Shih, G-T Huang and B-J Liu, 'An enhanced concept map approach to improving children's storytelling ability', *Computers & Education* 56, 3 (2011), 873–884.
11   D Charsky and W Ressler, '"Games are made for fun:" Lessons on the effects of concept maps in the classroom use of computer games', *Computers & Education* 56, 3 (2011), 604–615.
12   C Raphael, C Bachen, K-M Lynn, K McKee and J Baldwin-Philippi, 'Games for Civic Learning: A Conceptual Framework and Agenda for Research and Design', *Games and Culture* 5, no 2 (2010), 199–235.

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members, which we would be sure to balance out in terms of player experience. The groups' controlled division was meant to avoid specific teams getting a clear advantage over the others that would have made the game experience seem unfair. Table 1 depicts how students assessed their skills and willingness to join the gaming seminar on a 1 (worst) to 4 (best) scale.

Table 1 • *Students' skills in digital literacy and gaming – Kahoot survey before the experiment (Source: Compiled by the authors.)*

		DigiLit	Games	StratGames	Civ	Willingness
N	Valid	97	97	97	97	97
	Missing	0	0	0	0	0
Mean		2.49	2.76	2.07	1.58	2.61
Minimum		0	0	0	0	0
Maximum		4	4	4	4	3

Students perceived their digital literacy skills lower than experience with computer games, but knowledge of strategy games and particularly Civilization had been the lowest. It is important to underline what Table 2 shows about correlations between these variables. Willingness to participate in the gaming experiment was only moderately correlating with the experience of using Civilization earlier (Spearman rho = 0.269, p > 0.99), and we only found medium-strong correlations between gaming, strategy gaming and Civilization use after the non-parametric correlation test (see Table 2). We found it slightly surprising that the perceived assessment of digital literacy and gaming experience did not correlate with the willingness to learn the course by playing Civilization. We assume that the main reason for this had been the uncertainty of the new method and the requirements which had been only easily attainable to those who had experience in computer games.

After the second semester, our assumption was verified when students enrolled in the System Theory course, and the Civilization bases seminar was offered to continue. As we can see in Table 3, during the first semester in the Information Society course, we could form 7 groups with 19 students. During the second term, the number of students grew to 35, which we organised into 13 groups. Correlation tests have not shown any difference between these groups in gender or any other variable.

Courses would be held on a weekly or bi-weekly basis. This would give us a set of regular opportunities to play the game as a group and discuss possible difficulties that arise throughout the semester. The sixth game in the series, Civilization VI, would be the version used in the classroom, but any of the previous games would be used at home. Limitations of the computer hardware at our disposal meant that the latest game in the civilization series, Civilization VI, was not a reasonable choice. The chosen version then became Civilization IV, the latest of the games that would reliably run on our systems and receive some of the best critical acclaims. During the classes, the game would provide simulated examples useful in helping the student grasp the otherwise theoretical concepts in practice.

Table 2 • *Correlation between digital literacy, gaming experience and willingness to participate (Source: Compiled by the authors.)*

			DigiLit	Games	StratGames	Civ	Willingness
Spearman's rho	DigiLit	Correlation Coefficient	1,000	,246*	**,334****	**,296****	,170
		Sig. (2-tailed)	.	,015	**,001**	**,003**	,096
		N	97	97	**97**	**97**	97
	Games	Correlation Coefficient	,246*	1,000	**,419****	**,559****	,087
		Sig. (2-tailed)	,015	.	**,000**	**,000**	,394
		N	97	97	**97**	**97**	97
	StratGames	Correlation Coefficient	,334**	,419**	1,000	**,567****	,226*
		Sig. (2-tailed)	,001	,000	.	**,000**	,026
		N	97	97	97	**97**	97
	Civ	Correlation Coefficient	,296**	,559**	,567**	1,000	**,269****
		Sig. (2-tailed)	,003	,000	,000	.	**,008**
		N	97	97	97	97	97
	Willingness	Correlation Coefficient	,170	,087	,226*	,269**	1,000
		Sig. (2-tailed)	,096	,394	,026	,008	.
		N	97	97	97	97	97

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 3 • *Group distribution by semesters and genders (Source: Compiled by the authors.)*

	S1Group (Semester 1) Information Society							S2Group (Semester 2) System Theory												
Group Number	1	2	3	4	5	6	7	1	2	3	4	5	6	7	8	9	10	11	12	13
Male	2	2	3	0	2	2	0	2	1	2	0	2	3	1	3	1	3	2	0	1
Female	1	1	1	1	1	2	1	0	2	0	3	1	0	2	0	2	0	0	3	1

The first class in the Information Society course would be dedicated to introducing the game Civilization IV itself. For this purpose, a short clip was created by the third author of our paper and published online to familiarise students with the game's significant concepts (Figure 2). After assigning the students to their respective groups, we would begin teaching them the primary game mechanics, making sure that by the end of the first class, they would possess all knowledge necessary to initiate, save and load their games, to issue commands to their units, manage the production cues of their cities, assign technologies to research, and be able to find any additional relevant information on their own if need be. Assignments would be handed out via the e-learning systems in between classes.

A second class would be scheduled halfway through the semester to provide the students an opportunity to address any concerns that arise along the way in person. Additionally, if time permitted, this class would also be used to start a multiplayer game session, where the groups would play competitively against each other – practicing particular techniques

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connecting to the course material focused on the technology tree and exploring technology, focusing on decisions, causality, teamwork and generalisation.

Figure 2 • *Introductory video prepared by the authors to demonstrate the basics of the gameplay (Source: www.youtube.com/watch?v=bii4hNBtGCI)*

The third and final class would be dedicated to discussing the completed tasks and reflecting on the semester using a group interview format. The discussion would also focus on gathering feedback to judge the program's overall effect and identify areas to improve.

Over the semester, the groups would document the games they played and the tasks they completed in journals. These would contain the significant decisions made during their gameplay, the reasoning and thought processes, and their effects on the outcome compared and contrasted to their expectations. Solutions and answers to the assigned tasks and, optionally, any desired feedback would also be included in these journals.

The second semester of the course was different in many ways. Some of the limitations on us in the first semester were not present this time, and we also made several changes based on feedback gathered from the students on our last session. The bi-weekly sessions became a reality this time. During the lecture hours, a computer laboratory was made available, allowing us to organise regular sessions. A key difference was a much closer collaboration with the lectures and the assignments' connection with the topics presented during the lectures. Conceptually, the System Theory class's gaming sessions used Civilization as an illustration for the topic, starting with a presentation followed by team discussion and summarising the previous and the upcoming home assignment.

The first class had little difference compared to Information Society: students played Civilization, and newcomers had to familiarise themselves with the game mechanics. Topics of the second class were system attributes and system control. The third modelling was discussed along with organisational use: students had to play with 'Stanley's Parable' to demonstrate system models' limitations and apply flowcharts.

The fourth class dealt with system dynamics; students were introduced to the 'beer game' and the 'Surviving Mars' simulation. In the fifth class, MIT's Moral Machine was brought in, and topically students discussed decision-making, which was further extended in the sixth session with complex networks. Here two new games were introduced: Democracy 3 and Europa Universalis. Finally, in the last class, the topic of scale-free networks was covered: here, we returned to using Civilization.

In between classes, students would be assigned tasks involving further gameplay to complete with their group.

Group assignments were restructured to feature a task list with individual point amounts assigned to each sub-task to allow the students an easier understanding of each element's weight. We also decided to allow the students to form groups based on their choice. This was done based on the students' feedback, where group dissonance was the most common difficulty experienced. New players were more likely to learn the game well if they worked together with others they were comfortable with, regardless of the other players' skills. Groups were only formed by us in such cases where students did not form groups of their own or did not have enough members. It is worth mentioning that these were freshmen students who did not yet know each other well in the first semester.

The end would be a log of the events that occurred in the sessions, with specific attention dedicated to answering questions posed by the teachers.

5. DISCUSSION OF RESULTS

In Table 3 we summarise the number of students who provided feedback on their learning experience. Altogether, from the 54 students who acquired the material of the two semesters by using the Civilization game experience, 49 responded.

Table 4 • *Group distribution by semesters and genders (Source: Compiled by the authors.)*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not played	77	61.1	61.1	61.1
	Played	49	38.9	38.9	100.0
	Total	126	100.0	100.0	

In the following discussion section, we give a general summary of these reports, observations and juxtaposition of other sources such as colleagues' opinions.

5.1. Effectiveness and efficiency of learning

Attendance of classes varied considerably between the first and second semesters. Requirements were different; while in the first term, grades were given only based on the homework

submission, class attendance was not required for all the sessions; only two of them had been mandatory. After concluding, we required at least one team member to attend the seminars and the lectures. Interestingly, the 24 seated Computer Lab occasionally proved to be too small, and extra places needed to be created.

The 7 Study Groups during the first semester of the Information Society course reported that they enjoyed playing the game and working on the exercises. However, they did not value the content any higher than the lectures. From the course assessments, our students had a great time in the first semester but did not get much new information from our alternate method, and they gain most of the subject's content from the lectures. During the second semester, the 13 Study Groups, although still enjoyed the gameplay, had to work on more assignment topics that were more tightly connected to the topics of the lectures in System Theory.

The following basic knowledge concepts have been the learning objectives of the two programs:

Information Society
  – to understand the impact of technology on society and how technology development is impacted by social developments
  – technological determinism and diffusion theory
  – Gartner's Hype cycle
  – Social Construction of Technology and technorealism

System Theory
  – system approach, system attributes, target predicates and decision-making attributes
  – complex cause and causal loop diagrams, modelling, participation modelling
  – supply-chain management, flowcharts, Critical Path Method and principles of process mapping
  – basics of system dynamics and team dynamics

In summary, the students had to acquire the viewpoints and methodological frameworks of system analysis and the technology-society relationship. The key objective was to convey a comprehensive approach to study PA and understand how structure determines behaviour and results in specific events. Students' feedback on the learning experience is summarised in Table 5.

Apart from the learning experience, those how had chosen the Civilization gameplay valued easiness acquired knowledge better, and their class attendance was also more frequent (a grey area in Table 5). However, if we take a closer look at these differences – depicted in the lower sections of Table 5 – we see that those 18 students who took the Civilization seminars in both semesters (variable Both) did value all four questions higher than those students who took only one Civilization seminar or none. There might be several explanations for these variations, some of them could be the uncertainty at the beginning of the Information Society course, some – especially in the second semester – the lower willingness to attend classes (there is a drop from 8.5 to 6.36). Simultaneously, the easiness was assessed gradually higher (first semester 6.5, second semester 9.00 while the two

together 9.29). However, what is very promising is that knowledge acquisition seems to be consistently viewed more effectively with the Civilization seminar than amongst those students who had not taken that path. Unfortunately, with this sample, we were not able to conclude more. The difference has not proven significant by any means testing variation, so our case did not prove that this difference is not random.

Table 5 • *Students' feedback on the learning experience is categorised by participation (Source: Compiled by the authors.)*

			Experience	Easiness	Knowledge	Attendance
CIV_Played	Not played	Count	77	77	77	77
		Mean	8.03	8.52	6.14	6.86
		Standard Deviation	2.08	1.57	2.25	2.66
	Played	Count	49	49	49	49
		Mean	7.78	8.87	6.83	7.09
		Standard Deviation	2.94	1.22	2.19	2.19
Participation	Regular	Count	77	77	77	77
		Mean	8.03	8.52	6.14	6.86
		Standard Deviation	2.08	1.57	2.25	2.66
	Infosoc	Count	10	10	10	10
		Mean	7.50	6.50	6.50	8.50
		Standard Deviation	.71	2.12	.71	2.12
	Sysanal	Count	21	21	21	21
		Mean	7.57	9.00	6.86	6.36
		Standard Deviation	3.65	.96	2.38	2.34
	Both	Count	18	18	18	18
		Mean	8.29	9.29	6.86	8.14
		Standard Deviation	1.50	.76	2.27	1.35

We get more insight into students' perceptions if we analyse their written comments about two questions: a) description of substantial knowledge and skill areas acquired during the course; and b) sharing any comment about the course, both positive and negative. Table 6 shows the keyword analysis results using the responses from the first set of answers, and Table 7 shows the keywords from the second. For the analysis, we used AntConc 3.4.4., a freely available but robust multiplatform tool for carrying out corpus linguistics research and data-driven learning, developed by Anthony Laurence at the Faculty of Science and Engineering at Waseda University in Japan.

The keyword analysis has been executed in two steps. Firstly, we created a text corpus from the students' responses about the two topics – the first file consisted of 450 words (on the knowledge content of the course). The second consisted of 559 words (on the experience being in the course). These two lists then were used as the keyword list range, or as a corpus reference, compared to which I calculated the so-called keyness variable for the three groups of students – who took the regular sessions (Regular), who only took part in the information society course (Infosoc), and who took part in the system theory

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class (Sysanal). The analysis goes beyond a simple word count since it shows which words are unusually frequent (or infrequent) compared to the words in a reference corpus. This allows us to identify characteristic words – hopefully unique to the three student groups.

Table 6 • *Keyword analysis of students' response to concrete knowledge areas they learned (Source: Compiled by the authors.)*

	W.c.	Keyness	Regular		W.c.	Keyness	Infosoc		W.c.	Keyness	Sysanal
1	94	13.116	was	1	4	3.163	game	1	3	4.429	which
2	22	8.937	enjoyable	2	5	3.140	about	2	3	3.485	box
3	36	8.817	lectures	3	3	2.372	civ	3	3	3.485	these
4	14	5.687	only	4	4	2.370	different	4	6	3.055	we
5	14	5.687	opinion	5	6	2.139	many	5	2	2.953	applicable
6	50	5.344	more	6	7	1.939	things	6	2	2.953	network
7	12	4.874	found	7	3	1.611	has	7	3	2.759	most
8	12	4.874	Kahoot	8	2	1.581	civilization	8	2	2.067	elements
9	12	4.874	one	9	2	1.581	essential	9	2	2.067	help
10	12	4.874	teacher	10	2	1.581	helps	10	2	2.067	helped
11	12	4.874	them	11	2	1.581	lot	11	2	2.067	liked
12	12	4.874	there	12	2	1.581	managing	12	2	2.067	really
13	24	4.740	good	13	2	1.581	see	13	3	1.725	decision
14	24	4.740	would	14	2	1.581	semester	14	5	1.478	what
15	10	4.062	attend	15	2	1.581	significance	15	1	1.476	analysed
16	10	4.062	difficult	16	4	1.279	decision	16	1	1.476	became
17	10	4.062	like	17	6	1.057	this	17	1	1.476	causes
18	10	4.062	somewhat					18	1	1.476	choice
19	8	3.250	attending					19	1	1.476	choices
20	8	3.250	basically					20	1	1.476	components

Keyness is calculated using the Log Likelihood method.[13] When using either Log Likelihood or Chi-squared as the statistical measure, the following significance values apply:

– 95th percentile; 5% level; $p < 0.05$; critical value = 3.84
– 99th percentile; 1% level; $p < 0.01$; critical value = 6.63
– 99.9th percentile; 0.1% level; $p < 0.001$; critical value = 10.83
– 99.99th percentile; 0.01% level; $p < 0.0001$; critical value = 15.13

Taking this into consideration, in Table 6 we can see that the keyness of listed 14 words for the regular group is significant on a 5 per cent level, and two relevant words 'lectures' and 'enjoyable' on a 1 per cent level. All these words show a positive assessment of the whole course, 'teacher' is very relevant since the second semester and the excellent professor ran the lectures who used 'Kahoot' exercises at the end of each session. In the other two categories, we mostly see conjunctions and pre-positions on any significant level.

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[13]   P Rayson, 'From keywords to key semantic domains', *International Journal of Corpus Linguistics* 13, no 4 (2008), 519–549.

However, the word count column indicates the frequency of the unique phrases in each group. These – not significantly, though – express the difference using words like 'Civ, game, Civilization', and 'applicable, network, elements', and so on.

Table 7 • *Keyword analysis of students' response to learning experience during their courses (Source: Compiled by the authors.)*

	W.c.	Keyness	Regular		W.c.	Keyness	Infosoc		W.c.	Keyness	Sysanal
1	13	2.248	lectures	1	6	2.521	tasks	1	4	4.606	using
2	6	2.015	teacher	2	4	1.681	all	2	8	3.253	more
3	15	1.429	subject	3	4	1.681	been	3	5	2.839	enjoyable
4	4	1.343	assignment	4	4	1.681	civ	4	2	2.783	decision
5	4	1.343	basically	5	5	1.469	assignments	5	2	2.783	games
6	4	1.343	exam	6	5	1.469	from	6	2	2.783	impression
7	4	1.343	his	7	5	1.469	game	7	2	2.783	talking
8	4	1.343	lecturer	8	3	1.261	into	8	2	2.783	these
9	4	1.343	no	9	3	1.261	previous	9	2	2.783	you
10	24	1.284	was	10	3	1.261	will	10	4	2.186	my
11	3	1.007	am	11	4	1.069	alternative	11	2	1.913	about
12	3	1.007	experience	12	4	1.069	way	12	2	1.913	life
13	3	1.007	fair	13	28	1.043	to	13	2	1.913	most
14	3	1.007	humour					14	4	1.468	would
15	3	1.007	liked					15	1	1.391	aspects
16	3	1.007	overall					16	1	1.391	beer
17	3	1.007	than					17	1	1.391	ber

When in Table 7 we examine the keyness indicators for the students' experience – a general opinion about how they had felt during the courses – we find similar words in the regular cohort. However, none are significant 'key'. The situation is the same when we look at the Infosoc and Sysanal columns with quite many words describing the typical genres of the different experiments. After running a concordance analysis with the four occurrences of the only one crucial keyword 'using', we confirmed that three of these were reflecting the instructor's skills to use Kahoot, compelling examples, and the famous beer game, and only one referred to the use of gaming and related exercises. Running concordance analysis with the 2nd most frequent word, 'enjoyable', it became apparent that the second semester System Analysis course was highly rated because it was better organised. There were more team assignments, and students could choose more options for meeting requirements.

5.2. Technologies

Civilization models the impact of technology on society by using the 'technology tree'. Players choose how they climb this tree; that is, in what sequence they explore and deploy new technological innovations. To facilitate discourses on the complex technology-society relationships, we asked our students to discuss interesting technologies and their potential impact on society. The recommended technologies were included.

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5.2.1. Space technologies, new materials, cloning (future based)

– *Cloning and Genetic modification:* For improvements in military and population control and increasing the quality of life.
– *Extra-terrestrial bases:* To add the ability to construct bases on other astral bodies for a considerable boost to scientific research, as well as a significant increase in resources.
– *Terraforming:* To create resource deposits on the map and help shape the terrain to choose the player.
– *Wormhole theory:* This allows fast travel between planets.
– *Alternative energy sources:* Effects the populations' happiness to reflect the reduced environmental impact.

5.2.2. Information communication technologies (present, mainstream)

– *Nanotechnology:* For use in improving medical procedures and furthering scientific research capabilities.
– *Artificial intelligence:* To improve the effectiveness of mechanical units.
– *Automated vehicles:* Helps to improve the effectiveness of trade and economic growth.
– *3D printing:* Helps to reduce production costs in cities, provides cultural and happiness increases.
– *LED technology:* To reduce the power consumption of electronic devices, increasing happiness and reducing upkeep costs.
– *Retinal scanners:* To help provide an extra measure of defence for keeping researched technologies safe from foreign espionage.
– *Drone technology:* Improves military capabilities and surveillance at the cost of a negative impact on happiness.

5.2.3. Socio-technical concepts

– *Social networking:* Effects of population growth and the spread of culture.
– *Virtual reality:* For use in better training military units, with added cultural and entertainment values.
– *Universal translation technology:* An essential tool in aiding relations with external civilizations.
– *International sports events:* Helps to increase the population's health by promoting sports and exercise and providing cultural bonuses to hosting countries.

5.3. Further applications of gaming

To collect suggestions from students based on their experiences both with computer games and with their government studies, we asked them which other video games they believe could be used for other educational purposes in their program. The following is the summation of the recommended games and areas:

To better understand strategical thought processes and other similar functions, many of the students recommended the use of other well renowned *grand-strategy games* such as Crusader Kings (Figure 3), Europa Universalis, or Hearts of Iron.

Figure 3 • *Crusader Kings – grand strategy game illustration (Source: Compiled by the authors.)*

Various MMORPGs *(Massively Multiplayer Online Role-Playing Games),* such as World of Warcraft and Eve Online (Figure 4), were recommended to help depict a single individual's role within a sizeable coherent system.

Figure 4 • *Eve Online – MMORPG illustration (Source: Compiled by the authors.)*

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Several students recommended CCGs *(Collectable Card Games)* to showcase the importance of risk management, that is, how to utilise the tools under our control to cope with random occurrences within the system. We show a set of these in Figure 5.

Figure 5 • *Collectible Card Game illustration (Source: Compiled by the authors.)*

The various games in the *city builder game series* Sim City (Figure 6) were recommended for use in showcasing causality, the effects that elements of a system can have on the others, and how to create models and diagrams of the process. The Sim City games' tendency to showcase city information in graphs and charts was also a reason to suggest these games to improve data interpretation abilities. Other city builder games were also mentioned for this purpose, such as Banished or Zeus and Poseidon.

Figure 6 • *Sim City – city builder illustration (Source: Compiled by the authors.)*

The MMORPGs mentioned above were also commonly grouped with *team-based tactical action games,* such as DOTA 2 (Defense of the Ancients) (Figure 7) or Heroes of the Storm, to train in team structuring and communication.

Figure 7 • *Dota-2 – team-based tactical action illustration (Source: Compiled by the authors.)*

Numerous games of different genres were mentioned to help understand system characteristics and the ways to control and influence them. *Real-time strategy games* recommended here included Age of Empires, Starcraft and the Total War series. *Survival/crafting games* recommended included titles like Rust, Space Engineers and Minecraft – illustrations are shown in Figure 8.

Figure 8 • *Ages of Empires and Space Engineers – real-time strategy and survival game illustrations (Source: Compiled by the authors.)*

5.4. PA Problems that can be solved by games: the reception of the idea

Beyond the two particular courses' learning objectives, students reported other – more general – impacts of the experiment. The groups consisting of three members were introduced to develop teamwork and reflect in the journals on how they identified key

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decision points, assessed alternatives, and had come to joint decisions. They reported several learning conclusions and also how these exercises encouraged creativity.

After the course, we received feedback that it is easier to connect cause-and-effect relationships between the various legal areas and grasp how society is impacted as an organic system. This is especially important in central and eastern European PA education, which is traditionally employed only in law and often handles the different legal areas separately, barely touching technology's influence on administrative thinking.

Thanks to our acquired experience and the students' critical feedback, our methods during the Systems Theory course in the second semester became much more refined. Due to this, our alternative opportunity for course completion became a bolder, more extensive rival to the traditional 'lecture path'. Education of the subject proceeded along with the same goals as before: the broad expansion of PA skills through the use of our method while still teaching the material in the curriculum in an enjoyable fashion.

6. CONCLUSION

System Analysis and Thinking subjects with Information Society topics in PA education help future leaders understand our societies' complexities in the 21st century.

In the reported experiment at UPS, we tested the use of the turn-based strategy game Civilization to identify the effects of technology on society and individuals so that students become more foresightful and empathetic in the future of their choice. Information Society also emphasises the importance of Systems Theory as shown by the university in the course description. However, to demonstrate this to students, it is not enough to illustrate how culture and technology affect each other in an information society or what processes occur within society as a system – they must also understand how these dualities work. That is where our experiment's main contribution lies, especially with the deployment methods and practical tools presented to students. Participating students reported that putting technology and complex system thinking with using strategy simulation concepts at the beginning of their Government Studies program raises awareness and the experience factor of their education.
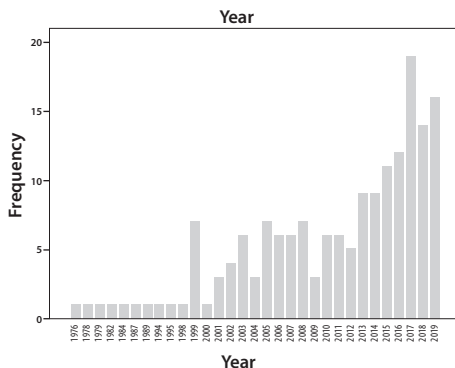
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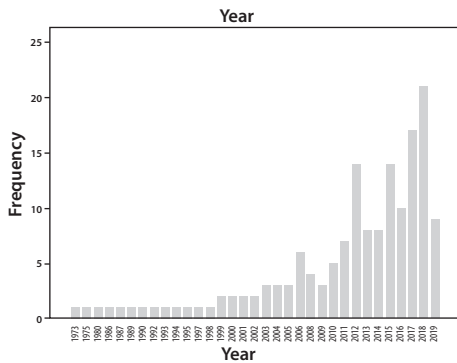
Appendix 1. Top cited papers; word keyness in abstracts; frequent journals, yearly publications – System dynamics and Public Policy

Authors	Title	Year	Source title	Volume	Issue	Page		Cited by
Bergek A., Jacobsson S., Carlsson B., Lindmark S., Rickne A.	Analyzing the functional dynamics of technological innovation systems: A scheme of analysis	2008	Research Policy	37	3	407	429	704
Vlachos D., Georgiadis P., Iakovou E.	A system dynamics model for dynamic capacity planning of remanufacturing in closed-loop supply chains	2007	Computers and Operations Research	34	2	367	394	252
Oliva R., Sterman J.D.	Cutting corners and working overtime: Quality erosion in the service industry	2001	Management Science	47	7	894	914	230
Oliva R.	Model calibration as a testing strategy for system dynamics models	2003	European Journal of Operational Research	151	3	552	568	138
Johansson D.J.A., Azar C.	A scenario based analysis of land competition between food and bioenergy production in the US	2007	Climatic Change	82	March	267	291	132
Ghaffarzadegan N., Lyneis J., Richardson G.P.	How small system dynamics models can help the public policy process	2011	System Dynamics Review	27	1	22	44	126
Georgiadis P., Vlachos D., Iakovou E.	A system dynamics modeling framework for the strategic supply chain management of food chains	2005	Journal of Food Engineering	70	3	351	364	124
Galanakis K.	Innovation process. Make sense using systems thinking	2006	Technovation	26	11	1222	1232	111
Gary M.S.	Implementation strategy and performance outcomes in related diversification	2005	Strategic Management Journal	26	7	643	664	84
Kollikkathara N., Feng H., Yu D.	A system dynamic modeling approach for evaluating municipal solid waste generation, landfill capacity and related cost management issues	2010	Waste Management	30	11	2194	2203	76
Dangerfield B.C.	System dynamics applications to european health care issues	1999	Journal of the Operational Research Society	50	4	345	353	69
Zhang X.H., Zhang H.W., Chen B., Chen G.Q., Zhao X.H.	Water resources planning based on complex adaptive system dynamics: A case study of Tianjin city	2008	Communications in Nonlinear Science and Numerical Simulation	13	10	2328	2336	60
Dutta A., Roy R.	Offshore outsourcing: A dynamic causal model of counteracting forces	2005	Journal of Management Information Systems	22	2	15	35	57
Liu X., Mao G., Ren J., Li R.Y.M., Guo J., Zhang L.	How might China achieve its 2020 emissions target? A scenario analysis of energy consumption and CO2 emissions using the system dynamics model	2015	Journal of Cleaner Production	103		401	410	55
Abbas K.A., Bell M.G.H.	System dynamics applicability to transportation modeling	1994	Transportation Research Part A	28	5	373	390	55
Forrester J.W., Mass N.J., Ryan C.J.	The system dynamics national model: Understanding socio-economic behavior and policy alternatives	1976	Technological Forecasting and Social Change	9	January	51	68	51

Rank	Freq	Keyness	Effect	Keyword	Rank	Freq	Keyness	Effect	Keyword	Journals
1	302 +	66.19	0.0182	policy	16	50 +	5.68	0.0031	elsevier	Journal of Cleaner Production
2	149 +	28.49	0.0091	policies	17	47 +	5.47	0.0029	demand	Journal of the Operational Research Society
3	116 +	23.84	0.0071	public	18	17 +	5.46	0.001	participatory	System Dynamics Review
4	54 +	12.95	0.0033	carbon	19	25 +	5,08	0.0015	green	Systems Research and Behavioral Science
5	72 +	9.95	0.0044	market	20	304 +	4,7	0.0182	that	Resources, Conservation and Recycling
6	67 +	9.53	0.0041	government	21	58 +	4.69	0.0036	scenarios	Energy
7	42 +	8.89	0.0026	population	22	13 +	4.67	0.0008	fit	Energy Policy
8	55 +	8,11	0.0034	emissions	23	13 +	4.67	0.0008	rps	European Journal of Operational Research
9	47 +	7.55	0.0029	waste	24	26 +	4.55	0.0016	emission	Journal of Construction Engineering and Management
10	33 +	7,28	0.002	price	25	12 +	4.31	0.0007	cap	Kybernetes
11	37 +	7,24	0.0023	renewable	26	12 +	4.31	0.0007	fcvs	Xitong Gongcheng Lilun yu Shijian/System Engineering Theory and Practice
12	26 +	6.91	0.0016	food	27	12 +	4.31	0.0007	hilsa	
13	31 +	6.61	0.0019	co	28	12 +	4.31	0.0007	offshoring	
14	302 +	6.46	0.0181	model	29	12 +	4.31	0.0007	pension	
15	26 +	5.88	0.0016	sectors	30	28 +	4,02	0.0017	limited	
					31	11 +	3.95	0.0007	poverty	

Year

Bar chart with vertical axis **Frequency** (0, 5, 10, 15, 20) and horizontal axis **Year** showing years: 1976, 1978, 1979, 1982, 1984, 1987, 1989, 1994, 1995, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019.

Authors	Title	Year	Source title	Volume	Issue	Page		Cited by
Garud R., Kumaraswamy A.	Vicious and virtuous circles in the management of knowledge: The case of Infosys Technologies	2005	MIS Quarterly: Management Information Systems	29	1	9	33	220
Hilty L.M., Arnfalk P., Erdmann L., Goodman J., Lehmann M., Wäger P.A.	The relevance of information and communication technologies for environmental sustainability - A prospective simulation study	2006	Environmental Modelling and Software	21	11	1618	1629	168
Otto A., Kotzab H.	Does supply chain management really pay? Six perspectives to measure the performance of managing a supply chain	2003	European Journal of Operational Research	144	2	306	320	158
Richardson G.P.	Reflections on the foundations of system dynamics	2011	System Dynamics Review	27	3	219	243	131
Verhoef E.V., Dijkema G.P.J., Reuter M.A.	Process knowledge, system dynamics, and metal ecology	2004	Journal of Industrial Ecology	8	January	23	43	85
Van Vuuren D.P., Strengers B.J., De Vries H.J.M.	Long-term perspectives on world metal use-a system-dynamics model	1999	Resources Policy	25	4	239	255	82
Alipour S., Mehboudi M., Rezakhani A.T.	Quantum metrology in open systems: Dissipative cramér-rao bound	2013	Physical Review Letters	112	12			80
Marshall D.A., Burgos-Liz L., Ijzerman M.J., Osgood N.D., Padula W.V., Higashi M.K., Wong P.K., Pasupathy K.S., Crown W.	Applying dynamic simulation modeling methods in health care delivery research - The SIMULATE checklist: Report of the ISPOR simulation modeling emerging good practices task force	2015	Value in Health	18	1	5	16	65
Feng L.H., Huang C.F.	A risk assessment model of water shortage based on information diffusion technology and its application in analyzing carrying capacity of water resources	2008	Water Resources Management	22	5	621	633	57

Rank	Freq	Keyness	Effect	Keyword	Rank	Freq	Keyness	Effect	Keyword
1	**156 +**	**39,01**	**0.0098**	**society**	20	17 +	4.66	0.0011	modern
2	**150 +**	**35.34**	**0.0094**	**technology**	21	21 +	4.61	0.0013	american
3	**60 +**	**11.91**	**0.0038**	**technologies**	22	12 +	4,6	0.0008	intake
4	77 +	10.91	0.0049	control	23	12 +	4,6	0.0008	liquid
5	37 +	7.93	0.0023	efficiency	24	12 +	4,6	0.0008	metal
6	20 +	7.66	0.0013	vibration	25	12 +	4,6	0.0008	noise
7	18 +	6,9	0.0011	neighborhood	26	22 +	4.51	0.0014	recycling
8	18 +	6,9	0.0011	quantum	27	15 +	4.48	0.001	stages
9	18 +	6,23	0.0011	n	28	11 +	4,21	0.0007	dc
10	22 +	5.97	0.0014	engineers	29	11 +	4,21	0.0007	metabolic
11	134 +	5.83	0.0084	systems	30	11 +	4,21	0.0007	steel
12	32 +	5.79	0.002	fuel	31	11 +	4,19	0.0007	technologists
13	15 +	5.75	0.001	reliability	32	55 +	4.14	0.0035	information
14	18 +	5.61	0.0011	engine	33	17 +	4.12	0.0011	coupling
15	15 +	5,08	0.001	motion	34	28 +	4,1	0.0018	field
16	15 +	5,08	0.001	open	35	14 +	4,05	0.0009	speed
17	13 +	4.98	0.0008	frequency	36	30 +	3,95	0.0019	innovation
18	13 +	4.98	0.0008	metals	37	120 +	3.95	0.0075	which
19	16 +	4.85	0.001	cell	38	44 +	3.89	0.0028	urban

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|---|
| System Dynamics Review |
| Xitong Gongcheng Lilun yu Shijian/System Engineering Theory and Practice |
| SAE Technical Papers |
| Journal of Cleaner Production |
| Journal of the Operational Research Society |
| Binggong Xuebao/Acta Armamentarii |
| Physical Review A |

Year

Appendix 3. Top cited papers; word keyness in abstracts; frequent journals, yearly publications – System dynamics and Gaming

Authors	Title	Year	Source title	Volume	Issue	Page start		Cited by
Jahangirian M., Eldabi T., Naseer A., Stergioulas L.K., Young T.	Simulation in manufacturing and business: A review	2010	European Journal of Operational Research	203	1	1	13	302
Senge P.M., Sterman J.D.	Systems thinking and organizational learning: Acting locally and thinking globally in the organization of the future	1992	European Journal of Operational Research	59	1	137	150	193
Shaeffer D.K.	MEMS inertial sensors: A tutorial overview	2013	IEEE Communications Magazine	51	4	100	109	120
Sterman John D.	TESTING BEHAVIORAL SIMULATION MODELS BY DIRECT EXPERIMENT.	1987	Management Science	33	12	1572	1592	109
Morecroft J.D.W.	System dynamics and microworlds for policymakers	1988	European Journal of Operational Research	35	3	301	320	106
Bakken B., Gould J., Kim D.	Experimentation in learning organizations: A management flight simulator approach	1992	European Journal of Operational Research	59	1	167	182	54
Kristianto Y., Helo P., Jiao J., Sandhu M.	Adaptive fuzzy vendor managed inventory control for mitigating the Bullwhip effect in supply chains	2012	European Journal of Operational Research	216	2	346	355	53

Rank	Freq	Keyness	Effect	Keyword	Rank	Freq	Keyness	Effect	Keyword	Rank	Freq	Keyness	Effect	Keyword
1	78 +	110.94	0.0121	gaming	23	50 +	11.98	0.0077	management	100	18 +	5,27	0.0028	issues
2	62 +	73.54	0.0096	game	26	21 +	11,4	0.0033	complexity	101	21 +	5,27	0.0033	modelling
3	55 +	49,02	0.0085	learning	28	10 +	10.68	0.0016	publications	102	13 +	5,04	0.002	make
4	31 +	43.39	0.0048	games	29	11 +	10.58	0.0017	team	104	16 +	4.88	0.0025	international
5	25 +	30,9	0.0039	interactive	34	35 +	9.49	0.0054	supply	105	10 +	4.78	0.0016	experience
6	88 +	25,04	0.0134	simulation	35	24 +	9.46	0.0037	about	109	13 +	4.74	0.002	perspective
7	45 +	23.66	0.007	decision	36	29 +	9.32	0.0045	making	115	18 +	4.55	0.0028	decisions
8	22 +	21.88	0.0034	p	37	10 +	10,03	0.0016	agents	116	14 +	4,43	0.0022	need
9	31 +	19.59	0.0048	chain	38	13 +	10,03	0.002	media	117	10 +	4.43	0.0016	aspects
10	14 +	19,02	0.0022	online	40	34 +	8.71	0.0053	models	118	30 +	4.43	0.0047	performance
11	14 +	19,02	0.0022	players	42	33 +	8.62	0.0051	social	119	11 +	4.41	0.0017	demonstrate
12	23 +	17.54	0.0036	group	43	10 +	8.61	0.0016	agent	120	93 +	4.41	0.014	with
13	14 +	17,12	0.0022	bullwhip	50	16 +	8.42	0.0025	role	121	16 +	4.38	0.0025	human
14	15 +	16.82	0.0023	environments	51	17 +	7.95	0.0027	computer	145	21 +	4,23	0.0033	effect
15	17 +	16.55	0.0027	students	54	21 +	7.59	0.0033	they	151	20 +	4,12	0.0031	value
16	16 +	15.21	0.0025	participants	55	59 +	7.42	0.0091	based	152	11 +	4,1	0.0017	allows
17	14 +	14.65	0.0022	play	67	11 +	7,14	0.0017	virtual	153	11 +	4,1	0.0017	behaviour
18	30 +	14.36	0.0047	business	68	16 +	6.95	0.0025	tool	154	19 +	4,02	0.003	support
19	12 +	14.29	0.0019	reality	72	16 +	6.62	0.0025	article	174	13 +	3.91	0.002	tools
20	16 +	13.29	0.0025	managers	81	20 +	5.91	0.0031	real	175	13 +	3.91	0.002	where
21	13 +	13.29	0.002	user	82	28 +	5.78	0.0044	complex					
22	25 +	12.53	0.0039	world	92	59 +	5.38	0.009	systems					

Simulation and Gaming
European Journal of Operational Research
Journal of the Operational Research Society
System Dynamics Review
Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)
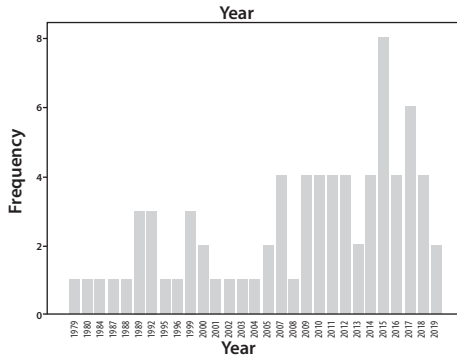
Year

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Tas Nemeslaki is a graduate of ELTE's theoretical education program. For many years, he has been a gamer and runs a video channel on tutorials, gameplays, and visual arts related to video and computer games. During this research, he worked at the National University of Public Service as a Teaching Assistant and was responsible for creating the Civilization scenarios and setups. After graduation, he entered ELTE's master's program in HR management, and presently he works as a native English tutor at BGC Hungary.

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Balázs Bartóki-Gönczy

REGULATION OF SOCIAL MEDIA PLATFORMS IN THE EUROPEAN UNION

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Social media platforms are mainly characterised by private regulation.[1] However, their direct and indirect impact on society has become such (fake news, hate speech, incitement to terrorism, data protection breaches, impact on the viability of professional journalism) that private regulatory mechanisms in place (often opaque and not transparent) seem to be inadequate. In the present paper, I would first address the problem of the legal classification of these services (media service provider vs. intermediary service provider), since the answer to this question is a prerequisite for any state intervention. I would then present the regulatory initiatives (with a critical approach) at the EU and national level which might shape the future of 'social media platform' regulation.

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[1] In the context of the present study, we mean private regulation as a set of rules applied by platforms to their own activities. By contrast, self-regulation is defined as the rules for private market participants being laid down by an independent body separate from them but composed of their members. Co-regulation is understood as a system where the State cooperates with representative bodies of private entities. We mean co-regulation where the state defines the frame of the rules defined by private operators and controls their execution.

1. INTRODUCTION

Social networks allow any citizen to publish the content of their choice and share it with other network users. They have revolutionised the media industry and the ways of communication by offering citizens and civil society a medium for direct expression. The possibility for citizens to exercise their freedoms of expression, communication and information are therefore considerably increased by these services. However, the capabilities offered by social networks give rise to unacceptable abuses of these freedoms. These abuses are committed by isolated individuals or organised groups to which large social networks, including Facebook, YouTube, Twitter or Snapchat, to name a few, have not answered satisfactorily for to date. However, by their policy of moderation, social networks are able to act directly on these most obvious abuses to prevent or respond to them and thus, limit damage in terms of social cohesion.[2]

Even Mark Zuckerberg (CEO of Facebook) has recognised that "we need an active role for governments and regulators. By updating the rules for the Internet, we can reserve what's best about it – the freedom for people to express themselves and for entrepreneurs to build new things – while also protecting society from broader harm".[3]

The challenge is how we can ensure the right to access to information and at the same time protect the users from online abuses. From a legal point of view, how should we define and regulate social media platforms? In this paper I aim to highlight some of these legal challenges and show the most likely way the EU will go on with the revision of the Electronic Commerce Directive (hereinafter: E-Commerce Directive).[4]

2. LEGAL CLASSIFICATION OF THE SOCIAL MEDIA SERVICE

2.1. The evolution of the audiovisual media services approach

Large Internet gatekeepers consider themselves tech companies. As Koltay mentions, it is in their best interest to do so, for two reasons. First, the regulations applicable to technology companies are far narrower and less stringent than those applicable to media companies (which are also subject to content regulation, special restriction on competition, the prohibition of concentration and the obligation to perform public interest tasks). Second,

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[2] Créer un cadre français de responsabilisation des réseaux sociaux: agir en France avec ambition européenne. Rapport de la mission 'Régulation des réseaux sociaux – Expérimentation Facebook', Secrétaire d'État chargé du numérique, 2019.

[3] Mark Zuckerberg, 'The Internet Needs New Rules. Let's Start in These Four Areas', *The Washington Post,* 30 March 2019.

[4] Directive 2000/31/EC of the European Parliament and of the Council of 8 June 2000 on certain legal aspects of information society services, in particular electronic commerce, in the Internal Market ('Directive on electronic commerce'), OJ L 178.

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the moral requirement of social responsibility is far less frequently mentioned concerning the activities of tech companies.

The E-Commerce Directive and the Audiovisual Media Services Directive (hereinafter: AVMS Directive)[5] seek to separate information society services from media services. According to the E-Commerce Directive, a service whereby the service provider selects or modifies the information transmitted is not an information society service within the scope of the Directive. On the other hand, the AVMS Directive excludes from its scope services that do not have 'effective control' over the content in question.

However, as a result of convergence, it is becoming increasingly difficult to determine clearly whether an online intermediary activity involves 'selection' of content or exercising 'effective control' over it.[6] It is enough to think only about content selection by algorithms. The EU legislator also seeks to adapt flexibly to the challenges of the age and to dynamically shape the concept of media service. Therefore, where the concept of media service is constantly expanding, the most delicate question is where to draw the line. It is unclear whether Facebook and other social media are still 'technical' mediators or they behave more like 'media' service. To determine this, we will analyse below the concept of dynamically changing media services, with particular reference to the future classification of social media services and video sharing platforms.

The scope of media services has been expanding over the last 30 years, albeit with cautious steps, but also in order to keep pace with the changing market environment, consumer habits and technological developments. The concept, codified in the AVMS Directive adopted in 2010, makes the editorial responsibility the heart of the definition. According to the Directive, audiovisual media service is:

> A service as defined by Articles 56 and 57 of the Treaty on the Functioning of the European Union which is under *the editorial responsibility* of a media service provider and the *principal purpose* of which is the provision of progrAVMS, in order to inform, entertain or educate, to the general public by electronic communications networks within the meaning of point (a) of Article 2 of Directive 2002/21/EC. Such an audiovisual media service is either a television broadcast as defined in point (e) of this paragraph or an on-demand audiovisual media service as defined in point (g) of this paragraph (…).[7]

'Editorial responsibility' means the exercise of effective control both over the selection of the programmes and over their organisation either in a chronological schedule, in case

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[5] Directive 2010/13/EU of the European Parliament and of the Council of 10 March 2010 on the coordination of certain provisions laid down by law, regulation or administrative action in Member States concerning the provision of audiovisual media services ('Audiovisual Media Services Directive'), OJ L 95.

[6] Tamás Klein, 'Adalékok az online diskurzusok szabályozási kérdéseihez', in *Sajtószabadság és médiajog a 21. század elején,* ed. by András Koltay and Bernát Török (Budapest: Wolters Kluwer, 2017), 156.

[7] Directive 2010/13/EU, Art. 1, point 1a) (emphasis added).

of television broadcasts, or in a catalogue, as in case of on-demand audiovisual media services. Editorial responsibility does not necessarily imply any legal liability under national law for the content or the services provided.[8] The Directive of 2010 does not further clarify what is meant by 'selection', but in practice there may be several cases where the answer to the question is unclear.

Therefore, the Directive of 2010 excluded many services from its scope. According to its audiovisual media service definition, it covered only audiovisual media services intended for the general public and having a clear influence on it, excluding, inter alia, private websites and services in which individuals make their own audiovisual content (for example, social media service providers).

In recent years, the EU legislature itself has recognised the need to adapt the material scope of media regulation to a rapidly changing reality. According to the European Digital Single Market Strategy adopted in 2015,[9] the AVMS Directive needs to be updated to reflect these changes in the market, consumption and technology. On 25 May 2016, the Commission published its Amending Proposal ('the Proposal')[10] explaining that the reason for the change was the emergence of new business models, which allowed new, growing players on the Internet to compete for the same audience (for example, video-on-demand service providers and video sharing platforms) offering audiovisual content. However, the Commission notes that television broadcasting, on-demand video and user-generated content are subject to different rules and that there are different levels of consumer protection.

The modification of the AVMS Directive was adopted in Fall 2018.[11] In terms of its scope, it represents two important changes to the Directive of 2010. The first, that the criterion of 'editorial responsibility' loses its significance in the concept of media service, focuses on the 'primary purpose' of the service:

> 'Audiovisual media service' means: a service (…) where the *principal purpose* of the service or a dissociable section thereof is devoted to providing progrAVMS, under the editorial responsibility of a media service provider, to the general public, in order to inform, entertain or educate, by means of electronic communications networks (…).[12]

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8   Directive 2010/13/EU, Art. 1, point 1c).
9   Digital Single Market Strategy for Europe, SWD(2015) 100 final.
10   COM(2016) 287 final, 2.
11   Directive (EU) 2018/1808 of the European Parliament and of the Council of 14 November 2018 amending Directive 2010/13/EU on the coordination of certain provisions laid down by law, regulation or administrative action in Member States concerning the provision of audiovisual media services ('Audiovisual Media Services Directive') in view of changing market realities, OJ L 303.
12   Directive 2018/1808, Art.1.

The biggest change, however, is the point in the amendment that extends the scope of media regulation to online 'video sharing platforms' (with less burden compared to audiovisual media services):

> 'Video-sharing platform service' means a service as defined by Articles 56 and 57 of the Treaty on the Functioning of the European Union, where the principal purpose of the service or of a dissociable section thereof or an essential functionality of the service is devoted to providing progrAVMS, user-generated videos, or both, to the general public, for which the video-sharing platform provider *does not have editorial responsibility,* in order to inform, entertain or educate, by means of electronic communications networks within the meaning of point (a) of Article 2 of Directive 2002/21/EC and the organization of which is determined by the video-sharing platform provider, including by automatic means or algorithms in particular by displaying, tagging and sequencing.[13]

2.2. What about social media services?

According to the original Commission proposal,[14] social media services fall within the scope of the AVMS Directive only if they provide a service that meets the definition of a video-sharing platform. According to the Council's amendment proposals adopted in March 2017, social media has become an important tool for information sharing, entertainment and education. Therefore, the Council argues that social media platforms should be subject to media regulation where audiovisual content represents a significant proportion of the social media interface.

To determine what constitutes 'a significant part', it is necessary to consider 1. whether the service provider has developed a separate business model for contents shared by third parties or by itself and 2. it is important to consider how audiovisual content is displayed.

I agree with this position since the social media service providers, such as Facebook, are increasingly taking on the role of 'editor', having significant and direct discretion in deciding what content may appear in users' 'daily news'.[15] It is a well-known fact that Facebook, Twitter, Snapchat and Instagram employ a dedicated editorial team to select the content available on their site.[16] Twitter CEO Jack Dorsey himself stated in 2016 that 'we recruited people to help us select the best tweets for Moments (…)'.[17]

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[13] Directive 2018/1808, Art. 1.
[14] COM(2016) 287 final, recital 3.
[15] Balázs Bartóki-Gönczy, *The online intermediaries as new gatekeepers of the access to information* (Budapest: Pázmány Press, 2018), 31.
[16] It is important to note, however, that the moderation of content on these sites and the editing of the news feed are governed by pre-written algorithms, as the huge amount of data can no longer be handled otherwise.
[17] Lucie Ronfaut, Enguérand Renault and Benjamin Ferran, 'Jack Dorsey (Twitter): «Les annonceurs attendent beaucoup de la vidéo»', *Le Figaro,* 12 May 2016.

This is linked to the controversy surrounding Facebook's 'Trending Stories' service launched in 2014. This 'box' at the top of the sidebar of the feed was intended to display the most current and recent news and highlighted in this section the news that was read and shared by many. What was important and interesting was not determined by algorithms, but by an editorial team. In addition, in gradually leaked documents,[18] statements by insiders and former editors revealed that the selection of news had overtaken conservative sources and the Liberals were clearly favoured by an editorial team whose subjective decisions were based on written instruction. So the problem was not only that, despite Facebook's assertions, it was edited selectively, but that it was done with bias. Facebook first denied the allegations, but later admitted that the personal bias of the editors could indeed have distorted the selection of news.

In addition to his assumed editorial role, the so-called 'fake news phenomenon' may also force social media service providers to take on new roles beyond that of the technical mediation provider. It is suspected that the Russian Federation has used the most popular social media providers as a tool to influence the U.S. presidential election in 2016. The case may have shocked Facebook itself, which first denied that its platform was appropriate for engaging in social debate at this level, but was forced to admit, after an internal investigation, that Russian propaganda reached about 126 million (!) U.S. citizens through the social media site.[19] Social media (or Facebook in particular) has a disillusioning power, and the influence and exposure of the public to fake news in the feed is a cause for concern. It has become clear that the vast majority of the population will indiscriminately indulge in everything they read through Facebook. In response, Mark Zuckerberg announced in October 2017 that they would tighten their rules on sponsored content. First, they have increased transparency by displaying the advertiser alongside supported content and what other advertisers are paying for on Facebook.[20]

In my view, these steps point to the fact that social media service providers, due to their indisputably important role and responsibility in social debate, are taking on a number of editorial tasks, simply being no more than technical service providers. This approach is shared by Potier and Abiteboul, who consider that all content published on a social network cannot be presented to the user without scheduling. The volume of content published implies that the platform defines an order of appearance, makes a selection, while leaving the user the possibility of searching, at his/her initiative, specific content. The content that the user will actually consult will primarily depend on the layout of its interface and the use of algorithmic rules to prioritise and individualise the presentation of the different content. The existence of this information structuring function plays an

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[18] Sam Thielman, 'Facebook news selection is in hands of editors not algorithms, documents show', *The Guardian,* 12 May 2016.

[19] Julian Borger, Lauren Gambino and Sabrina Siddiqui, 'Tech giants face Congress as showdown over Russia election meddling looms', *The Guardian,* 22 October 2017.

[20] Prayank, '5 Ways Facebook Will Improve Transparency in Ads and Avoid Fake News', *Guiding Tech,* 03 October 2017.

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essential role in the dissemination of content and in the capacity of social networks to prevent or accentuate damage to social cohesion. The observation of the existence of this content scheduling function, which constitutes a de facto editorial form, cannot call into question the legal status of these actors, nor lead to them requalify as publishers when the majority of social network services do not select prior to the publication of content.[21]

3. FIGHT AGAINST ILLEGAL CONTENT ON SOCIAL MEDIA NETWORKS

3.1. Responsibility in general of social media service providers for illegal content

Despite the tendencies described above, under EU law, social media platforms are still considered to be 'hosting service providers', as the users of such services store, sort and make available their own content in and through the systems. This means that, pursuant to the E-Commerce Directive, the platforms are required to remove any illegal content after they become aware of its infringing nature, but they may not be subject to any general monitoring and control obligation.[22]

Nevertheless, a tendency to challenge this principle could be observed recently. The Court of Justice of the European Union (hereinafter: CJEU), in its judgment C-18/18 of 3 October 2019, ruled that the Directive does not preclude a national court to order a host provider to remove content identical or equivalent to a message previously declared unlawful, provided that the message 1. remains essentially unchanged and 2. does not require an independent assessment from the host provider.[23] As the CJEU notes, 'although Article 15(1) [of the E-Commerce Directive] prohibits Member States from imposing on host providers a general obligation to monitor information which they transmit or store, or a general obligation actively to seek facts or circumstances indicating illegal activity (…), such a prohibition does not concern the monitoring obligations 'in a specific case'.'[24]

Such a specific case may be found, in particular piece of information stored by the host provider concerned at the request of a certain user of its social network, the content of which was examined and assessed by a court having jurisdiction in the Member State, which, following its assessment, declared it to be illegal. According to the CJEU, in order to ensure that the host provider at issue prevents any further impairment of the interests involved, it is legitimate for the court having jurisdiction to be able to require that host provider to block access to the information stored, the content of which is identical to the

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[21] Créer un cadre français de responsabilisation des réseaux sociaux: agir en France avec ambition européenne, 2019, 9.

[22] András Koltay, *New Media and Freedom of Expression: Rethinking the Constitutional Foundations of the Public Sphere* (Hart Publishing, 2019), 87.

[23] 'Blocking access to content previously declared unlawful: a new obligation for online platforms?', *Epra,* 15 January 2020.

[24] Judgment of the Court In Case C-18/18, point 34.

content previously declared to be illegal. In particular, in view of the identical content of the information concerned, the injunction granted for that purpose cannot be regarded as imposing an obligation on the host provider to generally monitor the information which it stores, or a general obligation to actively seek facts or circumstances indicating illegal activity.[25]

3.2. Germany

Germany was the first European state who adopted, in 2017, a *sui generis* act on social media service providers aiming to 'improve enforcement of the law in social media networks' (hereinafter: NetzDG).[26] The Act applies to 'telemedia service providers' which, for profitmaking purposes, operate internet platforms which are designed to enable users to share any content with other users or to make such content available to the public (social networks). Platforms offering journalistic or editorial content, the responsibility for which lies with the service provider itself, shall not constitute social networks within the meaning of this Act. The same shall apply to platforms which are designed to enable individual communication or the dissemination of specific content. The Act applies only to social media network providers having more than two million registered users in the Federal Republic of Germany.[27] The NetzDG imposes obligations in two important areas: 1. reporting and 2. handling of complaints about unlawful content.

As far as the reporting obligation is concerned, it applies to providers of social networks which receive more than 100 complaints per calendar year about unlawful content. The service providers concerned are obliged to produce semi-annual German language reports on the handling of complaints about unlawful content on their platforms and shall be obliged to publish these reports in the Federal Gazette and on their own website no later than one month after the time period concerned has ended. The reports published on their own website shall be easily recognisable, directly accessible and permanently available. The reports shall cover:

– general observations outlining the efforts undertaken by the provider of the social network to eliminate criminally punishable activity on the platform
– description of the mechanisms for submitting complaints about unlawful content and the criteria applied in deciding whether to delete or block unlawful content
– number of incoming complaints about unlawful content in the reporting period, broken down according to whether the complaints were submitted by complaints bodies or by users, and according to the reason for the complaint

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[25] Judgment of the Court In Case C-18/18, points 35–37.
[26] Act to Improve Enforcement of the Law in Social Networks (Network Enforcement Act), 12 July 2017.
[27] NetzDG, Art. 1.

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– organisation, personnel resources, specialist and linguistic expertise in the units responsible for processing complaints, as well as training and support of the persons responsible for processing complaints

– membership of industry associations with an indication as to whether these industry associations have a complaints service

– number of complaints for which an external body was consulted in preparation for making the decision

– number of complaints in the reporting period that resulted in the deletion or blocking of the content at issue

– time between complaints being received by the social network and the unlawful content being deleted or blocked

– measures to inform the person who submitted the complaint and the user for whom the content at issue was saved, about the decision on the complaint

The best evidence to date about the specific effects of NetzDG comes from the law's transparency requirements. Four major online platforms released their first transparency reports in June 2018: Google (that is, YouTube), Facebook, Twitter and Change.org. This provoked another round of debate about the law's impact and efficacy. Perhaps unsurprisingly, opinion remains divided.[28] According to Heldt, after the NetzDG came into force, initial reports reveal the law's weak points, predominantly in reference to their low informative value. When it comes to important takeaways regarding new regulation against hate speech and more channelled content moderation, the reports do not live up to the expectations of German lawmakers.

Since its adoption, the NetzDG triggered fierce debate and widespread concern about its implications for freedom of expression. The first concern surrounding freedom of expression was that NetzDG would encourage the removal of legal content, also known as 'over-removal'. Online platforms, it was argued, would not have the expertise or time to assess every complaint in detail. Relatedly, critics objected to NetzDG as an instance of 'privatised enforcement' because, rather than courts or other democratically legitimated institutions, platforms assess the legality of content. The NetzDG process does not require a court order prior to content takedowns nor does it provide a clear appeals mechanism for victims to seek independent redress.

A study of the experience of the first three years of the application of the law also reveals a number of shortcomings,[29] as a result of which the German Parliament passed an amending law on 6 May 2021.[30] According to the amendment, ISPs will be obliged not only to delete infringing content, but will also have to forward it to a centre set up at the Federal Criminal Office *(Bundeskriminalamt)* with the IP addresses of the users who published

28   Heidi Tworek and Paddy Leersen, 'An Analysis of Germany's NetzDG Law', *Transatlantic Working Group*, 15 April 2019.

29   Martin Eifert et al., 'Evaluation des NetzD im Auftrag des BMjV', 2020.

30   Gesetzentwurf der Fraktionen der CDU/CSU und SPD, Drucksache 19/17741.

the illegal content. This rule aims to make law enforcement more effective. Moreover, the amendment seeks to respond to the debate surrounding the limits of freedom of speech (for example, the questionable ban of Donald J Trump). The amendment obliges the service provider to give opportunity to object against its decision. It also obliges social media platforms providers to recognise and enforce the decisions of the various conciliation fora.

3.3. France

3.3.1. The 'Trust in the Digital Economy Act'

In 2004, the French parliament passed a law[31] aimed at boosting confidence in the digital economy by transposing the provisions of the E-Commerce Directive. The law has been amended fourteen times since its entry into force in 2004 as it prescribes some special provisions not foreseen in the E-Commerce Directive:
- The exemption from content monitoring does not apply if it is specifically and periodically ordered by an investigating authority.
- The law defines crimes[32] for the prevention of which platform providers have additional responsibilities such as:
  - The service provider must provide an easy-to-use and accessible reporting system for reporting these crimes.
  - They are obliged to report all cases brought to their attention to the competent national authority, law enforcement body.
  - They should disclose what measures have been taken against the commission of these crimes through the platform.[33]
- Failure to comply with the above obligations may result in a fine of EUR 15,000 or a term of imprisonment of up to one year. If the whistleblower acts in bad faith, he/she will face the same penalty.
- The authorities may, of their own motion or upon request, impose on social media service providers any measure that is appropriate to put an end to the illegal situation.
- The law obliges social media providers to retain all personal data necessary to identify the offender. These must be issued by the authorities.[34]

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[31]   Loi n° 2004-575 du 21 juin 2004 pour la confiance dans l'économie numérique.
[32]   Denying, glorifying, glorifying or inciting to commit crimes against humanity, incitement to hatred on the grounds of race, sexual orientation, gender, disability, child pornography, incitement (namely to sexual and sexist violence), crimes against human dignity.
[33]   Articles 6 and 6-1.
[34]   Article 6 (II).

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Since 2015, the law has specifically highlighted incitement to commit terrorist acts and their apology, as well as the crime of distributing pornographic recordings of minors.[35] The removal of such content may be requested by the designated national authority (OCLCTIC)[36] from the platform provider, with simultaneous notification to the ISP. If the platform does not remove the illegal content within 24 hours, the Internet access provider is obliged to terminate access to the illegal content. However, in some cases, the authority may ask the ISP directly to block the illegal content. In parallel with the request for removal, the authority forwards the request to the 'Personne qualifiée' (PQ) designated by the French Data Protection Authority (CNIL), who indicates if he/she does not agree with the request for removal. If the Authority does not withdraw the removal request as a result, PQ may go to court. In practice, PQ is made up of CNIL staff. The detailed rules of the blocking procedure and the PQ are regulated by a decree.[37] The PQ produces an annual report. According to the 2019 report,[38] in 2019 the organisation examined 18,177 cases, of which none indicated disagreement (in 2018 only two cases). Interestingly in the report, 68 per cent of the cancellation requests were fulfilled by the platforms. It is important that this refusal does not entail a sanction. In the last five years, PQ has objected to the request for cancellation in 11 cases. In six cases the application was withdrawn by the authority, in one case PQ changed its decision after receiving new information, and in four cases the court ruled on the matter, in all cases in favour of PQ.

3.3.2. Loi Avia

In France, the question of whether the rules in force are sufficiently stringent has long been a public theme. The law passed by the French Parliament on 13 May 2020[39] (the so-called Loi Avia) introduced a number of restrictions:
- Pornographic and terrorist content: platforms no longer had to remove terrorist and child pornographic content as an option (without penalty), but were obliged to do so within 1 hour, with a penalty of EUR 250,000 and one year of imprisonment.
- Other offenses: The amendment required that certain crimes defined in the Penal Code (excluding child pornography and terrorism, see above) must be removed by platform operators and search engines within 24 hours. The penalty has also been increased to EUR 250,000.

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[35] Article 6-1.
[36] Office central de lutte contre la criminalité liée aux technologies de l'information et de la communication.
[37] Décret n° 2015-125 du 5 février 2015 relatif au blocage des sites provoquant à des actes de terrorisme ou en faisant l'apologie et des sites diffusant des images et représentations de mineurs à caractère pornographique.
[38] https://www.cnil.fr/sites/default/files/atoms/files/cnil_rapport_blocage_2019.pdf
[39] Loi n° 2020-766 du 24 juin 2020 visant à lutter contre les contenus haineux sur internet.

The search engines and platform providers would have been designated by a regulation (specifying the minimum subscriber level, other criteria). Moreover, the Loi Avia, in order to fight against online hate speech, has foreseen the following rules:

- Set up an efficient and easy-to-use reporting system.
- The notifier must be duly informed of the notification. If the application is granted, it must be completed within 24 hours, if not, the notifier must be notified within 7 days. The right and possibility of appeal must be guaranteed.
- If content is removed, the author of the content must also be notified (if possible), giving him or her the right to appeal. This notification obligation does not apply in cases where, for example, it would delay the investigation.
- Service providers were required to follow the guidelines of the Media Authority (CSA) on the subject. They should have disclosed, in accordance with CSA guidelines, their moderation policy and their technical and human background. With regard to hate speech, the CSA would have issued an annual report on compliance with the law.

However, in a decision of the French Constitutional Council (Conseil Constitutionnel, 'the CC') of 18 June 2020,[40] a number of provisions of the Loi Avia adopted by the Parliament were declared unconstitutional and annulled. As far as the obligation on the removal within 1 or 24 hours is concerned, the CC acknowledged that freedom of expression may be restricted, but that it must be necessary, appropriate and proportionate to the aim pursued. According to the CC, the infringing nature of the content in question is not self-evident, its assessment is a matter for the designated authority alone. Furthermore, an appeal against a decision has no suspensory effect on enforcement and the one hour available is insufficient for a judicial decision to be made on the matter. Finally, the sanction envisaged is so significant that, overall, such a restriction on freedom of expression was deemed unconstitutional.

3.4. The European Commission's proposal for harmonised regulation at EU level

The European Commission has presented its proposals to regulate social media platforms. In fact, the European Commission has proposed two regulations on the 15th of December 2020: the Digital Services Act (hereinafter: DSA)[41] and the Digital Markets Act (hereinafter: DMA).[42]

The two proposed regulations encompass a single set of new rules applicable across the whole EU. The Commission aims to create a safer digital space in which the fundamental

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[40]   Décision n° 2020-801 DC du 18 juin 2020 du Conseil Constitutionnel de la République Française.
[41]   Proposal for a regulation of the European Parliament and of the Council on a Single Market for Digital Services ('Digital Services Act') and amending Directive 2000/31/EC, COM(2020) final, 2020/0361(COD).
[42]   Proposal for a regulation of the European Parliament and of the Council on contestable and fair markets in the digital sector ('Digital Markets Act'), COM(2020) final, 2020/0374(COD).

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rights of all users of digital services are protected and to establish a level playing field to foster innovation, growth and competitiveness, both in the European Single Market and globally.

The DSA is the renewal of the 20 years old E-Commerce Directive. It would introduce many new obligations on online platforms, such as transparency reporting obligations, cooperation with national authorities, designation of points of contact, stricter rules on consumer protection, and so on. The DMA is a competition law tool that provides for ex ante regulation of large online platforms acting as gatekeepers (for example, Facebook, Google). The initiative aims to ensure that gateway platforms operate in a transparent manner (without hampering market competition) and offer consumers the widest possible choice. The aim is for the internal market to remain competitive and open to innovation. Although at the time of the writing of this paper many questions are still to be cleared, it is certain that the DSA and DMA might be the basis of online platform regulation in the European Union.

The general objective of the intervention is to ensure the proper functioning of the single market, in particular in relation to the provision of cross-border digital services. The Commission has identified in the impact assessment of the proposal four specific objectives. The *first* is to ensure the best conditions for innovative cross-border digital services to develop. The aim is to ensure legal clarity and proportionality of obligations accounting for the differences in capability, resources but also impacts and risks raised by small, emerging services compared to very large, established ones. The *second* objective is to maintain a safe online environment, with responsible and accountable behaviour from digital services, and online intermediaries in particular. The DSA proposal aims at providing the legal clarity for online intermediaries, and in particular online platforms, to play their role in ensuring that their services are not misused for illegal activities and that the design of their systems does not lead to societal harms. The *third* objective is to empower users and protect fundamental rights, and freedom of expression in particular. The aim of this objective is to ensure clear and proportionate responsibilities for authorities as well as private companies, to safeguard freedom of expression online by establishing rules that do not inadvertently lead to the removal of information that is protected by the right to freedom of expression and that speech is not stifled or dissuaded online. *Finally,* the proposal aims to establish the appropriate supervision of online intermediaries and cooperation between authorities. This will require the best possible cooperation among all EU Member States, ensuring both an effective supervision and creating the best conditions for innovative services to emerge, as per the first specific objective.[43]

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43   2020/0361/COD, 36–37.

4. CONCLUSIONS

Social media services are difficult to integrate into the existing legal conceptual framework. While, de facto, more and more editorial activities are being performed (directly or through algorithms), social media service remains, de lege, a hosting service under EU law. However, the revision of the AVMS Directive has made it possible to extend the scope of media regulation to social media services in respect of elements of the service that meet the Directive's video-sharing platform concept. Due to the growing impact of social media in our society, the effective removal of infringing content has become a top priority. This issue is also sensitive because action against allegedly infringing content should not lead to a disproportionate interference with freedom of expression. The notice-and-take-down rules of the E-Commerce directive are outdated and will be reviewed this year at the EU level. The proposal of the European Commission leads to a more robust and uniform regulation but in the actual phase of the legislative procedure many questions remain unanswered and many provisions have to be clarified in order to avoid uncertainty when applying the regulation. It will also be interesting to see whether the national laws regulating social media platforms will remain in force or will be completely replaced by the new regulation. I do believe that it would be reasonable to resolve all issues at EU level, but if the final regulation does not achieve the desired goals, there is still the possibility of regulating the platforms at national level, as the example of Germany shows.

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EXTENDED FRAMEWORK FOR SMART CITY DEVELOPMENT: COMPLEMENTARY ELEMENTS OF A SUPPORTIVE ENVIRONMENT

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One of the most important focal points of the complex processes taking place in the world has been created by highly diverse urbanisation zones, which face the challenges of digital transition and smart development. At the same time, for historical, economic, cultural and geopolitical reasons, each settlement needs an approach that is tailored to its specific characteristics and needs. However, relatively little attention has been paid to developing the elements of a supportive environment, the process of planning and capacity-building needed to manage a smart city, and exploring concrete cases and best practices. This study examines initiatives supporting the conditions for smart city solutions within the framework of the Digital Success Programme launched in Hungary, with particular focus on the operation of smart city marketplace as an emerging info-communication platform for supporting the planning process.

1. INTRODUCTION

Today, around 55 per cent of the world's population, over 3.5 billion people, lives in cities and towns. This figure is expected to rise to 66 per cent by 2050, while the number and size of cities are also growing: while 83 cities had more than 1 million inhabitants in the 1950s, this number rose to 512 by 2016.[1] Obviously – for historical, economic, cultural and geopolitical reasons – each city needs an approach that is tailored to its specific characteristics and needs. It is for this reason that the concept of a 'smart city' has recently received special attention. Although there is no uniform definition, it is interpreted in the extremely rich international and ever-growing domestic literature as the development and local application of innovative solutions, the efficient and sustainable use of resources and cooperation with citizens.[2] So, the smart city phenomenon does not simply mean the introduction of digital technologies, but it also includes the development of a collaborative, digital ecosystem based on the active involvement of stakeholders and citizens. The leading role of large cities is obvious, but small and medium-sized towns have little or no resources, capacities and capabilities to address these challenges. Critical regional inequalities at both global and nation state levels can be further exacerbated by varying degrees of digital maturity which shows different levels influenced by the quality of governance, human capacities and the effectiveness of applied technology.

The level of maturity indicates the extent to which the institutional design and capacity-building of a given city are ready to develop and introduce smart solutions into its day-to-day operation.[3] However, a city does not work in an isolated way, so the environment and other – technological, human and institutional factors – have to be also taken into account. As a consequence, smart ecosystems show high complexity and interdependence as well as the requirement of co-creation and co-evolution. In order to translate these overarching goals into practical terms, the concept of a city business model can help city governments articulate how they will produce and deliver public value by integrating ICT into their current infrastructure and service provision. The smart city business model as a decision-making methodology and a planning tool reflects the status of key elements of digital maturity by identifying and mobilising human and financial resources as well as enabling collaboration through the use of ICT.[4] The business model logic also addresses how smart city solutions offer public value, to whom they offer it, and how they can operate

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[1] United Nations, 'World Urbanization Prospects: The 2014 Revision', 15 January 2021.

[2] Albert Meijer and Manuel P R Bolívar, 'Governing the smart city: a review of the literature on smart urban governance', *International Review of Administrative Sciences* 82 (2016), 392–408; Viale G Pereira, Peter Prycek, Enzo Falco and Reinout Kleinhans, 'Smart Governance in the Context of Smart Cities: A Literature Review', *Information Polity* 23, no 2 (2018), 143–162.

[3] Tetiana Fesenko and Galyna Fesenko, 'City-Governance: conceptualizing digital maturity model', *Socrates* 5, no 2 (2017), 106–122; Ayca Tarhan, Oktay Turetken and Hajo A Reijers, 'Business process maturity models: A systematic literature review', *Information and Software Technology* 75 (2016), 122–134.

[4] Alexander Osterwalder and Yves Pigneur, *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challenges* (Hoboken, New Jersey: John Wiley and Sons, 2010).

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it in a sustainable way. As cities differ from each other by having rather differing stages of smart development, there is no general theory and application for a smart city business model.

A growing body of literature on smart cities have addressed different aspects of digital maturity and business models so far.[5] However, relatively little attention has been paid to the conditions, elements and operations of the necessary supportive environment.

Based on this, the first argument of this article is that smart city developments can benefit from applying business model logic based on ecosystemic thinking, but projects and other smart initiatives have to be embedded into a broader framework of enabling a supportive environment. The establishment of a supportive environment is of key importance, including the necessary institutional, legal and human capacities. However, these main pillars form only a macro-level architecture of supportive environment which needs to be broken down into specific, smaller elements in order to avoid the 'one-size-fits-all' approach. These micro-elements have distinctive features depending on the context and requirements of a given smart city context. Thus, our second argument is that both the creation of a 'tailor-made' supportive environment and a proper business model are crucial for establishing an enabling framework which includes pilot projects, platforms for knowledge sharing, as well as smart city market places for bringing together stakeholders and successful smart solutions.

On the basis of exploring the enabling conditions of smart city developments this paper seeks to test them within the framework of the Digital Success Programme (DSP) in Hungary. Analysing the initial phase of the DSP, we assume that the potential of a supportive environment depends on the degree of complementarity among the identified three elements of it. From a viewpoint of smart city development, complementarity between pilot projects, knowledge sharing and market place can be treated as a key determinant in developing smart solutions and creating the conditions for scaling up successful smart solutions. The main aim of the paper is to outline the basis and directions for a forthcoming comprehensive research project. In this initial phase, the methods used include, in addition to an overview of the relevant literature, an analysis of DSP's regulatory environment, its strategic documents and pilot projects. As a consequence, the approach of the paper tends to be basically theoretical, but there are practical motivations behind the statements and remarks.

The paper is divided into three main parts. Following this introduction, we identify the key business models by examining their applicability to smart city solutions. In the next

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[5]   Krista Timeus, Jordi Vinaixa and Francesc Pardo-Bosch, 'Creating business models for smart cities: a practical framework', *Public Management Review* 22, no 5 (2020), 726–745; Oliver Gassmann, Karolin Frankenberger and Michaela Csík, *The Business Model Navigator: 55 Models that Will Revolutionise Your Business* (Harlow: Pearson, 2014); Nils Walravens, 'Qualitative indicators for smart city business models: The case of mobile service and applications', *Telecommunication Policy* 39, nos 3–4 (2015), 218–240.

part, we explore some specific elements of a supportive environment with special regard to the role of smart city market-place. In the third part, we address the practical applicability of the theoretical model thus developed in one of the pilot programmes, and the creation of a marketplace implemented under the DSP.

2. SMART CITY BUSINESS MODEL: MODEL, METHODOLOGY AND PLANNING TOOL

Over the past few years, business models (BM) have become integral for any organisation as an important concept in terms of development of new technology, social innovation and sustainability. Despite being a relatively new phenomenon, increasing attention has only recently been devoted to the emerging smart city business models both in academic literature as well as among local decision-makers and solution providers. Although there is still no common definition on smart city business model, within academic discourse the relationship between the adaptability of BMs to smart city development frameworks and related topics such as scaling up innovative solutions or projects is ongoing.[6] From a practical point of view, BM as a new unit of analysis helps to understand how firms 'do business', which are the preferred activities, not just how it is captured.[7]

BMs provide a tool for simulation and testing innovative ideas. The main factor we should focus on is the maturity of the smart city ecosystem which forms a value chain that enables stakeholders to develop different BMs which open up new demands and possibilities. From an innovation perspective, new markets are created due to new technologies and co-creation activities of the ecosystem actors. Accordingly, it is broadly accepted that BM is about how an organisation creates and captures value in terms of development of new technology, social innovation or sustainability in organisation.[8]

However, as the overall context and the level of digital maturity are different, there is no ready-made theory for smart city business models. A particular business model consists of the architecture or design of value creation delivery and capture mechanisms it puts in practice. Within this overarching framework, three stages of development can be identified for understanding the nature of business models. Closed business models relate

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[6]   Timeus et al., 'Creating Business Models', 727; Raimundo Díaz-Díaz, Luis Muñoz and Daniel Pérez-González, 'The Business Model Evaluation Tool for Smart Cities: Application to SmartSantander Use Cases', *Energies* 10, no 3 (2017); Daniel van den Buuse, Willem van Winden and Wieke Schrama, 'Balancing Exploration and Exploitation in Sustainable Urban Innovation: An Ambidexterity Perspective toward Smart Cities', *Journal of Urban Technology* 28, nos 1–2 (2020).

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to the existing value chains, mixed business models are very close to the network approach, while open business model follows the principles of sharing economy.[9]

Drawing on insights from relevant academic literature, we suggest adopting a combination of the basic patterns of BMs. The starting point is the four-dimension business model based on the 'Magic Triangle', which aims to obtain a deeper understanding of the customer segments of values proposition, value chain and profit mechanism.[10] The four dimensions identify what is offered to potential customers, how the offerings are produced and why the business model is profitable (these aspects form the peaks of the triangle) as well as who the customers are (this is the focal point inside the triangle). The components are also utilised to address the potential impact of the external environment. It highlights the role both of the enabling and hindering factors which make it necessary to put the usefulness of business models in a wider context.

As a first step, we suggest to broaden the scope of the above mentioned four-dimension model that Gassmann et al. proposed by filling it with the elements of the 'Business Model Canvas' (BMC). The canvas is composed of nine different building blocks, namely customer segments, value propositions, channels, customer relationships, revenue streams, key resources, key activities, key partnerships and cost structure.[11] It adds a practical framework to the four-dimension model by introducing the core value for development, identifying the target groups of them, listing key activities, exploring potential partners and financial opportunities. As a result, an adaptive business model framework could be established by combining the dimensions (what, how, who, why) of the general BM with the nine components of the BMC.

As a second step, the combined business model framework should be extended by the elements of an enabling supportive environment which are based on interrelated 'twin pillars'. We argue that each of these pillars match the dimensions of the 'Magic Triangle' and its components (See Table 1).

Nonetheless, the aim of this paper is not restricted to introduce the above proposed EBM in detail. On the contrary, we focus on some of the components of a supportive environment. Before analysing them, it has to be premised that there are many factors that can be part of any emerging supportive environment in a given context. According to van Winden and van den Buuse, the following drivers can be identified: regulatory and policy frameworks, knowledge transfer mechanisms and incentives, prospects for economies of scale, the management of ambidexterity, data exchange and system interoperability and standards to measure return of investment.[12] The first three components have been inserted

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9   Sari Perätalo and Petri Ahokangas, 'Toward Smart City Business Models', *Journal of Business Models* 6, no 2 (2018), 67.

10   Oliver Gassmann, Karolin Frankenberger and Michaela Csík, 'The St. Gallen Business Model Navigator', *Working Paper, University of St. Gallen,* 2013, 2.

11   Osterwalder and Pigneur, *Business Model.*

12   Willem van Winden and Daniel van den Buuse, 'Smart City Pilot Projects: Exploring the Dimensions and Conditions of Scaling Up', *Journal of Urban Technology* 24, no 4 (2017), 5. 55.

into the EBM, while economies of scale have been interpreted as an enabling condition of the market place. In addition, we argue that interoperability and standards to measure return of investment are integral parts of pilot projects and their scaling up process indeed. The management of ambidexterity (being exploration and exploitation) are also presumed to have significance in the context of upscaling smart solutions from pilot projects, but at the same time inherently embedded in the establishment and operation of smart city market places. In the next chapter we seek to introduce the role, functions and elements of a supportive environment following an integrative approach to smart city development.

Table 1 • *The extended business model (EBM) (Source: Compiled by the author based on Gassmann et al., 'The St. Gallen Business Model Navigator' and Osterwalder and Pigneur, Business Model)*

	Value target	Value proposition	Value creation	Value capture
Design parameters	Customers	Key activities	Key resources	Budget costs
	Customer relationship	Key partnership	Distribution channels	Revenue streams
Supportive environment parameters	Regulatory and legal framework	Marketplace	Knowledge creation	Pilot projects
	Policy framework	Economies of scale	Knowledge transition mechanisms	Upscaling

3. PREREQUISITES FOR SMART SOLUTIONS: DEVELOPING A SUPPORTIVE ENVIRONMENT

The starting point for a supportive environment is the need to create contact points between the needs and intentions of technology ('smart solutions') and key actors (urban governance, citizens and businesses). It is basically the responsibility of the city management to ensure that all stakeholders are addressed, and that messages to be sent to target groups are properly formulated and delivered. The prerequisite and essential element of this is the creation of an enabling, dynamic supportive culture with stable regulatory, legal and policy frameworks that open up the possibility for everyone, from entrepreneurs through the working age population to the elderly and young people in order to develop differentiated digital skills and to have access to advanced technological tools. As a consequence, a smart city is based on the network of actors involved and the cooperation among stakeholders based on mutual benefits via info-communication platforms, which are an essential element of moving forward. The platforms rely on the basic infrastructure available, but constantly upgrades it with state-of-the-art technology to match demand and supply, such as the quick and easy collection and delivery of publicly available data from the area of tourism to urban transport and mobility.

Info-communication platforms often perform a role of knowledge platforms which enable the necessary knowledge sharing mechanisms between stakeholders. It consists of both the various forms of formal trainings providing explicit knowledge and the transfer of tacit knowledge which is key in the replication process. In practical terms, efforts to

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be made in order to replicate any smart city solution – be it a complex business model or a concrete project – strongly interrelate with the forms and channels of knowledge sharing. The replication process includes two phases, namely exploration (acquiring knowledge) and exploitation (putting this knowledge to use).[13] Addressing them simultaneously, the two phases are called 'ambidexterity', which expresses the ability of firms and cities to pursue exploration and exploitation at the same time as two distinct modes of learning and activities.

Ambidexterity is of key importance in practice to manage the transition from the pilot or testing (experimentation) phase of a project to the upscaling (exploitation) phase. City governments often face the challenge of balancing between the two elements of organisational ambidexterity as the two phases need different competencies and capacities.[14] In order to tackle the problem, it is useful to divide the organisational ambidexterity into structural and contextual approaches.[15] The former suggests that an organisation should structurally separate organisational units dealing with exploration and exploitation in avoiding inherent tensions between them. The latter create a context that allows employees to simultaneously explore and exploit within the same unit. Previous experiences suggest that the focus on the two modes of ambidexterity strongly depends on the conditional factors (economic, regulatory and technological) which have an impact on the environment of smart developments. We suggest that city governments may have a choice to combine both in the form of hybrid ambidexterity. In practice, the establishment of a resilient management structure should be influenced by the relevant BMs. Accordingly, tailor-made facilitating programmes and knowledge transfer mechanisms are required because many small cities and towns lack the competencies and financial incentives to create the necessary institutional and administrative capacities. In such cases, knowledge transfer should be provided in the form of training programmes and advocacy networks initiated by national and regional governments or the EU, as a big founder of smart city projects.

However, the proper management of ambidexterity is a necessary but not sufficient condition of scaling up projects which have been tested and validated as successful. Many successful pilots are not continued, so their impact remains very limited. Decision-makers are often unwilling to continue successful pilots because of the potential risks and unforeseen costs that may arise in the long run – triggering negative feedbacks from the citizens, or in a case when regulatory, legal and policy frameworks are not supportive. Scaling up also becomes difficult if the innovation team is too far removed from the day-to-day operation, causing problems between city managers and operational departments.

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[13] Sidney Winter and Gabriel Szulanski, 'Replication as Strategy', *Organization Science* 12, no 6 (2001), 730–743; James G March, 'Exploration and Exploitation in Organizational Learning', *Organization Science* 2, no 1 (1991), 71–87.

[14] Oded Berger-Tal, Jonathan Nathan, Ehud Meron and David Saltz, 'Exploration-Exploitation Dilemma: A Multidisciplinary Framework', *Plos One* 9, no 4 (2014).

[15] Jan Ossenbrink, Joern Hoppmann and Volker H Hoffmann, 'Hybrid Ambidexterity: How the environment shapes incumbents' use of structural and contextual approaches', *Organization Science* 30, no 6 (2019), 1127; Susan A Hill and Julien Birkinshaw, 'Ambidexterity and Survival in Corporate Venture Units', *Journal of Management* 40, no 7 (2014), 1904.

Sometimes collaborating partners have very different interests and capacities in upscaling and implementation. Finally, funders and financers are often reluctant to finance smart city developments, finding them too risky by introducing new, unknown and expensive technologies and often where revenue streams are unclear.[16]

All in all, behind the key pillars of a supportive environment, a couple of hindering factors exist. One of the main problems is that despite many projects and pilots, smart solutions are often isolated and customised. Fragmented initiatives lack business models and financing opportunities and need – among others – overarching knowledge sharing, improved communication of project results to the public and interested stakeholders as well as 'tailor-made' capacity building. In order to avoid or alleviate such bottlenecks, the emerging smart city marketplaces offer practical solutions.

The general function of the marketplace is to facilitate integrated planning and management. It is a long-lasting process which includes enabling actions from problem identification and definition, through development and analysis of options, consultation and engagement to evaluation and review. In practice, the marketplace is an open, info-communication platform that connects government actors and investors with vendors of new technologies. The platform will help cities find comparable information on products, validated results of previous investments and peer reviews. As for vendors, they can offer their products and related smart solutions, bankable smart city proposals as well as showcase their previously successful innovations, focusing on types of towns and technologies. It helps to mobilise capital from different sources to finance projects at an early stage. The key function of the marketplace is therefore to facilitate, as well as simplify and accelerate the process of matching supply and demand, and to confirm and validate new technologies and the conditions for their application. An important element of the viability and sustainability of the marketplace is the spill-over effect, as a result of which new cities, data, information and feedback are constantly added.

The most obvious model is the Smart Cities Marketplace (SCM), lead and supported by the European Commission and bringing together cities, industries, SMEs, investors, banks, researchers and other smart city actors.[17] The SCM aims also at being a platform for cities, industries, SMEs, investors, researchers and other interested organisations who want to demonstrated and deploy smart city solutions in the sectors of energy, transport and ICT.[18] By acting as an interactive forum for discussion, SCM provides meeting opportunities (virtual and matchmaking sessions), databases of business models and potential partners. As the SCM does not have its own budget and it cannot itself fund or finance specific

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[16]   Van Winden and van den Buuse, 'Smart City Pilot Projects', 52.
[17]   For details visit https://eu-smartcities.eu
[18]   The EU's Smart Cities and Communities Innovation Partnership (EIP SCC) was developed to promote the rollout of smart city solutions in the EU. Launched in July 2012, it was set up by three Directorates of the European Commission (DG MOVE, DG ENERGY, DG CONNECT), in partnership with many cities and other stakeholders in Europe. From 1 October 2020, the Marketplace of the European Innovation Partnership on Smart Cities and Communities is called Smart Cities Marketplace.

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projects, all participants take part in their own capacity and on a voluntary basis. The current structure of the SCM consists of 6 Action Clusters (as an assembly of partners committing to work on specific issues related to smart cities) and 19 Initiatives (pool the work of the various partners around a particular objective).[19]

All in all, the SCM serves as an information and communication hub, which is used to communicate the latest news, events, documents, partnerships and development results. The platform makes it possible to find partners, investors and funding opportunities with appropriate expertise and experience in joint development projects, provides insight into completed or ongoing projects, evaluates the obstacles and opportunities arising during implementation and benefits from inspirational results.

Marketplace-type planning instruments are already available in several countries, allowing for flexible adaptation to local needs and opportunities and taking into account the particular level and spatial distribution of digital maturity. In the next section, we will present a marketplace toolkit within the Digital Success Programme (DSP) launched by the Hungarian Government in 2017 that focuses on the needs and opportunities of small and medium-sized towns.

4. INFO-COMMUNICATION PLATFORM FOR MARKET DIALOGUE: AN EMERGING HUB FOR SMALL AND MEDIUM-SIZED TOWNS IN HUNGARY[20]

In 2015, the Hungarian Government began a comprehensive digital development strategy with DSP 1.0. In the first phase, measures were introduced into the public administration system (for example free Wi-Fi in town centres and creation of a public data cadastre).[21] The second phase, which began in 2017 (DSP 2.0), defined the areas of development by chapter and coordinated implementation within the governmental organisation.[22] Currently, the implementation of the strategy has been managed by the Ministry of Innovation and Technology – with interdepartmental competence.[23] 'DSP Points' (1,500 in place at the end of 2019) assist smart city projects throughout the country, though mainly in smaller settlements. They are designed to provide scope for digital literacy development

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19   To date, SCM has 982 active members, 16 investor network members, 124 bankable project proposals have been received, 81 projects have been finished. For details visit https://eu-smartcities.eu

20   In this sub-chapter, I heavily relied on one of my previous papers: Tamás Kaiser, 'Smart City Governance from below: How Hungarian Towns Respond to the Need for Institutional Design and Digital Capacity Building', in *CEE e│Dem and e│Gov Days 2020 Social Networks and Social Media. Proceedings of the Central and Eastern European e│Dem and e│Gov Days 2020, Budapest,* ed. by Thomas Hemker, Robert Müller-Török, Alexander Posser, Dona Scola, Tamás Szádeczky, Nicolae Urs (Austrian Computer Society, 2020), 467–477.

21   See Government Decree 2012/2015 (XII. 19.) DWP 1.0.

22   See Government Decree 1456/2017 (VII. 19.) DWP 2.0.

23   See Government Decree 94/2018 (V. 22.).

and electronic administration. These specific tasks are aided by a 100-person mentoring network.

The four pillars of the DSP are digital infrastructure, digital competencies, the digital state and the creation of a digital economy. The pillars are supported by horizontal themes which fall into three interrelated subfields. The three subfields are as follows: professional training in digital regional development, smart city pilot programmes and a smart city marketplace. According to Article 3 of Government Decree 56/2017 (III. 20.), cited above, a 'smart city means a city (or town) that develops and implements its integrated urban development strategy on the basis of a smart city methodology, a town or group of towns that develops its natural and built environment, its digital infrastructure and the quality and economic efficiency of its services using modern and innovative information technologies in a sustainable manner, with the increased involvement of the population'. The horizontal nature of smart city development is also reflected in the fact that its implementation is supported by the main pillars. The digital state in and of itself entails the digital renovation of public administration, including the support of the online presence of local governments and the creation of a level playing field for the Hungarian digital industry. The digital competencies pillar encompasses Hungary's digital education strategy and digital competency development. Among other things, the digital economy pillar contains Hungary's digital start-up strategy.

In order to reach the scale and scope of the emerging supportive environment, Government Decree 252/2018 (XII. 17.) on the Establishment and Operation of Smart City Central Platform Services, appointed the Lechner Knowledge Centre as the provider of the centralised public service of the Geographic Information System Platform for Settlements and designated the city of Monor as the local government that is currently connected to the smart city central platform service; subsequently, other cities will follow suit. The essence of the platform is that a central 'standard package' will be developed, open for other settlements to join, where they will need to deal only with those developments that serve specific local needs. In addition, the Lechner Knowledge Centre develops Smart City Methodologies. Based on the requirements of Hungarian cities and the guidance of the European Union, the methodologies contain proposals that may ensure the systemic implementation of certain smart city development models. The Inventory of the Smart City Methodologies already contains 234 projects in Hungary, and 900 in the world in total. In Hungary, it monitors projects implementing smart city developments in roughly 66 settlements.[24]

From 2017 onwards, the marketplace element of the smart city component of the DSP strategy has been constantly evolving as a complex software solution – in a form of an info-communication platform – for developers and suppliers to present their smart city products and buyers to learn about the detailed features of the products. The platform established contains legally, technically and economically validated and quality-assured suppliers and products and makes them available primarily to local governments, state

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[24] See in detail 'Smart City Methodologies' http://okosvaros.lechnerkozpont.hu/hu

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and municipal institutions and business associations. One of the most important aspects of the marketplace is that the services provide financing options and return calculations, which greatly facilitate the work of municipal decision-makers considering smart urban developments. The goal is to make it easier for customers involved in the development (city leaders, company representatives) to find the right tools to meet their needs.

The process of entering the platform begins after registration with the creation of a profile. This is important in order for the platform to categorise settlements based on size and economic, social, geographical characteristics and issue maps. Registration and access to information is free for municipalities, while businesses have to pay a minimal fee. They will then have access to the marketplace, including the product catalogue. The most important element of the latter is a datasheet of available products, which contains legal and warranty information, technical and compatibility data, investment costs and social impact figures. A similar process takes place on the vendor side of the marketplace. After registration, candidates enter into a contract with the marketplace, followed by legal, technical and economic validation, then a social return calculation. This process results in a product data sheet which is made available to customers. The marketplace offers other services in the existing product catalogue, including trademarks, the registration of consultants, newsletters and blog information on financing options, and, in this context, runs a return calculator.[25]

The functioning of the marketplace is closely linked to the other two elements of the horizontal theme of the DSP smart city. Specialist training in digital spatial development, the first comprehensive smart graduate training course in Hungary, is provided by the Edutus University, the University of Public Service and the Moholy-Nagy University of Art and Design. The target group is made up of professionals who have the appropriate knowledge and influence concerning the decision-making processes of their cities or towns. The aim is to train professionals who have thorough knowledge of the relationship between digitisation and towns and cities and smart city considerations and practices. Graduates will be aware of smart city solutions and will have enough knowledge to launch and implement a related project.

The second component, the first phase of pilot projects at nine sites, is undergoing feasibility studies.[26] The methodology applied during the studies can serve as an example for municipal (smart city) developments: it plans data-based developments, takes into account the size and needs of the user community, the aspects of financing and sustainability, and the characteristics of the settlement. It is significant that the methodology also utilises the results of other digital strategies (for example education strategy, agricultural strategy, health strategy, Carpathian Basin digital ecosystem) applied to the situation assessment

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[25] 'Civitas Sapiens 2020, Smart City Conference, Hungary' (Budapest: Digitális Jólét Nonprofit Kft., 2020), 9–10.

[26] The pilot project locations: three districts in Budapest (the 8th, 11th and 17th), Tata and Tata County districts, Balatonfüred and Balatonfüred County districts, Tamás, Nyíradony and Nyíradony County districts, and two non-urban development areas: Tokaj, the mountain range, which covers the area of the Tokaj wine region, and the heart of Pannonia, which covers part of Lake Velence and the Vértes Mountains.

of smaller settlements. Finally, the studies present the cost structure (investment and maintenance) of the proposed developments based on the identified capabilities and opportunities, as well as the calculation of the return on the improvements.

The tools of this methodology are opinion polls and secondary data collection (examination of the administrative, economic, IT and social characteristics of the settlement/region based on the data of the Hungarian Central Statistical Office), the enumeration of existing developments, their analysis, the processing of accepted site development plans, and interviews with decision makers, the civil sector and institutional leaders, that is, all stakeholders in the area. The main purpose of surveys is to assess the digital status of a given area. The main elements of these surveys is to explore socio-demographic and statistical issues, use of internet and social media, use of e-government (customer gateway, e-administration), commerce and use of electronic payment methods and smart tools.[27]

It is too early to assess the effectiveness of the DSP marketplace. Nevertheless, by the end of 2020, the DSP Smart City Marketplace company list consisted of 19 registered companies which included a short description of each of them, as well as detailed information on their offered products. Taking the profiles and intended goals of the products, we have clustered them into different groups with an aim of specifying areas for development. However, in this early stage, neither the boundary conditions nor the expected outputs have been specified. The second aim was to match the identified clusters to the EU SCM Action Clusters. As the work of each Action Cluster is collected under thematic initiatives, it can be treated as an appropriate point of reference for marketplaces organised at national or local levels (see Table 2).

Table 2 • *Matching DSP Initiatives to EU Action Clusters (Source: Compiled by the author based on the EU Smart Cities Marketplace Charter and DSP Marketplace Company List 2021.)*

	Action Cluster	Registered Products Cluster	
EU SCM	*Sustainable Urban Mobility*	Geospatial Mapping System	DSP SCM
		Safe and Sustainable Transport	
	Sustainable Districts and Built Environment	Environmental Protection and Monitoring	
		Sustainable Installations	
		Energy Management and Monitoring	
		Smart Solar Power Energy Production	
	Integrated Planning Policy and Regulations	Smart Dashboard	
		Data Warehouse	
	Integrated Infrastructures and Processes	Integrated Communication System	
		Knowledge and Info Sharing	
	Business Model and Finance		
	Citizen Focus	Social Care System	
		Smart Recreation	

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[27] 'Civitas Sapiens 2020', 11.

As a result of a comparison, the products cluster of DSP SCM proved to be fundamentally compatible with the EU Action Clusters. However, so far DSP initiatives do not intend to make their own or common business models. Also, detailed financial proposals are absent. In addition, relatively few initiatives focus on developing projects based on wide-ranging citizen engagement. As business models and various forms of citizen engagement have key importance from the viewpoint of digital maturity, these components need to be developed. At the same time, it can be seen that in the realisation of smart city development, the goals and tools of a supportive environment based on common logic, and a multi-level, layered institutional structure are beginning to emerge.

5. CONCLUSIONS

Currently, all forms of settlement experience the need to respond to rapid changes by adaptive and innovative solutions which are an integral part of long-term strategies. However, any developments must take into account the geographical location, level of development, human resources, and basically the size of the given settlement, as in many respects the problems of small and medium-sized towns are different from those of developed, large cities.

The success of the responses depends to a great extent on the level of their digital maturity which expresses both the introduction of digital technologies, smart solutions, as well as the creation of a collaborative, digital ecosystem based on the active involvement of local authorities, enablers, technical solution providers, knowledge institutes, banks, financial institutions, co-initiators and so on. Accordingly, the level of maturity indicates the progress to be made in the field of institutional and administrative capacity-building. In other words, becoming a smart city could be understood as an inevitable process. Here, a lack of financial resources, difficulties in public procurement, and restrictions on the use of ICT tools are serious obstacles. In order to tackle the barriers and bottlenecks, there is a strong need for ecosystemic thinking in general, and for a 'tailor-made' supportive environment and adaptive business models in particular. An extended business model which includes design parameters and complementary elements of a supporting environment is crucial in order to become a real smart city.

However, the introduction of ICT tools, platforms, various channels of knowledge sharing, creating and operating a smart city marketplace, initiating knowledge transaction platforms are necessary but not sufficient conditions for building a smart city. The marketplace as an open info-communication platform is not enough to build a smart city. The lack of horizontal coordination, complementarity, collaboration, or acceptance between line ministries, departments, public agencies, local authorities, local businesses, solution providers and universities proved to be a well-known issue in organisations and projects, in addition a common problem in the implementation of smart city projects. In this paper we argued that instead of operating 'siloed' organisational structures and projects, holistically designed programmes with interrelated and complementary elements

are needed for triggering synergies. In practical terms, an extended business model based on a supportive environment fulfils the role of an enabling framework for integrated planning and management of smart city developments.

The experiences of the initial phase of the implementation of the DSP programme in Hungary clearly indicates that there is a strong need to create a supportive environment which requires the full involvement and cooperation of the municipal government and the citizens, as well as the development of effective management structures, business models, platforms and a sustainable marketplace. Having examined the initial phase of the DSP, it is obvious that the basic pillars of future developments are in place. However, in entering into the second, implementation or 'take-off' phase of the programme, many steps are still needed for mapping and mobilising the necessary resources, mostly in the field of financial opportunities and citizen engagement. These factors form the basis of an integrative framework capable of exploring the processes that determine the future of a smart city. Within this overall framework, our future research must pay particular attention to the different dimensions of smart city governance, where city leadership and partnership will play an important role not only in producing smart city content, but also in understanding and managing the smart city operation.

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THE HEALTH EFFECTS OF WORKING ON THE COMPUTER: WARNING SIGNS

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Computerisation and digitisation are an engine of social and economic change. Implementation and coordination of both work and leisure activities are already unthinkable without computers and smart devices. The benefits of computerisation are available immediately in the forms of faster problem solving, cost-saving, or the environmental impacts of using less paper in administration. However, the fact that we spend more and more time in front of computers also raises health issues. Harmful effects of bad sitting posture, short lightning or other factors conveniently fade into the background. An important reason for this is that their representation differs in time. The human body can adapt flexibly to various external factors; the formation of irreversible changes requires a relatively long time, which gradually evolves. Because of this asymmetry, a notice of preliminary signals and a preventive approach is highly advised.

This paper contributes to the ergonomic knowledge base by exploring the opinions about the early warning signs of the problems among higher education students. The analysis is based on the responses of 591 students to a voluntary online survey. The sample structure by age and job experience points to the increase of problems, drawing attention to necessary development actions.

KEYWORDS:
computer work, digitisation, ergonomics, sitting posture, working environment

1. INTRODUCTION

The computerisation and digitisation of recent decades have changed our lives in different ways. Besides reforming manufacturing management or new product features, a quintessential development area is services, especially in administration. Digitisation can be introduced as a buzzword that intertwines with both the business and public sector.[1] The spread of personal computers and later smartphones, along with the opportunities of the internet, led to a fundamentally new society and economy. Both personal and work activities increasingly depend on computers and a common characteristic of these activities is that interactions between humans and computers are commonplace. It is worth noting that human evolution is a much slower process than the changes in computer and information technology and this leads to problems. However, there are other factors of digitisation due to its complexity. The maturity models in the field[2] take several factors into account, focusing on technological, organisational, leadership issues, as well as the capability of the required changes in the systems.[3]

The diverse nature of the field goes beyond the scope of this paper. The goal of the study is limited to drawing attention to a seemingly less critical impact of the field, the health impact of exposure to computer work, especially the right sitting posture.

Availability of technical innovations and access to products was a fundamental problem at the beginning of digitisation. Based on the data provided by the Hungarian Central Statistical Office in Table 1, a technical background is no more a limitation on the national level (it is worth noting that local availability of the most developed services can be unequal between cities and rural areas, but the improvement is convincing). There is a remarkable improvement in the utilisation of technologies, even in everyday life.[4] Table 1 emphasises some indicators that confirm the general prevalence and the dynamic enlargement of computerisation.

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[1]   Markus Jakob and Helmut Krcmar, 'Which barriers hinder a successful digital transformation in small and medium-sized municipalities in a federal system?', in *Central and Eastern European e|Dem¸ and e|Gov Days 2018: Conference proceedings,* ed. by Hendrik Hansen, Robert Müller-Török, András Nemeslaki, Alexander Prosser, Dona Scola and Tamás Szádeczky (Wien: Facultas Verlags- und Buchhandels AG, 2018).

[2]   Katrin Hummel and Birgit Schenk, 'Digital maturity in the administration of a university of applied sciences', in *Proceedings of the Central and Eastern European E|Dem and E|Gov Days 2019,* ed. by András Nemeslaki, Alexander Prosser, Dona Scola and Tamás Szádeczky (Wien: Facultas Verlags- und Buchhandels AG, 2019).

[3]   Jakob and Krcmar, 'Which barriers hinder a successful digital transformation'.

[4]   Balázs Budai, Balázs Kőnig, Gábor Törley and Anna Orbán, *Elektronikus közigazgatás-szervezés, közigazgatási technológia* [Electronic Organisation of Public Administration, Administrative Technology] (Budapest: Nemzeti Közszolgálati Egyetem, 2012).

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Table 1 • *Some indicators of computer and internet use in Hungary (2006–2019) (Source: Compiled by the authors based on Summary tables (STADAT), Time Series of Annual Data, Information, Communication, 2020)*

	Number of mobile internet subscriptions	Number of internet subscriptions	Regular (daily or almost daily) internet users (percent)	Computer users in the population by date of last use – within 3 months (percent)	Online purchases within 3 months of the date of last purchase (percent of the population)
2006	199,784	1,329,625	60.3	52.1	4.7
2007	356,721	1,832,023	71.6	58.0	6.9
2008	570,835	2,310,914	72.8	62.5	7.7
2009	933,000	2,803,543	76.7	61.9	8.8
2010	1,306,912	3,341,464	78.5	63.3	10.2
2011	2,154,842	4,332,525	81.8	68.7	12.5
2012	3,177,412	5,455,639	82	71.5	14.7
2013	4,072,242	6,479,849	85.2	73.0	17.2
2014	5,139,320	7,692,676	86.7	76.0	20.2
2015	5,647,284	8,329,443	86.7	72.3	23.0
2016	6,191,403	9,001,928	89.2	–	26.6
2017	6,546,269	9,480,413	89.5	74.6	26.2
2018	6,830,491	9,939,157	90.3	–	28.8
2019	7,061,697	10,255,608	93.5	–	35.0

The number of internet subscriptions has been dynamically growing in recent years; it has increased more than 3.5 times in the last ten years. A tremendous increase is found in mobile internet subscriptions; the difference is sevenfold in this period. Regular internet use was typical of 60.3 per cent of the Hungarian population in 2006, while the indicator value was 93.5 per cent in 2019. Computer use (excluding smartphones) shows a similar pace of expansion; however, the differences in the indicators suggest the increasing priority of smartphones. Online shopping has also become popular. 35 per cent of the population purchased something through the internet in 2019 (at least once in the three months before the interview).

The ratio of households having a desktop or a mobile computer has significantly increased between 2006 and 2014 (Figure 1). Compared to each other, the spread of portable versions has grown dynamically in households.
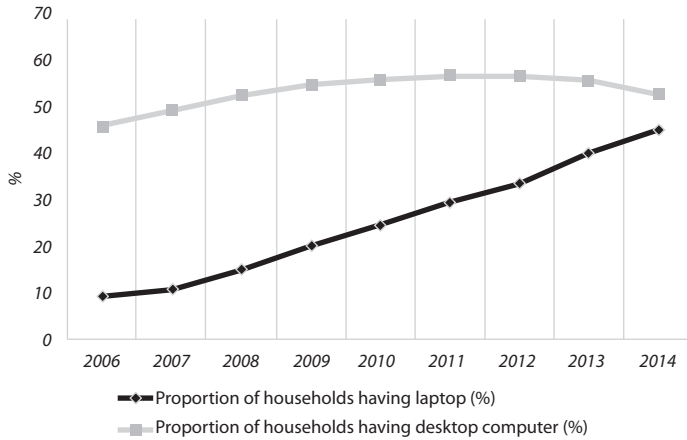
Figure 1 • *The spread of desktop and portable computers (2006–2014) (Source: Compiled by the authors based on Summary tables (STADAT), Time Series of Annual Data, Information, Communication, 2020)*

The spread of computers and related services was remarkable in the 2010s, even in administration. There were 223,514 computers used in public administration, defence and compulsory social security in 2005; it increased to 305,928 by 2013. The number of servers increased by 45 per cent during this period.

Table 2 • *Use of information and communication tools in public administration, defence and compulsory social security (percent) (Source: Compiled by the authors based on Summary tables (STADAT), Time Series of Annual Data, Information, Communication, 2020)*

Item	2009	2011	2013	2015	2017
Computer	99.7	99.3	100.0	99.6	100.0
Internet	98.9	98.3	99.6	99.6	99.4
E-mail	98.1	98.1	98.3	98.6	99.2
Web page	–	58.0	80.9	84.3	87.9
Social media tools	–	–	–	36.5	43.0

2. PROBLEM FORMULATION

The literature of computerisation and IT/ICT[5] mainly focuses on the tasks and processes managed by computers but gives less attention to the physical factors of the work environment. Of course, the human experience is considered, but ergonomic aspects,

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[5] IT: Information technology; ICT: Information and communications technology.

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especially the long-term health effects, are often left in the background. There is a time-asymmetry to observe that makes the perception of the problems difficult. While the benefits of computerisation and digitisation seem to greatly exceed the risks both on macro and micro levels, including but not limited to the labour market,[6] education,[7] or digital inequality,[8] the physical impacts on the human body must be considered. Unfavourable health impacts, which are the results of sitting in front of a computer, lead to reduced working capacity. A relevant difficulty in analysing the phenomena is that both working and free time activities are increasingly dependent on computers, and the health impacts are independent of the purpose of the activities. All these seem to be marginal issues of digitisation until disruptions due to illness endanger work processes.

Intensified computer work leads to an increased load on the musculoskeletal system, on the eyes, and mental health can also be influenced.[9] Managing human–computer interactions requires a comprehensive approach, including ergonomic issues. Computer vision syndrome (CVS) covers most symptoms, but it focuses mainly on ocular-related problems.[10] According to workplace design for computer activities,[11] other factors may be included. Moreover, developing healthy workplaces requires a more sophisticated approach.[12]

The proper sitting posture, selection of tools and scheduling lead to both desirable and undesirable impacts. Feeling discomfort and declining performance are the first signs. Developing health problems or even leaving the workplace can be the outcome.

Medical and epidemiological monitoring is the key to long-term problem solving, but the complexity of the topic both allows and urges route-finding research with a targeted scope. Nevertheless, medical experiments are time-consuming. Analysing personal opinions by surveys is more superficial but straightforward to implement and appropriate for outlining problems. Through this, the investigations aim to enhance the knowledge base of human–computer interactions.

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[6]   Oliver Sievering, 'Effects of digitalization on the labor market in Baden-Wuerttemberg', in *Central and Eastern European e|Dem̦ and e|Gov Days 2018: Conference proceedings,* ed. by Hendrik Hansen, Robert Müller-Török, András Nemeslaki, Alexander Prosser, Dona Scola and Tamás Szádeczky (Wien: Facultas Verlags- und Buchhandels AG, 2018).

[7]   Robert Müller-Török, Alexander Prosser and Birgit Schenk, 'Digitisation and system integration in the public sector – Consequences for teaching', in *Proceedings of the Central and Eastern European E|Dem and E|Gov Days 2019,* ed. by András Nemeslaki, Alexander Prosser, Dona Scola and Tamás Szádeczky (Wien: Facultas Verlags- und Buchhandels AG, 2019).

[8]   Rinaldo Evangelista, Paolo Guerrieri and Valentina Meliciani, 'The economic impact of digital technologies in Europe', *Economics of Innovation and New Technology* 23, no 8 (2019).

[9]   Céline McKeown, *Office Ergonomics: Practical Applications* (New York: CRC Press, 2008).

[10] Caleb Teo, Phoebe Giffard, Venerina Johnston and Julia Treleaven, 'Computer vision symptoms in people with and without neck pain', *Applied Ergonomics* 80 (2019).

[11] A detailed guide is to find in Wesley E Woodson and Donald W Conover, *Human Engineering Guide for Equipment Designers* (Berkeley: University Press, 1973); Anne D Kroemer and Karl H E Kroemer, *Office Ergonomics* (London: Taylor & Francis, 2001) and Hai B Yang, Shu Guang and Yu T Feng, 'Health office chair design based on ergonomics', *Applied Mechanics and Materials* 274 (2013).

[12] Bernadett Szolnoki, 'Egészségfejlesztéshez kapcsolódó szervezeti döntések támogatása a 4C modellel', *Magyar Minőség* 28, no 1 (2019).

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3. RESEARCH GOAL AND LIMITATIONS

Computer work is critical to health, and through this, it has social and economic effects.[13] The use of mobile and smartphones especially shows spectacular implications of addiction in everyday activities. The spread of use foreshadows the understanding of unfavourable impacts, as well.

The development of bodily harm and diseases caused by computer activities comes over time.[14] Early identification is critical to successful corrective or preventive actions. This endeavour is the reason why students are the focus of the investigations. There is an excellent opportunity to intervene on time to prevent harm and disorders through education and training. Moreover, it is important to get used to the right working environment earlier than when a student in higher education.[15] The target group is limited to higher education students; however, the research experience may have a broader outlook since computerisation and digitisation are a general phenomenon.

The study uses a voluntary survey that asks about a feeling of exhaustion or pain related to computer work (evaluated on a 6-point scale):
– in the eyes
– in the hands and arms
– in the fingers
– in the back and shoulders
– in the neck
– in the waist
– general evaluation of feeling computer work exhaustion

The research goal is to explore the situation and to check the patterns by the grouping factors. Age, gender and job experience are used as grouping factors. Nowadays, having job experience is typical among full-time students, in the form of an internship or part-time employment. These students deal with computer work and the workplace in different ways.

This study contributes to this knowledge base by asking business and public administration higher education students about their experience with the health impacts of computer work. The research sample of the study consists of the voluntary, anonymous responses of higher education students collected between 2018 and 2019. There are students of business, public administration and law studying at various Hungarian higher education institutions. The representativeness of the sample is not checked. Data collection

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[13] Shivendu Shivendu and Ran A Zhang, 'The Impact of Digitization on Content Markets: Prices, Profit, and Social Welfare', *MIS Quarterly,* Forthcoming.
[14] Kroemer and Kroemer, *Office Ergonomics.*
[15] Suman Singh and Jyoti Wadhwa, 'Impact of computer workstation design on health of the users', *Journal of Human Ecology* 20, no 3 (2006).

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is performed by an online form managed in the EvaSys Survey automation system, and data analysis is conducted with the IBM SPSS version 25.[16]

Due to the data collection method and the voluntary nature of the survey, the interpretation of the results is limited; however, the results may be informative. A relevant limitation of the results is that the results are based on the self-evaluation of the respondents by a voluntary survey and not on a professional medical examination. The research can be considered as an awareness-raising pilot study in the field.

4. RESULTS

4.1. Sample characteristics

The research sample includes 591 items. 368 respondents (62.3 per cent) are females, and 223 (37.7 per cent) are males. 265 (44.8 per cent) of the respondents have some job experience, including a job or internship. The distribution of the sample is not uniform based on the age of the respondents. Respondents born in 1990 or earlier are underrepresented (13.4 per cent). 136 (23 per cent) were born between 1991 and 1995, while 306 (63.6 per cent) between 1996 and 2001. It is worth noting that five respondents were born in 2001; there is no separated category established.

The reliability of the survey is acceptable by the Cronbach alpha test (0.858) for the questions about health impacts and general evaluation. Cronbach's alpha remains within the acceptance range if any items are deleted[17] (Table 3). The Kolmogorov-Smirnov test fails for the normal distribution of the responses, and the two-tailed significance is .000 for each item. Therefore, ANOVA[18] analysis is conducted by the Kruskal-Wallis method. For easier comparison, the results by grouping factors are presented with the mean values.

14.9 per cent of the sample reported some proven health problem related to computer work, and 22.7 per cent of them are uncertain about this. Assuming that the development of health problems may take a long time, but it can be different for different parts of the body, the survey among higher education students is applicable for finding the early warning signals for establishing preventive actions.

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[16]   The statistical analysis follows the instructions of Earl R Babbie, *The Practice of Social Research* (Boston: Cengage Learning, 2015); Daniel Stockemer, *Quantitative Methods for the Social Sciences: A Practical Introduction with Examples in SPSS and Stata* (Berlin: Springer, 2018).

[17]   Cronbach's alpha is a measure of internal consistency of scale-evaluation questions, it is usually accepted over 0.7 value.

[18]   ANOVA: Analysis of Variance, statistical procedure of the significance of differences between groups.

Table 3 • *Cronbach-Alpha test results for the survey (Source: Compiled by the authors.)*

	N	Mean	Std. Deviation	Cronbach's alpha if item deleted
Eyes	591	3.80	1.562	0.846
Hands and arms	591	2.68	1.539	0.839
Fingers	591	2.46	1.447	0.846
Back and shoulders	591	3.99	1.582	0.827
Neck	591	3.64	1.718	0.827
Waist	591	3.30	1.714	0.841
Do you generally feel tired with computer activities?	591	3.27	1.408	0.838

4.2. Survey results

The mean values of the responses (Table 3) suggest a moderate negative health impact of computer work on the human body. A detailed examination of the distributions (Table 4, Figure 2) gives a more nuanced overview. The questions about feeling tired (or pain) in different parts of the body measure the experience of the respondents on a 6-point scale (1: not at all, 6: often). The distribution of the responses is labelled not typical (1 and 2 values), moderate (3 and 4 values), or harmful (5 and 6 values).

The results show that the respondents do not feel computer work to be exhausting; only 20.1 per cent marked 5 or 6 values for this question. However, the largest group marked moderate values (3 or 4 values) with a share of 47.2 per cent.

Table 4 • *Distribution of the responses about the exhausting or harmful characteristic of computer work (percent) (Source: Compiled by the authors.)*

	Eyes	Hands and arms	Fingers	Back and shoulders	Neck	Waist	Feeling generally tired of computer activities
Not typical	24.9	53.3	59.2	20.1	30.5	36.7	32.7
Moderate	38.1	30.6	29.6	36.7	32.5	34.7	47.2
Harmful	37.1	16.1	11.2	43.1	37.1	28.6	20.1
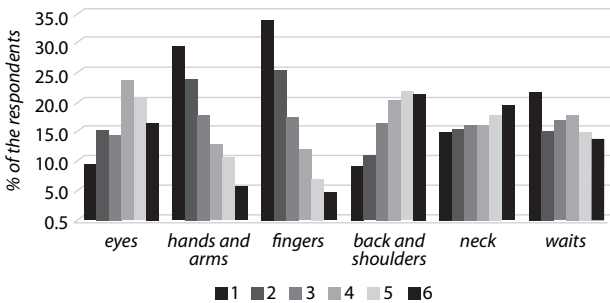
Figure 2 • *Distribution of the responses (measured on a 6-point scale) (Source: Compiled by the authors.)*

The distribution of the responses emphasises that eyes, back and shoulder are the primarily compromised body parts, that is, these can be considered the first indicators of the exhausting or harmful characteristic of computer work. Hands, arms and fingers are not typically reported by the respondents. Neck and waist show a more uniform distribution.

4.3. Differences by grouping factors

The differences of the self-reports by the grouping factors are summarised in Figures 3 to 6. The statistically significant differences[19] are marked by '*' at the name of the body part in the figures. The test results are presented in Table 5. With regards to computer work, the question about perceived health problems is also included for testing the reliability of the survey (Figure 3). Respondents who know about health problems related to computer work consistently marked higher values in the evaluation of the body parts.
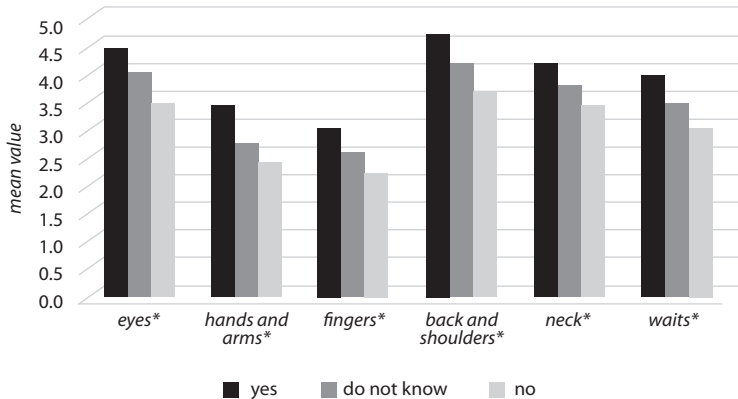
Figure 3 • *Mean values of the evaluations by recognised health problems related to computer work (Source: Compiled by the authors.)*

The analysis confirmed significant differences for most of the aspects investigated. The results show that health problems occur more often among older respondents (Figure 4). Eye tiredness is considered the most critical issue, except among the youngest group. Differences by age are apparent even if the results are not significant.

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[19]   A difference is considered statistically significant if the asymptotic significance level is less than or equal to 0.05.

Table 5 • *ANOVA results of the Kruskal-Wallis test (Source: Compiled by the authors.)*

		Eyes	Hands and arms	Fingers	Back and shoulders	Neck	Waist	Feeling tired of computer activities
Age category (df = 2)	H[20]	21.34	11.37	4.34	6.62	7.72	2.74	21.96
	Sig.	0.000	0.003	0.114	0.036	0.021	0.254	0.000
Gender (df = 1)	H	11.04	1.54	0.01	17.39	3.98	0.55	2.00
	Sig.	0.001	0.214	0.942	0.000	0.046	0.457	0.158
Job (df = 1)	H	0.53	3.64	5.41	4.07	0.78	4.08	5.94
	Sig.	0.468	0.057	0.020	0.044	0.377	0.044	0.015
Health problems caused by regular computer use (df = 2)	H	33.58	27.88	20.16	35.94	15.71	23.71	33.49
	Sig.	0.000	0.000	0.000	0.000	0.000	0.000	0.000
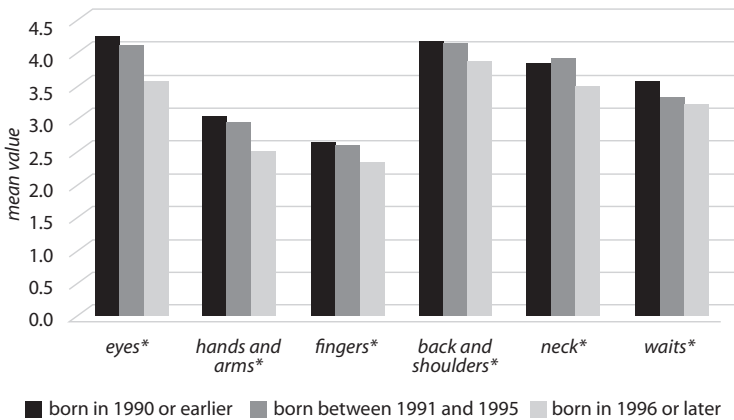
Figure 4 • *Mean values of the evaluations by age categories (Source: Compiled by the authors.)*

The significant differences by gender are limited to eyes, neck and back and shoulders (Figure 5). Females seem to be more exposed to the harmful effects of computer work than males but clarifying whether this is indeed a higher exposure or just a difference in valuation requires further investigations.

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20   H: Kruskal-Wallis H indicator value.
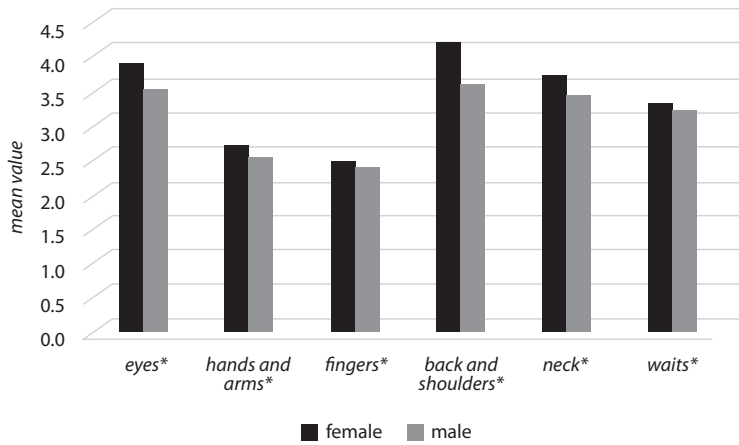
Figure 5 • *Mean values of the evaluations by gender (Source: Compiled by the authors.)*

Results by job experience (Figure 6) show that the respondents who have a job experience have higher mean values than without it, respectively. The differences are significant fingers, waist, back and shoulder. Assuming that exposure to computer work is higher among these people, the intensity of the load has an impact on the extent of the problems.
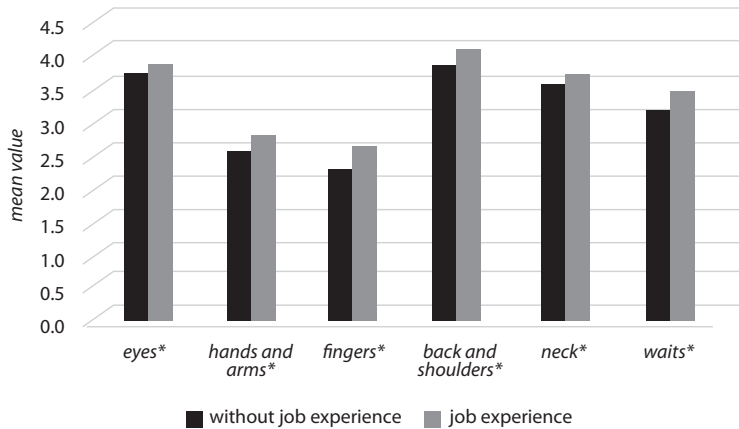
Figure 6 • *Mean values of the evaluations by job experience (Source: Compiled by the authors.)*

5. DISCUSSION

Statistics confirm that computerisation and digitisation increasingly influence our daily lives and work. The internet is no more just a channel to share information. It becomes a platform for various activities, including communication, banking and shopping. Due to the Covid-19 pandemic, even the different levels of education,[21] as well as family gatherings, became virtual. Access to this world requires an active and expanding use of ICT tools. Time spent with a computer involves physical and mental strain on the human body. On the other side, computer work can increase productivity. The effectiveness of working with a computer shall be evaluated in a comprehensive approach (Figure 7).
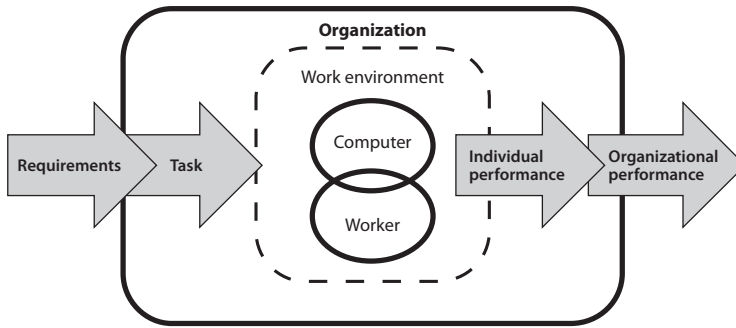
Figure 7 • *The role of the working environment in achieving organisational performance (Source: László Berényi, 'Számítógépes munkahelyek ergonómiája a gyakorlatban', Marketing and Management 47, no 3 (2013), 76–86.)*

Since a computer is a tool for activities, it must be adapted to the requirements of the tasks and the characteristics of the human body. There is an asymmetry in practice. Being able to use computers requires adaptation. Even when there is a high-end computer available as well as an excellent IT background, organisational issues influence performance. Defining the task and establishing the working environment regarding the task requirements are also conditions of the performance. Due to the human body's flexible adaptation to environmental impacts, unfavourable health impacts may remain hidden for a long time.

Moreover, short-term and temporary actions are not healthy solutions. Developing the working environment can be successful if task properties and the evaluation of the

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[21]   41/2020. (III. 11.) Korm. rendelet az élet- és vagyonbiztonságot veszélyeztető tömeges megbetegedést okozó humánjárvány megelőzése, illetve következményeinek elhárítása, a magyar állampolgárok egészségének és életének megóvása érdekében elrendelt veszélyhelyzet során teendő intézkedésekről [Government Decree 41/2020. (III. 11.) on measures to be taken in the event of an emergency ordered to protect the health and life of Hungarian citizens in order to prevent a human epidemic causing a mass illness endangering the safety of life and property and to remedy its consequences].

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working environment is available. Exploring the perception of health impacts is a relevant component of the evaluation.

The survey results confirm the importance of healthcare, ergonomics and professional warnings about computer work. The data collection method of this survey is a necessity for finding the critical point for leading a preventive approach. Despite the shortcomings and limitations, the large sample allows for focus on outlining the problems. Unfortunately, medical evidence is only available when the damage is irreversible.

The proportion of moderate and rather exhausted ratings is remarkably higher among respondents with job experience (Figure 6), and this is a warning sign. The health impacts do not depend on the purpose of the activity, and it is related to sitting posture and exposure. Assuming that leisure and other non-job-related activities are present in the life of the respondents regardless of work, work gives extra load and stress that may lead to increased tiredness.

According to the questions about feeling tired or pain in one or more body parts, two issues stand out from the other based on both the average values and the distribution of the responses: eye, back and shoulder. A correlation analysis is conducted whether the felt tiredness or damage is limited to the given body part of the respondents, or there are multiplied problems. The results confirm that problems do not come alone. Cluster analysis[22] is performed to check whether particular patterns of health problems can be detected. The hierarchical clustering with Ward-method (that gives the most homogenous groups by the minimum variance) confirms two clusters (Figure 8). Cluster 1 includes 70.9 per cent of the respondents who feel the harmful effects of computer work more seriously.

Furthermore, they feel computer work is significantly more exhausting. Among these respondents, problems go beyond eye tiredness. The members of Cluster 2 feel eye problems the most seriously based on the mean values.
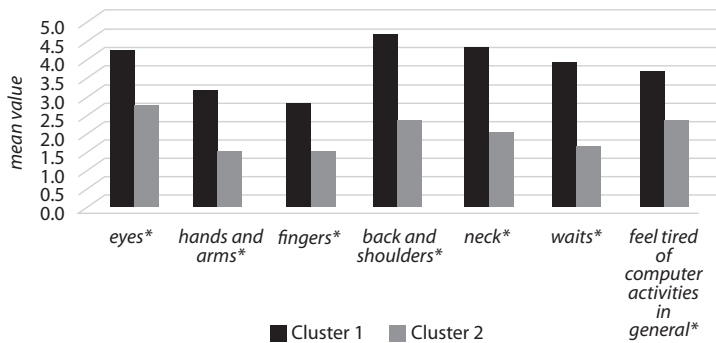
Figure 8 • *Mean values of the evaluations by cluster analysis results (Source: Compiled by the authors.)*

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22   The paper leaves the detailed calculations of the clustering procedure. The input data of the model is the database of the evaluation questions on feeling tired or pain in any body parts.

6. CONCLUSIONS

Computer work is a complex challenge. Continuous improvement of equipment, systems and procedures increasingly allows for faster and widespread access to services for work or entertainment. People spend even more time on different computers. Due to the high adaptability of the human body and mind to different environmental conditions, the negative impacts of the activities remain hidden for a long time. The designers can force the prevention of undesirable effects, but user attention is also essential.

The survey results point out that strain on the eyes and the musculoskeletal system is remarkable, regardless of the age or gender in the sample. The harmful effects are more typical with age and increased computer workload (those with work experience in the sample). The difference in outcomes between respondents who have or do not have job experience suggests that computer activities are considered less exhausting when it is not related to work. According to the results, eye tiredness can be the very first sign of problems. Awareness of this is a fundamental challenge.

The main policy implication of the study is that more serious attention should be paid to the health impacts of computer work. Prevention can be supported by technological innovations (ergonomic tools), but the root cause is the uncontrolled degree of exposure. People must recognise the dangers and understand the meanings of the early warning signs. It significantly includes the development of education in the field.

The knowledge base of ergonomics must be implemented in related regulation on the local (organisation) level and with legal regulation. However, the regulation of occupational health[23] includes screen work issues;[24] its scope is limited to employment relationships and other legal relations.

Having a break during computer work is essential for reducing static strain on muscles and refreshing the skeletal system. Systematic training activities promote both preventing problems and reducing their impact.[25] Beyond the favourable physiological impacts, mental relaxation is available. Considering that labour safety law obligates a break, the results show an unsatisfactory picture.

Training programs are needed, especially enhancing the ergonomic attitude formation in higher education institutions because it is the last staircase to climb before work.

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[23] 1993. évi XCIII. törvény a munkavédelemről [Act XCIII of 1993 on occupational safety].

[24] 50/1999. (XI. 3.) EüM rendelet a képernyő előtti munkavégzés minimális egészségügyi és biztonsági követelményeiről [Decree of the Ministry of Health 50/1999 (XI.3.) on minimum health and safety requirements for work in front of a screen].

[25] Bernadett Szolnoki, 'Mit tehet a foglalkoztató a mozgásszegény életmód ellen?', in *Műszaki tudomány az északkelet magyarországi régióban, 2019*, ed. by Sándor Bodzás and Tamás Antal (Debrecen: Debreceni Akadémiai Bizottság Műszaki Szakbizottsága, 2019).

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Ildikó Legárd

EFFECTIVE METHODS FOR SUCCESSFUL INFORMATION SECURITY AWARENESS

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Information security awareness is becoming increasingly important these days. It is not enough to have a well-developed physical and logical protection of the system and stored data; the users of these systems have to keep up with technological development and have to be sufficiently aware or cautious when using these systems. Information Security Awareness Programs provide the most effective solution for the improvement of users' information security knowledge and digital competencies.

The aim of this study is to help organisations in finding and providing an effective way of knowledge transfer. The study identifies the key elements of the implementation of the awareness programs and highlights the importance of communication channels and methods. The essay summarises and shows the most effective techniques that experts can use in order to draw the user's attention toward information security, like real-life simulation scenarios, interactive games, themed awareness videos and other gamification techniques.

1. INTRODUCTION

The rapid increase in digitalisation, the tremendous development of ICT tools and services, the widespread use of the Internet, and rapid access have brought about the need for information security to keep data and information produced safe from various security threats and risks.

NATO's interpretation of information security (INFOSEC) by the Allied Joint Doctrine for Information Operations: 'As part of OPSEC (Operations Security) the goal of Information Security (INFOSEC) is to protect information (stored, processed or transmitted), as well as the host systems, against a loss of confidentiality, integrity and availability through a variety of procedural, technical and administrative controls. INFOSEC includes a range of measures that are applied on a routine basis under the auspices of security policy to protect information. (…) INFOSEC is an integral element of all military operations and encompasses Communications Security (COMSEC), Computer Security (COMPUSEC), Computer Network Defence (CND), an integral part of Computer Network Operations (CNO), and together with personnel, document, physical and procedural security, it must be considered at the earliest conceptual stages and throughout the planning of an operation.'[1]

Many experts agree that the weakest link in the field of information security is the human factor, namely the user. Social engineering is a type of threat that builds on influencing, manipulating and exploiting the vulnerability of the human factor. Social engineering attacks can be divided into two types of attack, depending on the methods used by the attacker: human-based and computer-based. The most popular forms of human-based attacks are: asking for aid or support, assistance (reverse social engineering), identity theft, thumbstone theft, shoulder surfing, dumpster diving and tailgating. Computer-based attacks are: phishing (for example scam, vishing, smishing, pharming, whaling), malicious programs (for example: viruses, trojans, scripts, keylogger, spyware, baiting, ransomware), attacks based on public Wi-Fi and attacks based on mobile apps.[2]

There are various types of measures under information security (for example modern preventive tools and security systems in place) and one of them is information security awareness.[3] According to Kruger and Kearney 'whilst information security generally focuses on protecting the confidentiality, integrity and availability of information, information security awareness deals with the use of security awareness programs to create

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[1] AJP-3.10 Allied joint doctrine for information operations, NATO/PfP unclassified publication, 2009.
[2] Ildikó Legárd, 'Building an Effective Information Security Awareness Program', in *Central and Eastern European EDem and EGov Days 2020,* ed. by Thomas Hemker, Robert Müller-Török, Alexander Prosser, Dona Scola, Tamás Szádeczky and Nicolae Urs (Wien: Österreichische Computer Gesellschaft, 2020), 190.
[3] Abigail N W Prah, Angela A Otchere and Kojo E Opan, 'The Perceived Effectiveness of Information Security Awareness', *Information and Knowledge Management* 6, no 7 (2016), 62.

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and maintain security-positive behavior as a critical element in an effective information security environment'.[4]

This study is structured as follows. Next to the introduction, the second section reviews the conceptual framework including information security awareness and information security awareness programs. Section 3 identifies the key elements of the implementation of security awareness programs. Section 4 discusses and evaluates the main focus areas of the training material and the most effective ways and different information security awareness tools and techniques; presenting the role of a practice-oriented approach and gamification in security awareness and summarises the most important communication channels. Finally, the last section presents the main properties of the study.

This study utilises the qualitative method of research that is based on a secondary, in-depth analysis of literature. The aim of this method is to review, analyse and compare the most important concepts and theories in the field of information security awareness, especially effectiveness, the choice of methods, communication channels and gamification techniques.

2. CONCEPTUAL FRAMEWORK

This section presents the most important concepts: information security awareness and information security awareness programs.

2.1. Information security awareness

There is no generally accepted concept of information security awareness, but several Hungarian and international researchers have tried to define its components.[5] Hussain Aldawood and Geoffrey Skinner[6] emphasise individual aspects of information security awareness, while András Nemeslaki and Péter Sasvári[7] and Burcu Bulgurcu et al.[8] highlight its organisational aspects.

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[4]   Hennie A Kruger and Wayne D Kearney, 'A prototype for assessing information security', *Computers & Security* 25, no 4 (2006), 289.

[5]   Ildikó Legárd, 'Célpont vagy! – A közszolgálat felkészítése a kiberfenyegetésekre', *Hadmérnök* 15, no 1 (2020), 95; Ilirjana Veseli, *Measuring the Effectiveness of Information Security Awareness Program* (M. S. thesis, Gjøvik: Gjøvik University College, 2011), 87; Charlie C Chen, B Dawn Medlin and R S Shaw, 'A cross-cultural investigation of situational information security awareness programs', *Information Management & Computer Security* 16, no 4 (2008), 360–376.

[6]   Hussain Aldawood and Geoffrey Skinner, 'Reviewing Cyber Security Social Engineering Training and Awareness Programs – Pitfalls and Ongoing Issues', *Future Internet* 11, no 3 (2019), 1–16.

[7]   András Nemeslaki and Péter Sasvári, 'Az információbiztonság-tudatosság empirikus vizsgálata a magyar üzleti és közszférában', *Infokommunikáció és Jog* 4, no 60 (2014), 169–177.

[8]   Burcu Bulgurcu, Hasan Cavusoglu and Izak Benbasat, 'Information Security Policy Compliance: An Empirical Study of Rationality-Based Beliefs and Information Security Awareness', *MIS Quarterly* 34, no 3 (2010), 523–548.

Overall, the concept of information security awareness could be summarised as a set of knowledge, skills and behaviours that provides the users with the appropriate level of IT and information security knowledge, the skills that build on it and ensures its application, and the corresponding behaviour that appears as an internal need and recognises the importance of information security.[9] At the same time, information security awareness is part of an organisation's culture, a way of thinking and behaving that ensures that employees within the organisations are aware of and are ideally committed to the security objectives of their organisation and are enforcing security measures.[10]

| KNOWLEDGE ATTITUDE BEHAVIOR | PERSONAL INFORMATION SECURITY AWERENESS | ORGANIZATIONAL SAFETY CULTURE |
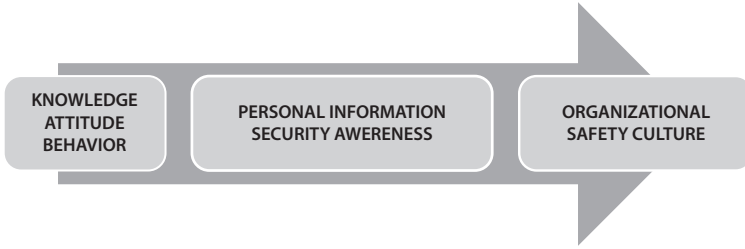
Figure 1 • *Security awareness (Source: Legárd, 'Building an Effective Information Security Awareness Program', 193.)*

Both NATO and the EU address the issue of awareness in their strategic documents.

The 2010 Strategic Concept 'Active Engagement, Modern Defence', which is a resolute statement on NATO's core tasks and principles, its values, the evolving security environment and the Alliance's strategic objectives, states: 'We will ensure that NATO has the full range of capabilities necessary to deter and defend against any threat to the safety and security of our populations. Therefore, we will: (…) develop further our ability to prevent, detect, defend against and recover from cyberattacks, including by using the NATO planning process to enhance and coordinate national cyber-defence capabilities, bringing all NATO bodies under centralized cyber protection, and better integrating NATO cyber awareness, warning and response with member nations.'[11] To achieve this goal, NATO reinforces its capabilities for cyber education, training and exercises[12] and NATO and the EU are strengthening their cooperation on cyber defence, notably in the areas of information exchange, training, research and exercises.

In June 2019, the EU Cybersecurity Act (CSA) entered into force and ENISA became the European Union Agency for Cybersecurity, with a new permanent mandate. According to this act, in order to raise awareness and education, ENISA shall:

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9   Legárd, 'Célpont vagy!', 95.
10   Nemeslaki and Sasvári, 'Az információbiztonság-tudatosság', 169.
11   *Active Engagement, Modern Defence. Strategic Concept for the Defence and Security of the Members of the North Atlantic Treaty Organization* (Brussels: NATO Public Diplomacy Division, 2010).
12   'Cyber defence', 23 May 2019.

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(a) raise public awareness of cybersecurity risks, and provide guidance on good practices for individual users aimed at citizens, organisations and businesses, including cyber-hygiene and cyber-literacy;

(b) in cooperation with the Member States, Union institutions, bodies, offices and agencies and industry, organise regular outreach campaigns to increase cybersecurity and its visibility in the Union and encourage a broad public debate;

(c) assist Member States in their efforts to raise cybersecurity awareness and promote cybersecurity education;

On 16 December 2020, the European Commission and the High Representative of the Union for Foreign Affairs and Security Policy presented a new EU Cybersecurity Strategy.[13] The EU's new Cybersecurity Strategy for the Digital Decade forms a key component of Shaping Europe's Digital Future that states: 'Improving education and skills is a key part of the overall vision for digital transformation in Europe.' A Digital Education Action Plan is essential to boost digital literacy and competences at all levels of education.[14]

2.2. Information security awareness programs

Effective protection against threats can be ensured by the security awareness of the users, which can be achieved through a well-organised and successful security awareness program.

Many international IT security standards refer to the implementation of an awareness program as a requirement for getting certifications, such as ISO 27001, COBIT, or ISO 9001: 2000.

Instead of the definition, previous studies concerning information security awareness programs focused on different aspects and purposes of the programs.[15]

Abigail N W Prah et al. state that information security awareness programs can be used by organisations to make their employees conscious of the security threats that could affect them and how they can be mitigated with security measures. The most important goal of the program is to positively affect the behaviour and attitudes of employees towards information security.[16] In their article, Mark Wilson and Joan Hash from the National Institute of Standards and Technology (NIST) define security awareness as follows: 'Awareness is not training. The purpose of awareness presentations is simply to focus attention on security. Awareness presentations are intended to allow individuals to

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13   'The EU's Cybersecurity Strategy in the Digital Decade', 16 December 2020.
14   'Shaping Europe's Digital Future', 2020.
15   Legárd, 'Building an Effective Information Security Awareness Program', 192.
16   Prah et al., 'The Perceived Effectiveness', 62.

recognize IT security concerns and respond accordingly. (…) Awareness relies on reaching broad audiences with attractive packaging techniques.'[17]

Based on the various approaches, security awareness programs can be described as a continuous effort of raising the attention of stakeholders towards information security and its importance, stimulating security-oriented behaviours,[18] and ideally inducing stakeholders' compliance to security policies and guidelines.[19]

According to Wilson and Hash, there are three major steps in the development of an IT security awareness and training program: designing the program (including the development of the IT security awareness and training program plan), developing awareness and training material, and implementing the program. 'Awareness and training programs must be designed with the organization mission in mind. It is important that the awareness and training program supports the business needs of the organization and be relevant to the organization's culture and IT architecture. The most successful programs are those that users feel are relevant to the subject matter and issues presented.'[20]

David Lacey also states that the first step of developing an effective security program is to identify the requirements and the key problem areas, analyse the root causes and develop the programs that indicate corrective actions.[21]

Regarding relevant studies and best practices, I could set up a model of the key elements of the implementation and the most important five steps to ensure the success of security awareness programs and to help organisations to design their own specific program.[22]

[17]   Mark Wilson and Joan Hash, *Building an Information Technology Security Awareness and Training Program* (Gaithersburg, MD: National Institute of Standards and Technology, 2003), 8–9.

[18]   Thomas R Peltier, 'Implementing an Information Security Awareness Program', *Information Systems Security* 14, no 2 (2005), 37–48; ENISA, 'A new users' guide: how to raise information security awareness', 2008; Susan Hansche, 'Designing a Security Awareness Program: Part I', *Information Systems Security* 9, no 6 (2001), 14–23; David D Maeyer, 'Setting up an Effective Information Security Awareness Programme', in *ISSE/SECURE 2007 Securing Electronic Business Processes Highlights of the Information Security Solutions Europe/SECURE 2007 Conference (part 1),* 2007.

[19]   Aggeliki Tsohou, Maria Karyda and Ramzi El-Haddadeh, 'Implementation challenges for information security awareness initiatives in e-government', *ECIS 2012 Proceedings,* 2012, 179; Mikko T Siponen, 'A conceptual foundation for organizational information security awareness', *Information Management & Computer Security* 8, no 1 (2000), 31–41.

[20]   Wilson and Hash, *Building an Information Technology Security Awareness,* 11.

[21]   David Lacey, *Managing the Human Factor in Information Security. How to Win Over Staff and Influence Business Managers* (Wiley, 2009).

[22]   Legárd, 'Building an Effective Information Security Awareness Program', 193–194.

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Figure 2 • *The key elements of the implementation of security awareness programs (Source: Legárd, 'Building an Effective Information Security Awareness Program', 194.)*

The study presents how an organisation can develop an information security program, and how it can pass on the right information to the right person in the right form.

3. TRAINING MATERIAL AND THE EFFECTIVE WAYS OF KNOWLEDGE TRANSFER (METHODS AND OPTIONAL COMMUNICATION CHANNELS)

The target user group for the program is either people without any previous training in the field of information security, or people who received training, but did not achieve a satisfactory result.

3.1. Training material

Information security awareness means that the employee:
- understands the meaning of definitions, exactly what we are talking about
- recognises what compromises the functioning of the information system
- helps prevention
- knows what to do in case of an IT incident[23]

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23   Nemeslaki and Sasvári, 'Az információbiztonság-tudatosság', 170.

Information security awareness consists of two main parts: in general, knowledge of IT and IT security and related skills, and on the other hand, knowledge of information security regulations and strategies.

But most important of all, if employees are aware of the security threats and how they can be mitigated, they can take appropriate action to prevent and correct security breaches. Therefore, the organisation as a whole can better prevent and mitigate these threats, especially social engineering attacks.

The training materials should be up-to-date, and should include the top threats identified in the most recent studies and analyses. In the following, the findings of several international organisations from 2020 are summarised:

The IOCTA is Europol's flagship strategic product highlighting the dynamics of cybercrime and the evolution of cybercrime threats. IOCTA 2020 states, that 'social engineering remains a top threat to facilitate other types of cybercrime. (…) However, despite the trend pointing towards a growing sophistication of some criminals, the majority of social engineering and phishing attacks are successful due to inadequate security measures or insufficient awareness of users'.[24]

Covid-19 Cybercrime Analysis Report by Interpol highlighted the below key threats:
- In one four-month period (January to April 2020) some 907,000 spam messages, 737 incidents related to malware and 48,000 malicious URLs – all related to Covid-19 – were detected by one of Interpol's private sector partners.
- Cybercriminals are increasingly using disruptive malware against critical infrastructure and healthcare institutions, due to the potential for high impact and financial benefit.
- The deployment of data harvesting malware such as Remote Access Trojan, info stealers, spyware and banking Trojans by cybercriminals is on the rise.
- Taking advantage of the increased demand for medical supplies and information on Covid-19, there has been a significant increase in cybercriminals registering domain names containing keywords, such as "coronavirus" or "Covid".
- An increasing amount of misinformation and fake news is spreading rapidly among the public.[25]

The European Union Agency for Cybersecurity (ENISA) calls attention to this problem in its document published at the end of 2020.[26]

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[24]   IOCTA, 'Internet Organised Crime Threat Assessment (IOCTA) 2020', 05 October 2020.
[25]   'COVID-19 Cybercrime Analysis Report', August 2020.
[26]   'ENISA Threat Landscape 2020: Cyber Attacks Becoming More Sophisticated, Targeted, Widespread and Undetected', 20 October 2020.

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ENISA Threat Landscape – 15 Top Threats in 2020

Figure 3 • *ENISA Threat Landscape – 2020 (Source:* www.enisa.europa.eu/topics/
threat-risk-management/threats-and-trends*)*

Based on several studies of the last few years and the above presented recent papers, the security awareness program should provide adequate knowledge of the following actual threats:

Table 1 • *Threats identified as affecting security (Source: Compiled by the author.)*

Threats	Studies
Password usage and protection (e.g.): • choosing a good password • password management • password sharing • locking workstation	Aldawood and Skinner (2018); Aldawood and Skinner (2019); Illésy et al. (2014); Kruger and Kearney (2006); Nemeslaki and Sasvári (2014); Parsons et al. (2014); Pattinson et al. (2012); Prah et al. (2016); Som and Papp (2016); Stephanou et al. (2008); Szász and Kiss (2018)

Threats	Studies
E-mail (e.g.): • phishing • scam • pharming • whailing • spam • opening attachments and links	Aldawood and Skinner (2018); Aldawood and Skinner (2019); Bányász and Krasznay (2019) Deák (2019); Illésy et al. (2014); Kruger and Kearney (2006); Nemeslaki and Sasvári (2014); Parsons et al. (2014); Pattinson et al. (2012); Prah et al. (2016); Stephanou et al. (2008)
Internet (e.g.): • dangerous Website/URL • web-based attacks • web application attacks • public Wi-Fi security risks • (home) router security settings • online shopping and payment • update • misinformation • DDos • defacement • botnets • cryptojacking • installing unauthorised software • accessing dubious websites • inappropriate use of internet	Aldawood and Skinner (2018); Aldawood and Skinner (2019); Bányász and Krasznay (2019); Deák (2019); Illésy et al. (2014); Kruger and Kearney (2006); Nemeslaki and Sasvári (2014); Parsons et al. (2014); Prah et al. (2016)
Social networking site (SNS) (e.g.): • sharing sensitive, personal data • posting about work on SNS • games • malware • ransomware • misinformation and fake news	Aldawood and Skinner (2018); Aldawood and Skinner (2019); Bányász (2015); Bányász (2017); Bányász (2018); Bányász and Krasznay (2019); Deák (2017); Deák (2018); Parsons et al. (2014)
Mobile equipment (e.g.): • physical security (physical manipulation, damage, theft and loss) • public Wi-Fi security risks • mobile application license	Aldawood and Skinner (2018); Aldawood and Skinner (2019); Deák (2017); Deák (2019); Illésy et al. (2014); Kruger and Kearney (2006); Parsons et al. (2014)
Data and information handling (e.g.): • data breach • information leakage • cyber espionage • adherence to company policies • clean desks policy • plug-in storage devices • home office – VPN • private use of electronic communications in the workplace and use of a private mail system for work • installing unknown software	Aldawood and Skinner (2019); Bányász and Krasznay (2019); Deák (2019); Illésy et al. (2014); Nemeslaki and Sasvári (2014); Parsons et al. (2014)
Incident reporting: • reporting suspicious individuals • reporting bad behaviour by colleagues • reporting all security incidents	Kruger and Kearney (2006); Parsons et al. (2014); Prah et al. (2016)

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3.2. Knowledge transfer methods and tools

The message of the program needs to be clear, meaningful, personal, memorable and contextualised. The specific, real-life examples and evidence can leave a lasting impression. The programs are more likely to be successful if the users feel that the subject matters and issues presented are relevant to their own needs.[27]

Aldawood and Skinner state that the traditional training methods, including onsite trainings and awareness camps, screensavers, posters, manual reminders and online courses are boring and tedious, leading to limited success. These methods tend to be very general and sometimes do not focus on the main objective of making staff remember the major manipulation techniques of hackers.[28] 'These traditional methods alone do not create sufficient safe culture among staff.'[29] Modern training methods, involving real-life simulation scenarios, interactive games, virtual labs, themed awareness videos and modules aim to provide awareness of social engineering and of how the social engineers actually perform an attack.[30]

The study of Kathryn Parsons et al. confirms the effectiveness of methods that provide useful knowledge and help with day-to-day tasks. They state that understandable, visible and 'convenient' security is the only way to ensure that users get useful knowledge in the field of IT security and also be motivated for the application of knowledge.[31] 'Training should be contextualized and should use case studies to improve both knowledge of what is expected and also understanding of why this is important'.[32]

Malcolm Pattinson et al. in their research of the detection of phishing e-mails, highlighted the effective role of scenario-based role-playing in awareness.[33]

Antónia Szász and Gábor Kiss confirm the efficiency of modern methods: 'It has been demonstrated that the educational method supported by decrypter programs that

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[27]   Kathryn Parsons, Agata McCormac, Marcus Butavicius and Lael Ferguson, *Human Factors and Information Security: Individual, Culture and Security Environment* (Published by Command, Control, Communications and Intelligence Division DSTO Defence Science and Technology Organisation, Edinburgh South Australia, 2010), 32; Tony Stephanou and Rabelani Dagada, 'The impact of security awareness training on information security behaviour: The case for further research', in *Proceedings of the ISSA 2008 Innovative Minds Conference, ISSA 2008,* Gauteng Region (Johannesburg), 2008, 5.

[28]   Aldawood and Skinner, 'Reviewing Cyber Security', 7.

[29]   Jemal H Abawajy, 'User preference of cyber security awareness delivery methods', *Behaviour & Information Technology* 33, no 3 (2014), 1–12.

[30]   Aldawood and Skinner, 'Reviewing Cyber Security', 6; Hussain Aldawood and Geoffrey Skinner, 'Challenges of implementing training and awareness programs targeting cyber security social engineering', in *2019 Cybersecurity and Cyberforensics Conference (CCC)* (Melbourne, 2019), 113–115; Kathryn Parsons, Agata McCormac, Marcus Butavicius, Malcolm Pattinson and Cate Jerram, 'Determining employee awareness using the Human Aspects of Information Security Questionnaire (HAIS-Q)', *Computers & Security* 42 (2014), 165–176.

[31]   Parsons et al., *Human Factors and Information Security,* 54.

[32]   Parsons et al., 'Determining employee awareness', 174.

[33]   Malcolm Pattinson, Cate Jerram, Kathryn Parsons, Agata McCormac and Marcus Butavicius, 'Why do some people manage phishing e-mails better than others?', *Information Management & Computer Security* 20, no 1 (2012), 18–28.

facilitate student activity had a significantly greater impact on the students' information security attitudes, practices, and awareness than those methods applying only video demonstrations.'[34]

Gamification is becoming more widespread and can be used in many areas, such as education.[35]

Several studies have attempted to define gamification, but according to the most accepted definition, 'gamification is the use of game design elements and game mechanics in non game contexts'[36] with the aim of making the study process more interesting and effective.[37]

Based on researches in this field of information security, it can be concluded that gamification has a place in security awareness.

Sam Scholefield and Lynsay A Shepherd identified that gamification and gamification techniques were useful methods of raising security awareness and participants enjoyed playing these types of applications and suggested that they increased their knowledge on password security.[38]

Melanie Volkamer et al. developed a game based smartphone app, named NoPhish, to educate people in accessing, parsing and checking URLs, that is, enabling them to distinguish trustworthy and non-trustworthy websites. The outcomes of their research is that 'NoPhish helps users make better decisions with regard to the legitimacy of URLs immediately after playing NoPhish as well as after some times has passed'.[39] Based on experience, the application was further developed and its effectiveness was measured by a pre- and post-test. The next study concluded that the 'effectiveness of "NoPhish" in increasing users' security awareness and the ability of detecting phishing URLs could be proven'.[40]

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34   Antónia Szász and Gábor Kiss, 'Jelszóvisszafejtő programok oktatási célú felhasználása és hatásuk az információbiztonsági tudatosságra', *Információs Társadalom* 18, nos 3–4 (2018), 82–104.

35   Tamás Kovács and László Várallyai, 'Gamifikáció, avagy a játékosítás szerepe napjainkban', *International Journal of Engineering and Management Sciences* 3, no 3 (2018), 171–180; Richárd Fromann and Andrei Damsa, 'Digitális pedagógia – A gamifikáció (játékosítás) motivációs eszköztára az oktatásban', *Új Pedagógiai Szemle* 3–4 (2016), 76–81; Diána Pacsi and Zoltán Szabó, 'A gamifikáció fejlődése és a magyar gamifikációs trend alakulása', *Studia Mundi – Economica* 4, no 1 (2017), 57–68.

36   Adrián Domínguez, Joseba Saenz-de-Navarrete, Luis de-Marcos, Luis Fernández-Sanz, Carmen Pagés and José-Javier Martínez-Herráiz, 'Gamifying learning experiences: Practical implications and outcomes', *Computer & Education* 63, no 1 (2013), 380.

37   Sebastian Deterding, Dan Dixon, Rilla Khaled and Lennart Nacke, 'From game design elements to gamefulness: defining gamification', in *Proceedings of the 15th International Academic MindTrek Conference,* 2011, 9–15; Fromann and Damsa, 'Digitális pedagógia', 76.

38   Sam Scholefield and Lynsay A Shepherd, 'Gamification Techniques for Raising Cyber Security Awareness', in *HCI for Cybersecurity, Privacy and Trust. HCII 2019. Lecture Notes in Computer Science,* ed. by Abbas Moallem (Cham: Springer, 2019), 191–203.

39   Gamze Canova, Melanie Volkamer, Clemens Bergmann and Roland Borza, 'NoPhish: An Anti-Phishing Education App', *International Workshop on Security and Trust Management,* 2014; Gamze Canova, Melanie Volkamer, Clemens Bergmann and Benjamin Reinheimer, 'NoPhish App Evaluation: Lab and Retention Study', *Workshop on Usable Security,* 2015.

40   Alexandra Kunz, Melanie Volkamer, Simon Stockhardt, Sven Palberg, Tessa Lottermann and Eric Piegert, 'NoPhish: Evaluation of a web application that teaches people being aware of phishing attacks', in *Informatik 2016,* ed. by Heinrich C Mayr and Martin Pinzger (Bonn: Gesellschaft für Informatik e.V., 2016), 509.

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3.3. Communication channels

The information security message can be disseminated through a number of different communication channels including formal and informal one-to-one communication, meetings with groups of employees, official correspondence such as letters, e-mails, telephone conversations, communication through discussion groups or chatting with individuals via internet. According to Sajjad ur Rehman et al., face-to-face communication is the most effective medium. The richest of these forms of communication is the one-to-one interaction.[41] We can also use corporate events (conferences, seminars, internal company meetings, road shows) as they can have a positive security influence to the persuasion process. We should attempt to use such methods as campaigns, newsletters, screensavers, DVDs, PR films or videos, trinkets, brochures and flyers to raise users' awareness.[42]

In summary, the following interpersonal, group and mass communication methods can be used in the awareness program:[43]

INTERPERSONAL COMMUNICATION METHODS

Dialogue
Discussion
Presentation
Telephone conversation
Correspondence, E-mails
Chatting via Internet
Invitations
Awards

GROUP COMMUNICATION METHODS

Conference
Seminars
Company meeting
Road shows
Audiovisual tools and techniques
IT Security themed films and videos
Printed papers
Newsletter
Wall-newspaper
Advertisement
Screensavers

MASS COMMUNICATION METHODS

Online websites
Online magazines
Online forums
Online newsletters (e.g. Sans Ouch)

Figure 4 • *Communication channel, methods and tools (Source: Legárd, 'Célpont vagy!', 100–101.)*

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41 Sajjad ur Rehman and Laila Marouf, 'Communication Channels and Employee Characteristics: An Investigation', *Singapore Journal of Library & Information Management* 37 (2008), 20–21.
42 Prah et al., 'The Perceived Effectiveness', 63; Parsons et al., *Human Factors and Information Security,* 32–33.
43 Legárd, 'Célpont vagy!', 99–101.

The language and communication should be understandable, visible and should avoid jargon and technical terminology. The program must be easy to use for all users on each level.[44]

It is very important to use marketing-oriented messages and the basic persuasion techniques such as: fear, humour, expertise, repetition, intensity and scientific evidence to seize attention, to establish credibility and trust, and to motivate action.[45]

The table below gives a concise evaluation of the matter.

Table 2 • *Summary table (Source: Compiled by the author.)*

Focus area		
Password usage and protection	Trainings on safe behaviour e.g. password safe keeping (E-learning/face-to-face)	Conferences Company meeting Seminars
	Gamification Applications	Newsletter
	Themed videos (from decrypter programs)	Seminars, road show
	Handout, posters,[46] screen savers[47]	(online) newsletter, wall-newspaper, online websites
	Password simulator	Seminars, road show
E-mail	Training (E-learning/face-to-face)	Conferences Company meeting Seminars
	Gamification applications[48]	Newsletter
	Handout, posters[49]	(online) newsletter, wall-newspaper, online websites
	Themed videos[50]	Seminars, road show, newsletter
	In case of suspicious/phishing e-mail	Dialogue (face-to-face/telephone conversation/e-mail)
	Phishing simulation – Simulate an attack via e-mail	Seminars, road show Test all employee

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44 Tsohou et al., 'Implementation challenges'; Parsons et al., *Human Factors and Information Security,* 4.
45 Peltier, 'Implementing an Information Security Awareness Program'; Hansche, 'Designing a Security Awareness Program'; Maeyer, 'Setting up an Effective Information Security Awareness Programme'; Tsohou et al., 'Implementation challenges'; Maria Bada, Angela M Sasse and Jason R C Nurse, 'Cyber Security Awareness Campaigns: Why do they fail to change behaviour?', *International Conference on Cyber Security for Sustainable Society,* 2015, 5.
46 For details see www.ncsc.gov.uk/information/infographics-ncsc; www.kaspersky.com/blog/infographic-password-protection/1446/; www.interpol.int/Crimes/Cybercrime/COVID-19-cyberthreats
47 For details see www.enisa.europa.eu/media/multimedia/material
48 For example NoPhish App: Kunz et al., 'NoPhish: Evaluation'; 'Zero Threat' app: https://leolearning.com/leo-grc-academy
49 For details see https://nki.gov.hu/wp-content/uploads/2019/07/NKI_tajekoztato_a_spamakrol.pdf; www.itgovernance.co.uk/minimise-phishing-infographic; www.trendmicro.com/vinfo/us/security/news/cyber-attacks/spear-phishing-101-what-is-spear-phishing
50 For details see www.enisa.europa.eu/news/enisa-news/ecsm-2020; https://cybersecuritymonth.eu/press-campaign-toolbox/material/videos/clip6

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Focus area		
Internet	Training (E-learning/face-to-face)	Conferences Company meeting Seminars
	Gamification applications[51]	Newsletter
	Handout, posters[52]	(online) newsletter, online websites, wall-newspaper, online websites
	In case of incident	Dialogue (face-to-face/telephone conversation/e-mail)
	Themed films and videos[53]	(online) Newsletter
Social media websites	Training (E-learning/face-to-face)	Conferences Company meeting Seminars
	Gamification applications	Newsletter
	Handout, posters[54]	(online) newsletter, online websites
	Screen savers	
Mobile equipment	Training (E-learning/face-to-face)	Conferences Company meeting Seminars
	Gamification applications[55]	Newsletter
	Handout, posters[56]	(online) newsletter, online websites
	Screen savers	
Data and information handling	Training (E-learning/face-to-face)	Conferences Company meeting Seminars
	Gamification applications[57]	Newsletter
	Handout, posters[58]	(online) newsletter, wall-newspaper
	In case of data privacy incident	Dialogue (face-to-face/telephone conversation/e-mail)
	Themed films and videos[59]	(online) newsletter
	Screen savers	
Incident reporting	Handout	Newsletter, wall-newspaper
	In case of incident	Dialogue (face-to-face/telephone conversation/e-mail)

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[51] No Phish App, Zero Threat app, Keep tradition secure app: https://keeptraditionsecure.tamu.edu

[52] For details see www.interpol.int/Crimes/Financial-crime/Financial-crime-don-t-become-a-victim; www.enisa.europa.eu/topics/wfh-covid19/media/copy_of_infographic-cyber-seure-ecommerce/view

[53] For details see www.interpol.int/Crimes/Cybercrime/COVID-19-cyberthreats

[54] For details see https://usa.kaspersky.com/resource-center/infographics/social-networking-dangers; www.sans.org/security-awareness-training/resources/posters/creating-cyber-secure-home

[55] Keep tradition secure app.

[56] For details see www.europol.europa.eu/publications-documents/mobile-malware-infographics; https://news.sophos.com/en-us/2013/12/19/infographic-anatomy-of-a-hacked-mobile-device

[57] Zero Threat app; Keep tradition secure app.

[58] For details see www.consilium.europa.eu/en/infographics/data-protection-regulation-infographics; www.trendmicro.com/vinfo/us/security/news/cyber-attacks/follow-the-data

[59] For details see www.kaspersky.com/resource-center/definitions/data-breach

In all incidents or suspicious cases, the most important is the continuous communication with the user by phone, e-mail or by personal contact providing them with personal feedback.

Always use audiovisual tools and case studies for training and conferences and seminars for illustration and better understanding.

4. CONCLUSION

It is important to keep in mind that users are the first targets of social engineering attacks, so the human factor is the first line of defence against security threats. Therefore, security awareness programs are one of the greatest defences.

The aim of this study is to provide useful assistance for organisations in developing information security awareness programs that ensure an effective transfer of information security knowledge. The paper emphasises that if the users have adequate skills to detect, prevent and resolve breaches or incidents, the program can prevent and mitigate security threats and risks that an organisation might face.

This practical guide provides an overview on a scientific basis of the threats and focus areas that the program should be concerned with and details the risks in each area. Because the information security message can be disseminated through a number of different methods, the research compares traditional awareness programs with modern trainings and reviews effective solutions such as gamification techniques and applications. The study demonstrates that it is important to make any awareness program interesting and up to date to positively affect the behaviour and attitudes of employees towards information security.

The program needs to be understandable and meaningful to the users and should avoid jargon and technical vocabulary. The essay systematises the communication channels according to the level of communication, presents the personal, group and mass communication methods and tools.

The study also gives a comprehensive picture set of all the threats (focus areas), corresponding with useful training methods and communication channels.

The conclusion is that each organisation should develop and implement an awareness program focusing on their own specificities and needs, especially on their threats and risks. In order to realise a safety-conscious organisational culture through individual safety awareness, the program has to use repetition and transfer the main message using multiple techniques and communication channels.

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Studies ●

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SUPPORT OF EDUCATION IN CYBERSECURITY

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Cybersecurity depends heavily on education. The paper addresses the support of education as the smartest investment in cybersecurity. To define priorities, an early estimate of the state of cybersecurity in Moldova by an online survey has been completed. A wide range of aspects related to cybersecurity education are elucidated within three basic periods: initial (school), transit (university) and reinforcement (implementation and use at workplace). Referred to in these are: formation of an 'informational' culture, target professions, curricula content, competences, cooperation with companies, digital education, e-learning platforms, information services, risks associated with human resources, etc. Also, conceptual aspects regarding the creation of a cybersecurity polygon in support of training in the field are described: basic objectives, main functions, structural components, the technological platform and methodological issues of creating the system of cybersecurity models for application as needed.

1. INTRODUCTION

One of the most intriguing findings is that 95 per cent of security incidents involve human errors. Most security attacks are concerned with human weakness to attract victims and persuade them to give involuntary access to personal and sensitive information. To eliminate errors caused by social engineering and negligence and to increase users' awareness of the threats, technologies and services should be combined with education in the field. Education in the field of cybersecurity is a necessary consideration for both individuals and families, as well as for businesses, governments and educational institutions.

We are facing an alarming shortfall of talent in cybersecurity. According to Cybersecurity Ventures, there will be 3.5 million unfilled cybersecurity jobs globally by 2021, up from one million positions in 2014[1] and of the candidates who apply, fewer than one in four are even qualified.[2] The U.S. Bureau of Labor Statistics predicts that cybersecurity jobs will grow by 31 per cent from 2019 to 2029, over seven times faster than the national average job growth of 4 per cent. Demand for information security analysts is expected to be very high, as these analysts will be needed to create innovative solutions to prevent hackers from stealing critical information or causing problems for computer networks.[3]

Given the rapid and continuous evolution of threats, it is critical that educational cybersecurity programs share best practices, curriculum and informatics support updates. But it is just as important for enterprises – from startup businesses to large corporations, and from small nonprofits to vast government agencies – to do their part. They have the means as well as the critical need to enhance their employees' cybersecurity knowledge.

By 2020, more than half a million attacks have been estimated to occur in every minute.[4] Cybersecurity Ventures predicts cybercrime will cost the world in excess of $6 trillion in 2021[5] that is approximately 4 per cent of global GDP. At the same time, in the period 2005–2014, the share of group organised cyberattacks increased by four times, reaching approximately 80 per cent of the total.[6] Respectively, cyberattacks are becoming more sophisticated, and defending against them is increasingly difficult, requiring deep knowledge in the field; IT security is becoming an even higher priority, and companies are in dire need of security policies, security solutions and employee education workshops.

Even those employees who arrive with security knowledge have more to learn. The field of cybersecurity is constantly expanding, with more domains to secure and more ways to attack. Intrusions are harder to detect; attackers are stealthier and more evasive. During the

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1   *The 2019/2020 Official Annual Cybersecurity Jobs Report* (Cybersecurity Ventures, 2020).
2   E Winick, 'A cyber-skills shortage means students are being recruited to fight off hackers', *MIT Technology Review,* 18 October 2018.
3   'Information Security Analysts', in Occupational Outlook Handbook, Bureau of Labor Statistics, U.S. Department of Labor.
4   V Voicu, 'Cybersecurity: Tendencies 2020', *Electronica Azi,* 06 April 2020.
5   *2019 Official Annual Cybercrime Report* (Cybersecurity Ventures, 2019).
6   L Ablon, M C Libicki and A Galay, *Markets for Cybercrime Tools and Stolen Information: Hackers' Bazaar* (Rand Corporation, 2014).

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coronavirus pandemic, the cybersecurity of health services was tested, while the adoption of new work and distance learning, interpersonal communication, and teleconferencing regimes also changed cyberspace. In this period, cybercriminals have been expanding their capabilities, adapting quickly and targeting relevant victim groups more effectively.

The best defence is to provide comprehensive educational programs and informatics support for all. You do not have to turn everyone into a cybersecurity expert. IBM, for example, requires all employees to complete digital training each year, which covers matters from secure handling of client data to appropriate sharing on social media sites. Employees can easily learn how to spot and avoid the most frequent types of threats, such as phishing attacks in emails.[7]

Whether taught in a school, university setting or carried out in an enterprise, cybersecurity is a holistic problem and needs a holistic solution. Just as educational institutions start to develop interdisciplinary approaches (such as joint programs between computer science and business, medical, law, economics, public policy, criminology and even journalism schools), organisations should ensure that their approach to security reaches the people responsible for infrastructure, human resources, data, applications, ethics assurance, management policy and legal compliance.

There have been technological advancements within the last few years to help secure corporate networks against unintentional, or intentional, risky behaviour by users. But while such technical controls and the establishment of sound policies are essential components of effective security, educating in cybersecurity is one of the best investments a country can make – and a rational recognition that it will take all of us to create a more secure future.[8]

The paper addresses issues related to basic periods of education in cybersecurity – initial (school), in transit (university) and reinforcement (at workplace) – and also related to adequate methodological and informatics support. First, an early estimate of the state of cybersecurity in the Republic of Moldova is presented to determine some priorities in the field.

2. STATE OF CYBERSECURITY IN THE REPUBLIC OF MOLDOVA

Out of the multitude of evaluations regarding informatisation in Moldova, few refer directly to cybersecurity.[9] Unlike the three indicators of 'Electronic Moldova'[10] and the four indicators

7   R Bulai, D Țurcanu and D Ciorbă, 'Cybersecurity in education', in *Proceedings of the CEE e|Dem and e|Gov Days 2019: Cyber Security and eGovernment* (Budapest, 2019).

8   M Viveros, 'Cyber Security Depends on Education', *Harvard Business Review,* 24 June 2013.

9   I Bolun, D Ciorbă, A Zgureanu, R Bulai, R Călin and C Bodoga, *State, Needs and Priorities of Information Security in the Republic of Moldova* (Chisinau: TUM, 2020).

10 'National Strategy for Building the Information Society – "Electronic Moldova"'. *Official Monitor* no 46–50, 25.03.2005.

of 'Digital Moldova 2020' strategies,[11] the 17 indicators of the 'Cyber Security Program' from 2016–2020[12] refer to the monitoring and evaluation of the policy documents in the field of information security implementation and not to assess the degree of cybersecurity achieved as a result of implementing the program actions. Also, the annual statistical reports 1-inf (Situation on informatisation and Internet connection) and 1-CE (Activity in the field of electronic communications) of the National Bureau of Statistics and the annual reports on the activity and evolution of ICT products and services market of the National Agency for Regulations in Electronic Communications and Information Technology do not contain indicators for assessing the degree of cybersecurity in the republic.

The only official sources of statistical data on cybercrime are the Register of Crimes, Criminal Cases, Criminals and Crime Materials, held by the Ministry of Internal Affairs and the Informatics system 'Criminal investigation: E-case', managed by the General Prosecutor's Office. However, the Republic of Moldova appears in some international evaluations in the domain, which show a slightly more advanced degree of cybersecurity in Moldova than the international average (Table 1).

Table 1 • *The Republic of Moldova in international cybersecurity rankings*
(Source: Compiled by the authors based on sources specified in the table.)

No.	Index name	Total countries in the ranking	The Republic of Moldova's place in the ranking
1	Global Cybersecurity Index, GCIv3, y. 2018–2019[13]	175	53
2	Cyber Readiness Index, CRI 2.0, y. 2015[14]	125	N/A
3	National Cyber Security Index – NCSI 2018[15]	100	40
4	National Cyber Security Index – NCSI 2020[16]	152	52

The first, incipient estimate of the state of cybersecurity in Moldova was done in 2020 (May 25 – June 20) by an online survey.[17] Research was focused on enterprises/organisations/institutions (EOIs). Five categories of EOIs were defined according to the number of employees: very small – up to 10 employees, small – 11–50 employees, small-medium – 51–100 employees, medium – 101–500 employees and large – over 500 employees. In the survey, 24 indicators were used. They were determined based on

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[11]   'National Strategy for the Development of the Information Society "Digital Moldova 2020"', *Official Monitor* no 252–257, 08.11.2013.

[12]   'National Cyber Security Program of the Republic of Moldova for the years 2016–2020', *Official Monitor* no 306–310, 13.11.2015.

[13]   *Global Cybersecurity Index 2018* (ITU, 2019).

[14]   Hathaway et al., *Cyber Readiness Index 2.0* (Potomac Institute for Policy Studies, 2015).

[15]   *National Cyber Security Index* (Tallin: eGovernance Academy, 2019).

[16]   Ibid.

[17]   Bolun et al., *State.*

respective international practice.[18] The survey results are described in the report of Bolun et al.[19]

The graph of the dependence of the percentage of EOIs (pEOIs) with high cybersecurity performance on indicators 1–23 are shown in Figure 1.
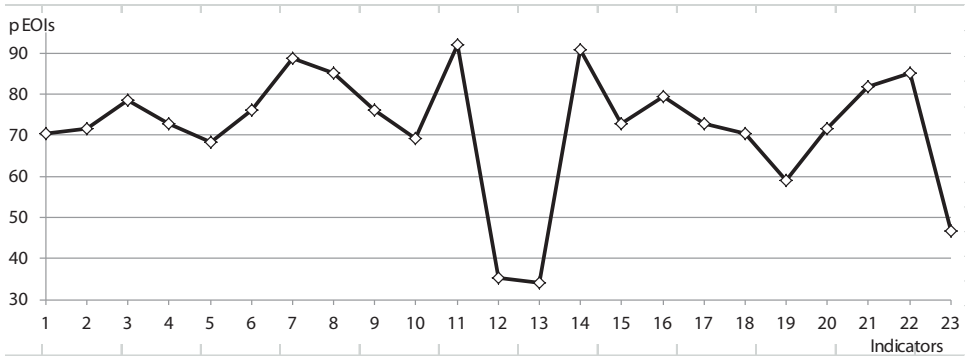
Figure 1 • *The %EOIs dependence on cybersecurity aspects 1–23 (Source: Compiled by authors.)*

Figure 1 shows that EOIs percentage in cybersecurity varies from 34.1 per cent to 92.0 per cent. Only at 34.1 per cent of EOIs is ensured, high cybersecurity performance in terms of Intrusion Prevention Systems/Wireless Intrusion Prevention Systems (IPS/WIPS) use at all perimeter nodes of the EOI informatics network (indicator 13) and, likewise, the use of Intrusion Detection Systems/Wireless Intrusion Detection Systems (IDS/WIDS) at all perimeter nodes of the EOI informatics network (indicator 12 – 35.2 per cent). These two indicators are critical (the least EOIs have high cybersecurity performance). Also, the cybersecurity audit of informatics space is performed only at about 46.6 per cent of the EOIs. A low degree of cybersecurity is also in terms of testing external and internal penetration to identify vulnerabilities and attack vectors on EOI informatics space (indicator 19 – 59.1 per cent), the use, in sensitive cases, of secure dedicated computers (indicator 5 – 68.2 per cent) and performing the iSecurity Audit of new informatics applications/systems before implementation (indicator 10 – 69.3 per cent). On the other hand, the best situation is with the automatic creation of backups of sensitive information on secure servers (aspect 11 – 92.0 per cent). A relatively high degree of cybersecurity is also important in terms of regulating access to resources (aspect 14 – 90.9 per cent), the use of VPN (aspect 7 – 88.6 per cent), the use of firewalls (aspect 8 – 85.2 per cent) and informing employees about the implications of informatics security, including possible malicious software (aspect 22 – 85.2 per cent). Overall, the average degree of EOIs

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[18] *ETSI GS ISI 001-1 V1.1.1 (2013-04) Information Security Indicators* (ETSI, 2013); *CIS Security Metrics* (Center for Internet Security, 2010); *CIS Controls v. 7.1 Measures and Metrics* (Center for Internet Security, 2019).

[19] Bolun et al., *State*.

cybersecurity (based on the 23 indicators) is about 71.7 per cent; that is, in 71.7 per cent of cases, regarding the 23 indicators, high cybersecurity performance is ensured.

For a more detailed comparison, Figure 2 shows the graph of the dependence on indicators 1–23 of pEOIs by categories according to the number of employees. It clearly indicates the big difference between the cybersecurity state of large EOIs (over 500 employees) and of the small ones (up to 10 employees inclusive) for each of the 23 indicators.

It should be noted that in case of EOIs with up to 10 employees, IPS/WIPS at all perimeter nodes of the corporate network are not used (indicator 13) nor is the cybersecurity audit of the informatics space performed (indicator 23) in any EOI. Among these, the number of EOIs using IDS/WIDS at all perimeter nodes of the corporate network (indicator 12), using dedicated VLANs (indicator 6) and testing external and internal penetration to identify vulnerabilities and attack vectors (indicator 19) is also reduced. Moreover, few such EOIs have implemented an internal iSecurity policy (indicator 1) and internal iSecurity regulations (indicator 2) and have a recovery plan in case of iSecurity incidents (indicator 3).

Significantly better than at EOIs with up to 10 employees is the state of iSecurity at EOIs with 11 to 50 employees. However, only 20 per cent of them use IDS/WIDS (indicator 12) and IPS/WIPS (indicator 13) at all perimeter nodes of the corporate network and only 52.6 per cent of them have implemented an internal iSecurity policy (indicator 1) and tests external and internal penetration to identify vulnerabilities and attack vectors (indicator 19).
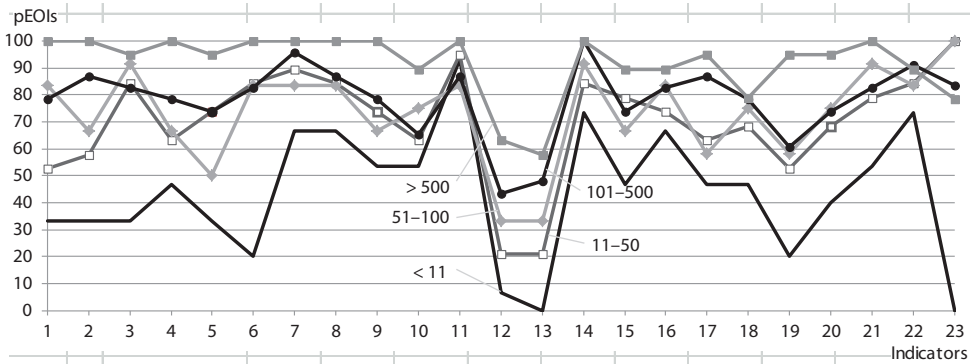
Figure 2 • *Dependence of pEOIs, by categories according to the number of employees, on indicators 1–23 (Source: Compiled by authors.)*

On average, the percentage of EOIs with high cybersecurity performance for EOIs with over 500 employees (91.7 per cent) is about twice as high as that for EOIs with up to 10 employees (43.8 per cent).

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Thus, even according to this narrow set of 24 indicators (for example, the ETSI set contains 97 indicators,[20] and the CIS Controls one – 171 indicators[21]), it can be concluded that the state of Moldovan EOIs cybersecurity is relatively low, which confirms the need for additional measures in the field. It is also important, in the respective training courses, to draw special attention to aspects with a relatively low cybersecurity performance.

3. THE INITIAL PERIOD – SCHOOL – ACQUAINTANCE WITH THE ASPECTS OF CYBERSECURITY AND SAFE 'SURFING' IN A VIRTUAL ENVIRONMENT

The peculiarity of the socio-economic development of the Moldovan economy, and of the world economy as a whole, determines the presence of a significant number of risks, including informational ones, which pose a threat to the stable functioning of any enterprise and person.

These aspects require the formation of an 'informational' culture, which should be cultivated in every person, starting with education in school. These will then develop in the course of evolution at the university and at the workplace. All these steps, in our view, must comply with certain requirements/standards, and with three pillars – three qualities:

a) to study – to explore – to know
b) to teach – familiarisation – to be able
c) responsibility – consciousness – implication

So, in school/lyceum we consider it is necessary to develop and to implement in the following areas: the study of awareness of students about staying safe while surfing the Internet; the familiarisation with the rules of safe work on the Internet; the formation of students' informational culture, the ability to independently find the necessary information using web-resources; discipline training while working on the network.

The trainees should know: the list of the Internet information services; the rules of safe work on the Internet; and the danger of a global computer network.

The trainees should be able to: responsibly treat the use of on-line technologies; work with a web-browser; use information resources; search for information on the Internet.

A good start for the Republic of Moldova is that on 14 June 2018 the Memorandum of Understanding on the development of digital education in general education was signed, and as a result of this agreement, the curriculum, the electronic support and the Guide for Students and Teachers of the 1st grade were developed; the virtual library, www.smartedu.md, was consolidated; funds were collected for the procurement of digital tablets and laptops in support of teachers across the country. The 'Digital Education' module is compulsory for 1st

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[20]   *ETSI GS ISI 001-1 V1.1.1 (2013-04) Information.*
[21]   *CIS Controls v. 7.1 Measures.*

grade pupils and optional for those of 2–4 grades. In this respect, it is important that Digital Education also develops a cybersecurity culture; cybersecurity education modules must be included in every curriculum of Informatics for all the grades from the 1st to the 12th.

The International Center for Protection and Promotion of Women's Rights 'La Strada' of the Republic of Moldova undertook a series of actions to create information services for both children and parents/teachers (portal www.siguronline.md). The portal provides young users with the opportunity to access useful information about how to protect themselves from abusive content and actions in the virtual environment, how to develop a responsible attitude to the posted content and to report possible abuse while retaining anonymity. The Police General Inspectorate has been involved in a number of projects such as, *Together we make the Internet better!* and, *An informed child – A protected child,* for the protection of children's rights and needs in the Republic of Moldova. We realise that we all have a common responsibility to make cyberspace safer for everyone, especially for children, namely through information, education and awareness.

4. THE TRANSIT PERIOD – THE UNIVERSITY – THE STUDY AND DEVELOPMENT OF THE PRINCIPLES AND STANDARDS TO ENSURE AND HAVE RESPECT FOR CYBERSECURITY

Methods and cybersecurity technologies – is the youngest area of IT in our country. The other areas – software, hardware, service – on the contrary, have roots in the 'inherited' technologies that were formed several decades ago.

Education of cybersecurity can be divided in two directions: the first is future civil servants, whose activities are not focused on the direct provision of cybersecurity, and the second is training future officials, whose activities are directly focused on the provision and supervision of cybersecurity.

When forming the list of competencies, various formal sources of requirements that employers can present to cybersecurity specialists were analysed: legislatively approved qualification requirements of the Republic of Moldova state institutions; requirements for civil servants working in the field of cybersecurity; recently established professional standards in the field of IT and IS; various international standards for the protection of information, from which one can learn much valuable information about what different levels specialists should be able to do; regulatory documents existing at enterprises describing the functional responsibilities of such specialists, and so on.

Education in the field of cybersecurity, in addition to methods and technologies for protecting information resources, always includes the study of means of attack, too.

The peculiarity of cybersecurity as an educational subject is that it must combine knowledge in the field of natural sciences and technology, as well as in law, management and a number of humanities. Therefore, in addition to courses on methods and means of data protection, fundamental mathematical disciplines, advanced IT training, and the study

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of organisational and legal aspects of ensuring cybersecurity should be included in the limited scope of the curriculum.

The complex of technical disciplines for students of cybersecurity is also optimised – they study various aspects of cybersecurity in the physical environment and the features of the organisation of this environment itself, mastering the theory and practice of building computing systems. In addition, graduates of this specialty should be able to solve all organisational issues of cybersecurity, which is also dedicated to a separate discipline.

Between 10 July and 31 October 2017, a survey was conducted to identify the target professions and training needs in the field of IT security in Moldova.[22] The questionnaire, containing 23 questions, was completed by 199 companies – IT companies, the provider companies of electronic communication services and banks, which demonstrates an increased interest from companies in the field of cybersecurity. Almost 69 per cent of professionals in the field specified that they need additional training in computer security. Based on this survey, in recent years, at the Technical University of Moldova, the State University of Moldova, the Academy of Economic Studies of Moldova and Alecu Russo State University of Balti, new learning programs in cybersecurity are emerging.

For the design and development of license and master programs in Cybersecurity, an analysis of European curriculum documents has been carried out as well: European Agency for Network and Information Security (ENISA), Cyber Security Education, National Institute of Standards and Technology (NIST) for Cybersecurity Education (NICE), Information Systems Security Association (ISSA), Information Systems Audit and Control Association (ISACA), Toward Curricular Guidelines for Cybersecurity (ACM), IEEE Computer Society, and so on.

At these four universities, the targeted training of specialists for the Central Bank, the Ministry of Internal Affairs, and other state institutions of the Republic of Moldova is conducted. This approach has a number of advantages. The organisation, recruiting graduates who actively collaborated during the last years of training with the university, receives not only the necessary specialist but also a person whom they already know from both a professional and moral point of view, which is important for working in the field of cybersecurity. Likewise, specialists of enterprises with whom the faculty cooperates, actively participate in educational process, and this involvement of practitioners in teaching allows maintaining the relevance of the courses.

Currently there is a technical-scientific centre at the Technical University of Moldova. In fact, it has also become the centre of crystallisation of educational processes on cybersecurity – teaching experience is spread through it, advanced data protection technologies being actively developed and introduced into the educational process. Today, this centre is gradually turning into a mini technology park that teaches students and provides various services in the field of cybersecurity, solving quite complex tasks in the development of new protection methods for the state or commercial enterprises.

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[22]   Bolun et al., *State.*

Such a synthesis of business and education allows the university independently to earn money to improve its educational process and to attract highly qualified specialists to teach and improve the professional level of its employees.[23]

For higher professional education in the field of cybersecurity, the cooperation with companies, which are developing data protection tools, is vital. For universities, such cooperation is not only an opportunity to get modern equipment and software, but also a way to make students feel the pulse of the industry. For market participants, it is an opportunity to influence the university environment, to help universities prepare necessary industry specialists. Therefore, university professors and practical workers from the company highly appreciate the level of theoretical training of specialists in the field of cybersecurity in universities, but note its insufficiency from the practical point of view. The main difficulty that university graduates face in finding employment is the lack of skills in the applied use of their knowledge. According to both teachers and practitioners, close cooperation with companies makes it possible to remedy this situation.

Therefore, we believe that the effect brings an integrated approach to the implementation of the program, which involves a combination of its three main elements: training, research activities and practice. The university partners 'Bitdefender', 'Endava', 'Academia Cisco' provide free training courses, teaching materials, analytical and statistical data, research and reviews of the company leading experts on computer and cybersecurity. Distance seminars are held for teachers and students, master classes and meetings with experts are organised. Under the guidance of experts, students write graduation projects on topics proposed by the company, prepare analytical reviews and articles. Leading experts review all these materials, and the results of the most interesting student studies are applied in the work of the company.

The second line of study at the faculty is the cybersecurity aspect of future students whose activities are not focused on the direct provision of cybersecurity. In this case, we consider the method of using the educational-research cryptographic system at the State Engineering University of Armenia, a success.[24] In this respect, TUM initiated a project to develop the Security e-Learning Platform, a teaching-learning tool, individual and distance learning, research and demonstration of real-world security solutions based on case studies. At the beginning, 5 modules are provided: Criminal Investigation Forensic, Malware Analysis, Reverse Engineering, Clean Code and Capture the Flag (CTF Competition with Various Security Exercises). Such an approach can be used not only by cybersecurity teachers and students, but also by those who do not have a professional background in the field, but intend to study this area whether they are interested in increasing their security skills or to better understand security issues.

With the development of information technologies and the growth rate of their implementation in all socially significant spheres of society, the problems of information protection become more substantial, which determine the emergence of specialties related

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23   Bulai et al., 'Cybersecurity in education'.
24   Г Маргаров, 'Воспитание защитников информации' [Educating defenders of information], Открытые системы 28, no 4 (2009).

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to information protection in the list of areas for training specialists in most technical universities. However, knowing the basics of cybersecurity is necessary for almost every user of electronic means of processing and exchanging information. In essence, cybersecurity tends to turn into a 'third literacy' along with 'second literacy' – computer skills and information technology.

5. REINFORCEMENT PERIOD – RESPECTING A VIABLE CYBERSECURITY STRATEGY AT THE WORKPLACE

One of the important directions in ensuring cybersecurity is the implementation of it at the workplace in each institution, public or private. One can use advanced software and hardware methods and means of ensuring cybersecurity, write the most correct and complete cybersecurity policies, but without the participation of all the employees of the company/institution, the effectiveness of the cybersecurity framework will be minimal. The human factor is the weakest link of any ISF.

Risks associated with human resources, the so-called personnel risks, are basic for all other types of risks that pose a threat to the stability of an economic entity. Moreover, in the area of risk formation, again, the personnel decide everything. The entire enterprise management system directly depends on the personnel management system. The prevention and minimisation of personnel risks is the main task in the human resource management process. It is necessary to take into account the fact that the conditions for the occurrence of such risks are present at each stage of the personnel management process.[25]

The process of managing human resources in a company is continuous and is conditionally divided into several stages: the formation of personnel structure, the use of human resources and the release of personnel. Personnel and cybersecurity at all stages should be built at the forefront. The discrepancies between the qualitative and quantitative composition of the staff and the ineffectiveness of the selection procedures are only the main aspects that the organisation may face.[26]

The fact that the weakest-protected link in any process or system is the human being has been known since pre-computer times. Therefore, among prevailing cybercriminal situations, those in which, as a component of the information system, it is the person that is being exposed. Cybercriminals are actively using social engineering techniques when attacking them: according to the Symantec Corporation, almost 70 per cent of successful attacks are associated with it.[27]

Practical implementation of all the provisions of the established cybersecurity policy will require long-term practical efforts from the company. One of the main and most difficult areas of employment is to work with the staff whose goals are the selection and preliminary

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[25]   Bulai et al., 'Cybersecurity in education'.
[26]   A Bogatiriova, 'Personnel risks'.
[27]   Васильев, В and Д Сергеев, 'Человек — самое слабое звено в ИБ' [Man is the weakest link in information security].

inspection of personnel recruited (for service); staff training; achievement of the mutual understanding of managers and employees in matters of cybersecurity; psychological training in order to withstand the methods of so-called *social engineering.*

In one of his books, Bruce Schneier, a well-known cybersecurity specialist, noted that the 'mathematical system is impeccable in the general system of cybersecurity measures, computers are vulnerable, networks are generally lousy, and people are just abominable. I have studied many issues related to the security of computers and networks, and I can say that there is no solution to the problem of the human factor'.[28]

This statement most clearly and vividly demonstrates the importance of targeted measures for the selection, placement and work with the personnel of an enterprise in order to prevent the creation of 'bottlenecks' and so-called information systems and so on; the human factor has not become the most significant source of threats to cybersecurity. The main reason determining the importance of the human factor in the general system of information protection is that, with all the sophistication of modern automation tools, information systems continue to be man-machine complexes and their (systems) functioning depends largely on the work of individuals. It is for this reason that inadequate treatment of information system components by employees of an enterprise can cause serious damage to cybersecurity even if there are well-developed security policies and highly efficient software and hardware information protection.

In addition to careful selection, one of the important bases for working with personnel is its training in methods of ensuring cybersecurity and safe work with information systems. Training and the subsequent control of the received (available) knowledge can be both primary, and repeated. In general, the employee of an enterprise cannot be allowed to perform his or her duties and work with information systems until he/she has been trained in cybersecurity and will not be familiarised in details with all the requirements and generally applicable rules at the enterprise; be fully trained in the methods and techniques of ensuring cybersecurity necessary for the performance of his/her official duties; be acquainted with all possible measures of responsibility (disciplinary, administrative, criminal) that can be applied to him/her in case of violation of the requirements, as well as in the event of damage caused by his/her fault.

At the end of all preliminary work, the employee must give all the necessary commitments not to disclose confidential information, and testify in written form that he/she is fully familiar with the basic provisions of the security policy. In the course of work, an enterprise may also conduct periodic monitoring of knowledge and skills related to cybersecurity in order to attest to the competence of employees in this field. In addition, one of the training tools may be periodic staff familiarisation with actual examples of recent incidents related to cybersecurity. Besides, additional training of enterprise personnel can be carried out in the following cases: the introduction of new automated information systems; changes in business processes of the enterprise; changes in security policy requirements, for example,

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28   Б Шнайер, *Секреты и ложь. Безопасность данных в цифровом мире* (СПб.: Питер, 2003).

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due to the emergence of new threats, changes in legal requirements, expansion of markets, changes in the attitude of management and owners of the company to cybersecurity issues and other factors – all these clarifications and changes must also be fully and promptly communicated to the staff.

In the process of learning, a clarification of rational reasons, for which the company applies such a security policy, may have some significance. This can serve both, better to understand and assimilate the positions of the security policy, as well as to relieve some of the psychological tensions that inevitably arise when taking restrictive measures and imposing additional duties, the necessity of which is not always obvious and understandable to ordinary employees and specialists.

A separate area of ordinary training and advanced training can be the development of company personnel skills to counter the methods of social engineering. The use of social engineering methods for illegal entry into information systems is associated with the so-called 'human factor', which is a combination of certain psychological inclinations and characteristics of thinking and behaviour, which are peculiar to almost all people. To the number of such propensities and features can be attributed: inability to adequately assess the danger in some situations; specific relation to rarely occurring events (dulled attention); excessive trust and reliance on automation; susceptibility to manipulation, based, for example, on the desire to help people (including strangers) or on excessive trust of people dressed in a special uniform, and so on.[29]

To minimise the risks associated with human factors, it is necessary to organise a documented and approved work of the staff by the company management towards increasing awareness and training in cybersecurity, including the development and implementation of plans, training programs and awareness-raising in the field of cybersecurity, as well as monitoring the results of the implementation of these plans. Education of the personnel in the field of cybersecurity is necessary for the following purposes: developing and maintaining awareness among employees of the importance of safety in the use of information technologies, knowledge of the procedure for handling undesirable events and incidents; awareness of the employees of their role and place, as well as the duties and responsibility for ensuring the protection of information in the company; increasing the level of knowledge by employees of the basic rules of cybersecurity; communicating to employees the main positions, restrictions and requirements of existing documents (policies) in the field of cybersecurity; bringing to employees facts about which cybersecurity tools are used, as well as how to use these tools correctly and effectively.

The need to train and raise awareness of cybersecurity personnel is governed by the GD No. 201 Mandatory Cybersecurity Requirements of 03/28/2017, which requires public institutions to implement the Cybersecurity Management System. The head of the authority shall designate by an administrative act the person responsible for the implementation

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[29]   A Анисимов, *Менеджмент в сфере информационной безопасности* (Департамент информационной безопасности и работа с персоналом) [Information Security Management. Information Security Department and Human Resources].

of the cybersecurity management system in the institution and the responsible person shall be required to participate, at least once a year, in cybersecurity training courses and, respectively, to organise courses for the employees of the institution.

Cybersecurity education should include the following areas: raising awareness of workers in matters of cybersecurity (general course); safe work with personal data in the company; organisation of business continuity and recovery after interruptions. The main forms of education can be individual training (introductory, repeated and extraordinary briefings); special training with the involvement of external training centres; awareness raising: distance learning, social engineering methods (memos, posters, screen lockers, and so on, reflecting all the requirements of the enterprises' regulatory documents on cybersecurity).

In accordance with the State Norms of Moldova, training and awareness plan requirements should be established for the frequency of training and awareness-raising. Unfortunately, a survey conducted in 2018 on a sample of about 160 companies and institutions within a project to raise IT needs to increase cultural information and cybersecurity in Moldova shows that companies and institutions do not pay sufficient importance to cybersecurity (62 per cent of respondents) and that they do not have a training and awareness program on cybersecurity (81 per cent of respondents).

It is also necessary to determine the list of documents that appear as evidence of the implementation of training and awareness-raising programs in the field of cybersecurity. Individual training (instruction) should be completed with an oral survey, and an assessment of the acquired skills of the safe ways of work. The employee who conducted the briefing should check the knowledge.

With a distributed institution structure, it makes sense to impose responsibilities for training and awareness raising in the field of cybersecurity to a special employee appointed in each remote unit. As part of the self-assessment, the internal auditors of the institution should regularly monitor the level of awareness of employees of the audited units, the completeness and accuracy of the training documents and the timeliness of communicating new cybersecurity requirements.

The cybersecurity service should monitor the effectiveness of training by quantitative and qualitative analysis of the actions of employees, followed in response to certain events.

The training system under consideration is a scalable process aimed at constantly improving the level of knowledge, skills and qualifications in the field of cybersecurity of employees and integrated with existing business processes. As a result of the introduction of a training system and raising awareness in the field of cybersecurity in an institution, the number of incidents in this area related to human factors will be significantly reduced, as well as an improvement in the misuse of resources will become apparent.

Success and high security, including cybersecurity, provide a continuous process of education and training of personnel in the field of cybersecurity. Training can be carried out in some areas and forms. Namely, the Complex Program: full-time courses; e-courses; introductory briefings; posters; screensavers; animated and video clips; computer games; booklets, brochures, memos; souvenirs; efficiency mark, a comprehensive program to improve awareness of the company's staff. What is good about an integrated approach in addressing

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issues of raising the awareness of company personnel in matters of cybersecurity? It guarantees a high level of security of the company information resources; involves staff training cybersecurity on an ongoing basis; helps to manage the risk more effectively; has a positive effect on the company image; testifies to a high level of responsibility of the company management towards its employees; helps to prevent losses that are inevitable when staff of the company violates cybersecurity. *Security Competitions (Cyber Drill, CTF) or Computer games,* offer a new look to the problem of compliance with the cybersecurity rules adopted by the company and to invite colleagues to participate. An entertaining cybersecurity quest is the best way to convey the most important skills and knowledge to employees.

Since 2018, the Information Technology and Cyber Security Service, in collaboration with European partners, the Technical University of Moldova and some Moldovan private companies, managed to organise several Cyber Drill sessions for security officers from national companies and institutions. Also, students from the Technical University of Moldova organise annually CTF competitions and also participate in the international ones: Suceava (Romania), Bucharest (Romania), Volga (Russia), and so on.

Evaluating the effectiveness of implementing an awareness-raising program is a very important phase of the awareness program. It is advisable to evaluate the effectiveness of the program after the staff has been trained and a number of measures have been implemented to maintain a corporate security atmosphere in the company. Part of the events should be aimed at assessing the effectiveness of implementing an awareness-raising program. In this regard, you can send authorised, provocative messages by corporate e-mail and SMS/MMS, which motivate users to violate corporate rules and corporate security policies. The purpose of the work is to assess the implementation of basic corporate security rules by employees when using corporate e-mail and business cellular communications, in order to improve the program for raising awareness of corporate security issues.

In the framework of the work implementation to achieve the stated goals, the tasks of checking the elements of the program of raising awareness on the following issues are solved: password policies; compliance with license fairness; anti-virus attacks; complying with the rules of IT services use in terms of e-mail and Internet utilisation; abidance with cybersecurity rules when using service mobile devices and cellular service communication. Typical ways in which an enterprise can constantly remind its employees of the need to be careful are: placing and periodically changing (updating the design and content) reminders of the need to comply with the requirements of cybersecurity policies on items constantly in sight of employees during the working day: wall and desktop calendars, coffee mugs, covers of notebooks, desk exhibits, pens, pencils and other stationery; periodic emailing of relevant messages; use of screensavers containing relevant reminders; use of voice mail and speakerphone for periodic transmission of messages about the need to comply with cybersecurity rules, and so on.[30]

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30   K Mitnick and W Simon, *The Art of Deception: Controlling the Human Element of Security* (Indianapolis: Wiley, 2002).

6. A CYBERSECURITY POLYGON IN SUPPORT OF EDUCATION

In support of education, experimentation, research, adaptation and development (EERAD-ment) in cybersecurity in the Republic of Moldova, the PINFOSEC polygon is being implemented.[31] The polygon will create conditions, provide necessary infrastructure and tools for EERAD-ment, based on which practical recommendations will be elaborated and differentiated cybersecurity solutions will be proposed, taking into account the particularities of the republic. The basic objectives of PINFOSEC polygon consist in:

1. Creation of an extensive technological platform for the EERAD-ment of cybersecurity solutions (SECIM)
2. Development of SECIM modules for the EERAD-ment of cybersecurity solutions
3. Development of a system of cybersecurity models (SIMOSI) for application as needed
4. Implementation of SECIM modules within the SIMOSI system, research through simulation of their cybersecurity features and further the afferent, depending on the case, cybersecurity solutions development to strengthen performance
5. Integration with the INFOSEC website for differentiated information of public administration institutions, economic agents, organisations and population regarding the dangers, vulnerabilities, incidents, means and necessary actions of cybersecurity and of other important aspects in the field, thus forming the PINFOSEC informatics space (iSpace)

PINFOSEC iSpace will be created as a secure virtual computer network (RINFOSEC) within the Technical University of Moldova (TUM) Informatics Network. Within RINFOSEC, equipment can be used only within the PINFOSEC iSpace. PINFOSEC means will be used to create, configure and emulate various informatics infrastructures and cyber incident situations, intended for the EERAD-ment of cybersecurity means in accordance with objectives defined above. Therefore, RINFOSEC will include such informatics means as: network stations, routers, switches, wireless access points, data transfer channels, transmission media, including wireless ones, software tools, computer applications, specialised software, various information resources, and so on. The basic technological solution of resource cooperation for exploring the PINFOSEC iSpace will be a client–server one.

As mentioned above, the SECIM platform will form the technological support of cybersecurity means that will be EERAD-ed within the PINFOSEC polygon. One of them is the *EduSec* educational platform – a special environment for training, awareness programs, training of hacking skills, and so on.

SECIM modules will be adaptations/developments of some means of cybersecurity. They will be developed using as a starting point, for example, the CIS Controls set of actions/sub-controls[32] or similarly, including those aimed at meeting the performance requirements, as

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31   I Bolun, D Ciorbă, A Zgureanu, R Bulai, R Călin and C Bodoga, *Report "PINFOSEC polygon concept"* (Chisinau: TUM, 2020).

32   *CIS Controls v. 7.1 Measures.*

measured by the ETSI Information Security Indicators.[33] Based on SIMOSI cybersecurity models, concrete differentiated cybersecurity solutions will be generated, adapted to needs of various categories of entities in Moldova, considerably facilitating the respective activities and, at the same time, strengthening the expected effects. The SECIM platform extensibility will allow the resultant continuation of the EERAD of cybersecurity solutions in rhythm with the advancement of theoretical results and of practical means in the field.

7. CONCLUSIONS

Cybersecurity depends a lot on education. We need to make security more of a realistic notion for the general public. A lot of users do not necessarily know the destination of their data. Rather than just corporate security awareness training, as professionals, we need to be bringing cybersecurity culture into people's homes, as well.

Cybersecurity truly is a public safety issue. We have seen weaponised social media posts, IT devices turning into attack droids, and phones being hacked to see GPS locations. These issues are everyday occurrences. Therefore, we need to regulate the idea of security into our everyday culture, exactly the way we have normalised other safety issues. It could be illustrated by a simple example with cars. When it was found that the cars were unsafe, seat belts were added.

For the Internet, we need a security-focused and educational mindset. This is especially the case in regards to innovations within technology. A scary awareness video is insufficient. In contrast, cybersecurity should be an ongoing education. The more we equip the public with this knowledge, the more efficient we will be in the future.[34]

We would like to note that one of the main qualities that should be developed starting from school and cultivated at all subsequent stages is consciousness and awareness that a person is a part of a whole class, group, working team, and that success, prosperity and security depends on each individual's intellectual, spiritual and physical contribution. By instilling a sense of consciousness, the person will rejoice for the work that is being done, and this is the best guarantee that cybersecurity and success in any business will be achieved.

In order to strengthen the training activities, the critical aspects regarding the EOIs cybersecurity are identified and some aspects of the creation of a cybersecurity polygon are approached. It is estimated that PINFOSEC polygon will significantly contribute to ensuring the necessary conditions for improving the education in cybersecurity.

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[33]   *ETSI GS ISI 001-1 V1.1.1 (2013-04) Information.*
[34]   T A Howard, 'Cybersecurity Culture: The Root of the Problem', *United States Cybersecurity Magazine.*

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Amadea Bata-Balog

BOOK REVIEW: *THE 21ST CENTURY PUBLIC MANAGER* BY ZEGER VAN DER WAL[1]

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Zeger van der Wal's latest book entitled 'The 21st Century Public Manager: Challenges, People and Strategies' published in 2017 is in many ways a unique and milestone work, truly global in scope and ambition, both in its mapping of the complex 21st century landscape of public administration, and in offering a clear perspective for practitioners, while also inspiring them on their journeys. Along these lines, the value of the book is in its basic premise that "public management matters" and that of the demanding rethinking of the roles, responsibilities, skills and strategies of purposeful public servants while navigating in the ever-changing VUCA world – one characterised by volatility, uncertainty, complexity and ambiguity. The book was intended to serve as a practical manual and indeed is an extremely useful guide, being an asset for professionals, students and educators who wish to follow a logical framework in understanding contemporary public policy challenges.

KEYWORDS:
global megatrends, public administration, public policy, public servants, VUCA world

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1   Zeger van der Wal, *The 21st Century Public Manager: Challenges, People and Strategies* (London: Palgrave Macmillan, 2017).

In our contemporary globalised world, when a serious pandemic can actually shut down the whole world for almost a year now (Covid-19), when one of the most determining members of the European Union leaves the integration beyond recall (Brexit), or when facing the most complicated openings to a new administration in modern history with regard to the United States – just to mention a few defining events – it can be stated that we have entered a new era full of unexpectedness. This unpredictable nature of the VUCA[2] world at stake – characterised by *volatility, uncertainty, complexity and ambiguity* – presents profound challenges for many policymakers and public managers across the globe. As a matter of fact, public administration, its role and tasks, have always been changing with age, related to economic, social, political and cultural characteristics, the goals of governance, consistently facing internal and external challenges, going along with global trends (as economic interconnectedness, demographic changes, digital deluge, climate change) and pervasive public problems of the 21st century.[3]

Defining the concept of public administration is not an easy task, since there is no approach, method or discipline with which a notion for public administration could be developed – not even at the level of conceptual abstraction – that meets the need for completeness[4]. Nor it is effortless to describe public managers themselves, who should be prepared and respond to an ever-changing world which is fertile with disruptions and complications. However, Zeger van der Wal took the effort to expand the horizon on such an intriguing topic as *The 21st Century Public Manager* and how to get along in such a challenging environment.

The highly acclaimed author, Zeger van der Wal is an Assistant Dean (Research) and Associate Professor at the Lee Kuan Yew School of Public Policy, National University of Singapore, a researcher, a Global Public Management Expert and a widely recognised lecturer having extensive experience in executive education. This is why he also intended his book to be valued as a practitioner-oriented teaching text that apart from being addressed to those aspiring public managers who aim to invest more in their work or want to look for some motivation, is also for students enrolled in public administration or public management courses, who are interested in knowing more or becoming a good 21st century public manager. *The 21st Century Public Manager* was published by Palgrave Macmillan in the framework of *The Public Management and Leadership Series in April 2017.* The state-of-the-art edition has received positive accolades in newspapers and top journals in the field, and widespread international attention from the U.S. to India, Korea, Russia, Australia, China and the Netherlands; and has been translated into Arabic, Chinese and Mongolian – unfortunately not (yet) into Hungarian.

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2   VUCA is an acronym, first used in 1987, already in connection with leadership theories of Warren Bennis and Burt Nanus. From the beginning of the 2000s, it has subsequently taken root in emerging ideas in the field of management and strategic leadership.

3   Rosamond Hutt, 'What are the 10 biggest global challenges?' *World Economic Forum,* 21 January 2016.

4   András Patyi, *A közigazgatási működés jogi alapjai. A magyar közigazgatás és közigazgatási jog általános tanai* (Budapest: Dialóg Campus, 2017).

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Van der Wal's accessible and readable book serves as a practical manual and an extremely useful guide to navigate the complex world of public management. A central argument of the book is that a successful public manager of the 21st century – not using the VUCA world as an excuse – can turn emerging challenges into immense opportunities for public value creation. Thus in order to do so, van der Wal provides public managers with a set of tools and a mindset to address this new era. He is convinced that 'public management matters'[5] and that the work of public servants is decisive in the creation of good government.

The structure and content of the book are embedded in a logical framework which is clearly outlined in the beginning of the edition. The author structured his work in twelve chapters, covering 201 pages, which are followed by an all-inclusive bibliography. Already when reading the *Introduction* of the book, it becomes apparent for the reader that this volume will not only be intellectually satisfying, but inspiring at the same time, as van der Wal is passionate in delivering information about who public managers really are and how they strive to manage and navigate in a VUCA world.

The second chapter provides a critical overview of *Traditional* versus *New* roles, skills, competencies and values for public managers. In order to accomplish this, it offers a historical retrospective – nevertheless, not returning to the medieval times of China or India, but – to the first half of the 20th century, crediting the founding father of public administration as Max Weber, who cultivated the traditional, rule-oriented bureaucratic type of public manager. The chapter then goes on to show how public managers have developed into 'businesslike', performance-focused managers, and finally to networking, relation-focused collaborators. If you were having some doubts of the latest trends, you are not wrong if you realise that these types or models, and the 'administrative craftsmanship of 1.0, 2.0, 3.0'[6] are actually combined in an effective and successful 21st century manager. Apart from utilising the right toolbox with skills, 21st century public managers 'need to operate on the basis of the right values and motivations which, taken together, constitute a so-called public service ethos'.[7] But how will the emergence of a VUCA world affect these values and motivations? Along these lines, the chapter joins to a bright number of recent scholarly articles, books, consultancy reports and government documents discussing the future public sector workforce as an essential means for good governance, but this edition is exceptional in raising questions that are especially practitioner-oriented.

The third chapter identifies the *Trends and Drivers* of global megatrends, hypes and shocks that impact managerial operating environments, highlighting the eight most decisive ones, such as those that concern individuals, the global economy, and those that are in relation to the physical environment. All tightly relate to one another. First of all, it was the rapid 1. technological evolution that changed the world completely and increased

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[5]   Van der Wal, *The 21st Century Public Manager,* xiv.

[6]   Ibid. 12. Citing Paul t' Hart, *Ambtelijk Vakmanschap 3.0. De zoektocht naar het handwerk van de overheidsmanager* (The Hague: VOM, 2014).

[7]   Ibid. 20. Citing: Rayner et al. 'Organizational citizenship behavior and the public service ethos: Whither the organization?', *Journal of Business Ethics* 106, no 2 (2012), 117–130.

the availability of data and information that coupled with an increasingly empowered and educated population, which resulted in 2. great expectations from governments and strong demands for transparency. Such dynamics fundamentally have changed the practices of public administration, which was further challenged by 3. demographic changes, as well as population moves. 4. Economic interconnectedness is beyond doubt, which largely determines the economic and policy agenda of international and domestic governance actors. Meanwhile, the massive growth of 5. public debt and subsequent fiscal pressures have come to be one of the most profound public sector trends in the developed world, which additionally has seen 6. global power shifts with developing countries coming into the scene, especially with the start of the 'Asian century and the – truly – multipolar world'. As a result of the ever-increasing 7. urbanisation phenomenon, megacities appear as 'nodes of growth and governance' raising as many threats as opportunities. As a downside of the aforementioned trends, 8. climate change and resource stress, which although is a popular topic of recent discussions, is still far away from many countries' interests and policy agendas.

The following chapter builds upon these megatrends impacting public administration, translating them into seven *Demands, Dilemmas and Opportunities*. What the author makes clear through a lifelike example is that public managers of today and the future are faced with a 'cascade of multi-faceted and contradictory demands which, in turn, result in complex public management dilemmas'.[8] Apart from being aware that not all demands and dilemmas are unfamiliar or new in their nature, but in fact are a result of the round-about 21st century trends and drivers, many are distinct and inexperienced yet. The key question is to what extent public servants of this age can manage these demands and dilemmas in a way to transform them into opportunities – if possible. After giving a short foreword on each cluster of managerial demands identified by Van der Wal, he then offers strategies and tools for practitioners, discussing the roles, attributes and competencies that they need in order to handle and dominate these challenges day by day during their work. Chapter 5 to 11 are structured around these seven critical demands according to the following: *Managing Stakeholder Multiplicity, Managing Authority Turbulence, Managing the New Work(force), Managing Innovation Forces, Managing Ethical Complexities, Managing Short Versus Long Time Horizons* and *Managing Cross-sectoral Collaboration.*

Without spoiling the main ideas of these chapters, it must be noted that each are very detailed in elaborating on the diverse challenges current and future public managers have to tackle. When it comes to *Managing Stakeholder Multiplicity,* it is realised that due to emerging and interconnected megatrends, more and more public issues require building collaborations or networks with the engagement of public, private and non-profit organisations. With more and more stakeholders getting involved, solving public problems eventually become more complicated due to such concerns as responsibility and

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8   Ibid. 39.

accountability.[9] Communication and networking with these stakeholders is not an easy job for any public manager, thus one needs good framing and branding strategies, while social media-literacy has also been recognised as a necessary means for problem solving and management.

Another confronting task in public administration is *Managing Authority Turbulence,* which originates from the fact that there has been a decline in respect for traditional authority, arising with scepticism over expertise by the vocal public which consumes often exaggerated social media (with fake news) – all making legitimacy rather consequential than self-evident.[10] Reading this chapter, a practitioner will develop a good sense of the causes and manifestations of the phenomenon of authority 'shock' and will learn eight managerial responses, such as mastering political astuteness, maintaining institutional continuity and policy consistency or advocating collaborative leadership, among others. However, implementing these strategies, with the wave of retirement of senior managers, is challenging to deal with as younger generations of employees entering the labour market that is confused with new forms of work and new types of workplaces. The manifestation of the challenges of *Managing the New Work(force)* – versatile, unpredictable and boundless career paths of Generation Y, a diverse workforce, computerisation and robotisation or the disappearance of traditional job security – are all over, but the chapter does not hold back the opportunities of these currents, additionally, it goes into HRM issues, too.

As a cause and as a consequence of the megatrends discussed before, innovation sooner or later appears in the field of public administration. Either because it is indeed needed or it is pressured into practice. The question is how public managers choose to respond, whether they can overcome traditional public sector barriers to renew and experiment or if they choose to stay with traditional practices if public values are believed to be lost via 'disruptive' innovation. (Is innovation always 'good'?) Either way, according to *Managing Innovation Forces* and its stages effectively, van der Wal argues that public managers should 'change the way they think, operate, respond, facilitate, and produce'.[11]

A variety of ethical dilemmas alongside competing values and obligations make public managers sleepless at night. 21st century public managers are expected to be skilled at *Managing Ethical Complexities* in a way that they must operate both ethically – good – and effectively – well.[12] After identifying the types of unethical behaviours, key managerial areas are described, one of which is the determination of political-administrative boundaries. Supposing that public servants are/should be separate from the political domain while serving the public interest,[13] it often proves to be difficult, or sometimes even impossible to

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9 Denhardt et al., *Public Administration: An Action Orientation* (Boston: Wadsworth, 2014).

10 Van der Wal, *The 21st Century Public Manager,* 68. Citing: Mark C Suchman, 'Managing legitimacy: Strategic and institutional approaches', *Academy of Management Review* 20, no 3 (1995), 571–610.

11 Ibid. 107. Citing: Cat Tully, 'Stewardship of the Future Using Strategic Foresight in 21st Century Governance', U*NDP Global Centre for Public Service Excellence,* 2015, 4–5.

12 Gjalt de Graaf and Zeger van der Wal, 'Managing conflicting public values: Governing with integrity and effectiveness', *The American Review of Public Administration* 40, no 6 (2010), 623–630.

13 Woodrow Wilson, 'The study of administration', *Political Science Quarterly* 2, (1887), 197–222.

remain apolitical eternally while getting things done. This consideration is not a newborn issue, while for instance the rise of big data, a game-changing phenomenon creating the concern of privacy violations, has recently been rapidly advancing.

Avoiding to meet only short-term pressures and demands, (most of the cases in relation to election cycles,) pressing megatrends – such as demographic changes, urbanisation or climate change – necessitate that public managers plan ahead in order to mitigate possible fiscal, demographic and environmental pressures. The remainder of this chapter gives an idea on how foresight methods and resilient systems can support practitioners in public administration with *Managing Short Versus Long Time Horizons,* which is another high-priority 21st century demand.

The seventh and final managerial demand, defined in Chapter 11 – *Managing Cross-sectoral Collaboration* – is an issue that has been raised time after time in the previous chapters, but here it gets more attention and justification. Key drivers are outlined for engaging in collaborative practices and arrangements with partners and partnerships (for example, PPPs), demonstrating collaborative behaviour with non-state actors (often especially citizens), – ranging from leveraging outside expertise or financial resources to empowering citizens – and the challenges and opportunities that each of these drivers presents. Collaborative partnerships, although presenting considerable challenges to public managers, in fact, can 'yield the largest potential benefits for solving super-wicked problems'.[14]

After concluding the analysis on specific demands for public managers that originate from the VUCA world, the closing chapter synthesises the key observations of the resourceful author on the ideal profile of *The 21st Century Public Manager.* Van der Wal, being aware of socio-economic and cultural differences of public administration, understands that the universalism of such a profile is critical. However, the overall, global trends featured in this book all point towards the urge for public managers to become smart, savvy, astute and entrepreneurial while maintaining a strong public service ethos, collaborative and connected yet authoritative in content and style, an active anticipator of what matters now as well as in the future, and a generalist-specialist who never stops learning.[15]

A remarkable strength of this book is that it is truly international in scope with regards to the scene of public administration. It acknowledges that while 'public servants are united in their calling to serve the public'[16] they experience different challenges while operating in diverse contexts and circumstances depending on which part of the world they live. On the other hand, though, it is unavoidable to realise that economic interconnectedness, combined with technological developments, ensure that 'public administration is no longer

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[14]   Van der Wal, *The 21st Century Public Manager,* 177.
[15]   Also see Zeger van der Wal, 'Five key characteristics of the 21st century public manager'.
[16]   Assel Mussagulova, 'The Twenty-First-Century Public Servant: A Developing Country Perspective', in *The Palgrave Handbook of the Public Servant,* ed. by Helen Sullivan, Helen Dickinson and Hayley Henderson (Palgrave Macmillan, 2020).

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bound by national borders, as the traditional definition of the field has implied'.[17] Since the international dimensions of public administration are more important than ever, and eventually 'all public management work will internationalize and globalize in the decades to come',[18] van der Wal shows different viewpoints, issues and practices from all around the world – case studies from the developed and developing world, from the U.K. to China, Sweden to India, and even Hungary.

For a better understanding, the book provides boxes and illustrative materials (tables, figures) as well as dozens of references, granting that the work is based on extensive theoretical background and a remarkable literature overview. Beyond accurate citations, the author adduces conversations with a number of officials, interviews with public leaders and managers, together with bringing plenty of real-life examples to support his points, which all make the concepts and problems come alive and easy to relate to, and frame the analysis more credibly. Van der Wal's engaging style of writing makes *The 21st Century Public Manager* a highly valuable read that should be in the collection of all those who wish to follow a logical framework in understanding contemporary public policy challenges. This book, however, is especially recommended to students and educators as educational material in public administration programs. Indeed, the transfer of knowledge and 'best practice' in the field of public administration is of utmost importance as it is linked to public sector performance and national competitiveness.[19]

With unprecedented challenges ahead, government officials and political leaders are driven to find new and innovative ways to tackle long-standing matters.[20] In order to do so, an equipped public managerial team is needed, who must rethink their roles, responsibilities, skills, strategies and values while contending with the VUCA world. Certainly, 'we are about to see significant changes both to what public servants do and the ways in which they do it'.[21] Zeger van der Wal's latest edition is in many ways a unique and milestone work, both in its mapping of the complex 21st century landscape of public administration, and in offering a clear perspective for practitioners, while also inspiring them on their journeys.

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[17]   Denhardt et al., *Public Administration.*

[18]   Van der Wal, *The 21st Century Public Manager,* 34.

[19]   Norbert Kis and András Nemeslaki, 'Comprehensive HR development in the public sector: The case of National University of Public Service as an innovative institutional framework' in *Government vs. Governance in Central and Eastern Europe: From Pre-Weberianism to Neo-Weberianism?* 22nd NISPAcee Annual Conference, 2014.

[20]   Robert P Beschel, Blair James Cameron, Jana Kunicova and Bernard C Myers, 'Improving Public Sector Performance: Through Innovation and Inter-Agency Coordination', *The World Bank, Global Report – Public Sector Performance,* October 2018.

[21]   Helen Dickinson and Helen Sullivan, *Imagining the 21st Century Public Service Workforce* (Melbourne School of Government: University of Melbourne, October 2014).

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András Bojtor – Gábor Bozsó

COMPARATIVE ANALYSIS OF EVIDENCE-BASED POLICIES IN THE ERA OF DIGITALISATION

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Digital transformation speeds up and strengthens an already growing demand for a well-functioning public administration with e-governmental services. The outbreak of the global Covid-19 pandemic edged such actions forward even more. Public administration with embedded institutions enables the formulation of a competitive environment. The implication of digital services can decrease the negative effects of an economic crisis. Evidence-based policy-making is a component of good governance next to transparency, sustainability, efficiency, integrity and an approach of being people-centric. Digitalisation brings new challenges for public service and governments are taking various measures in response to them. There is an evolving need for citizen-centric electronic public administration services. National performance can be expansively analysed in a globalised world – with international comparisons. The paper conducts an international comparative analysis about the developments of citizen-centric digital transformation in public administration after 2014 with special focus on Hungary and selected reference countries.

Keywords:
citizen centricity, DESI, digital transformation, e-government, EGDI, evaluation, indicator ranking

1. INTRODUCTION

As a consequence of the outbreak of the global Covid-19 pandemic (stated by the WHO on 11 March 2020), severe lockdowns and restrictions were imposed by governments all over the world at high economic and societal costs.[1] In this environment, greater attention is being given to digital solutions and services. Digital solutions can mitigate the harmful economic effects of government interventions to control the pandemic and provide positive effects to public health interests.[2] Digital forms of collaboration have increased rapidly as a consequence of the changed environment,[3] making it necessary for public administrations to adopt and at the same time define the technological circumstances by introducing laws and providing the necessary infrastructure (5G availability). The usage of digital public services increased significantly in 2020.[4] Digital transformation accelerated in the health sector[5] (for example, using video visits, mobile phone applications), in pandemic prevention and crisis management,[6] also in education where children, teachers and parents[7] were all challenged by digital education. E-government services, in a broader definition, include any form of information and communication technologies used in public administration,[8] providing connection among citizens, businesses and state agencies and also among state agencies themselves. These services can improve transparency, decrease the level of corruption, positively affect economic growth and increase convenience.[9] Cost saving is based on two pillars: citizens and businesses save time and effort to handle their issues personally in one-stop-shops of public administration, and on the other side, less one-stop-shops need to be maintained because of the smaller number of personally handled cases. There is no need to digitalise paper-based documents and better data collection are available to the central body of public administration, on which evidence-based policy

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[1]   Thomas Pueyo, 'Coronavirus: The Hammer and the Dance', 19 March 2020.

[2]   Varun Grover and Rajiv Sabherwal, 'Making sense of the confusing mix of digitalization, pandemics and economics', *International Journal of Information Management* 55 (2020).

[3]   Mitsuru Kodoma, 'Digitally transforming work styles in an era of infectious disease', *International Journal of Information Management* 55 (2020).

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[9]   Attah Ullah, Chen Pinglu, Saif Ullah, Hafiz Syed Mohsin Abbas and Saba Khan, 'The Role of E-Governance in Combating COVID-19 and Promoting Sustainable Development: A Comparative Study of China and Pakistan', *Chinese Political Science Review* 6 (2020).

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decisions can be issued. The connections among government agencies are also more precise and quicker; government effectiveness improves. State capacity matters in the fight against the Covid-19 pandemic and increased government effectiveness is significantly associated with lower death rates.[10]

Based on the results of the Electronic Public Administration Operational Program and the State Reform Operational Program 2007–2013, analysed by Aranyossy et al.,[11] the Hungarian Government has handled the digital transformation of public administration as a priority since 2014. This article analyses the changes in Hungarian e-governance and digital public services through selected international indicators between 2014–2020 and reveals the relevant background processes. The analysis addresses not only performance in terms of absolute values, but also assesses the relative position to carefully chosen benchmark countries. The selected indicators put a special focus on the citizen-centric e-services of public administration.

2. E-GOVERNMENTAL DEVELOPMENTS IN HUNGARY

The Hungarian Government introduced structural reforms in the Hungarian public administration in the last decade. The European Union's Excessive Debt Deficit Procedure against Hungary (levied in 2013) and bailout program of the International Monetary Fund and the European Commission (repaid in 2016) provided strong conditionality to the Hungarian Government. The results of the introduced changes were opposite of the common practice of the European Union.[12] Despite global decentralisation trends, Hungary centralised its public administration, formulated on a strong and capable state concept.[13] Territorial administration was completely restructured, the complete reform of local governments was introduced and the University of Public Service was established as a main body to provide human resource management of public administration with well-trained and capable human resources, which was also positively evaluated by the OECD.[14] Essential elements of the public administration reform programmes[15] are being implemented by developmental projects financed by the Public Administration and Civil

[10]   Balzhan Serikbayeva, Kanat Abdulla and Yessengali Oskenbayev, 'State Capacity in Responding to COVID-19', *International Journal of Public Administration,* 07 December 2020.

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[14]   OECD, 'Hungary: Public Administration and Public Service Development Strategy, 2014–2020', 13 December 2017.

[15]   Közigazgatási és Igazságügyi Minisztérium, Magyary Zoltán közigazgatás-fejlesztési program (MP 12.0), 2012; Közigazgatási és Igazságügyi Minisztérium, Magyary Zoltán közigazgatás-fejlesztési program (MP 11.0), 2011.

Service Development Operative Programme (PACSDOP) between 2013–2020. More than 935 million euros are planned to be spent on the development of the Hungarian public administration, which plays an important role in the process of improving the performance and efficiency of the Hungarian state with its indirect effects on the competitiveness of the business sector. The outcomes and impacts should be measurable and detectable in international comparisons, as well. A well-functioning evaluation can distinguish the changes caused directly by the intervention or just as side-effects of unintended circumstances. There is a consensus on the need to draw distinction between outcomes and impacts, however, their exact definitions are still subject to academic disputes.[16] While short- and medium-term results are defined as outcomes, impacts are long-term results of an implemented measure.[17] In the 2014–2020 programming period, the EU Cohesion Policy Fund invested in institutional capacity building and reforms under Thematic Objective (TO) 11: 'Enhancing institutional capacity of public authorities and stakeholders and efficient public administration.' Relevant developments and interventions of the Hungarian development policy are summarised and coordinated in the Public Administration and Civil Service Development Operative Program,[18] based on Hungary's Public Administration and Public Service Development Strategy (PADPSDS) 2014–2020.[19] The National Digitalization Strategy 2021–2030[20] was introduced in 2020 as a successor of PADPSDS, also building on the initiatives of the Digital Success Programme (DSP 2.0 – Strategic study,[21] Hungary's Artificial Intelligence Strategy 2020–2030,[22] PCDS-Public Collection Digitalization Strategy,[23] DSS – Digital Startup Strategy of Hungary,[24] DES – Digital Education Strategy of Hungary,[25] DEDS – The Digital Export Development Strategy of Hungary[26]). The main aim is to make public entities deliver public services in a professional, cost-effective and customer-oriented manner. In the 2014–2020 EU budget period, the key feature of good governance, in addition to cooperation and policy polarisation, is results-orientation[27] to ensure more efficient use of budgetary resources.

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16 Brian Belcher and Markus Palenberg, 'Outcomes and Impacts of Development Interventions: Toward Conceptual Clarity', *American Journal of Evaluation* 39, no 4 (2018), 478–495.

17 *OECD Glossary of Key Terms in Evaluation and Results Based Management* (Paris: OECD Publications, 2002).

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19 Miniszterelnökség, 'Közigazgatás- és Közszolgáltatás-fejlesztési Stratégia 2014–2020', 2015.

20 Innovációs és Technológiai Minisztérium, Belügyminisztérium, 'Nemzeti Digitalizációs Stratégia 2021–2030, Partnerségi konzultációra bocsátott, nem végleges változat', 2020.

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25 Digitális Jólét Program, 'Magyarország Digitális Oktatási Stratégiája', 2016.

26 Digitális Jólét Program, 'Magyarország Digitális Exportfejlesztési Stratégiája', 2016.

27 Philip McCann, *The Regional and Urban Policy of the European Union: Cohesion, Results-Orientation and Smart Specialisation* (Edward Elgar Publishing, 2015).

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The Digital Market Strategy[28] emphasises the support of inclusive e-society in the member states of the European Union; the published Action Plan[29] lists the concrete actions to improve online public services. Based on the Tallin Declaration,[30] which emphasises the user-centric principle in digital public services, the Berlin Declaration[31] in December 2020, reinforces the EU digital government policy contributing to core European values and fundamental rights. The digital transformation in public administration is triggered mainly by the external environment: technology rapidly changes and the expectations of citizens increases, and less commonly by internal pressures to realise the need of improving applied processes.[32] The developments should take into consideration office processes and citizens' expectations with the constraint of technological possibilities.[33]

3. INTERNATIONAL COMPARISONS

3.1. Methodological biases

Before applying indicators from international indicator systems, its limitation must be observed. International indicators do not take national characteristics into consideration. Financial investments alone cannot grant good national results in composite ranking systems which take into account infrastructural, social and regulator attitudes. At the same time, a satisfactory infrastructure does not mean that the population chooses to use the provided services online instead of traditional, personal service use.

An international comparative analysis can be mainly carried out based on data collected by international institutions, like the International Institute for Management Development, World Economic Forum (WEF) and the World Bank. Almost always there are certain values behind these data collections. Some cases include shortage of methodological transparency or defined reasoning of data.[34] In other cases, the international rankings 'simplify social phenomena, level unwarranted normative judgements, and selectively diagnose complex

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[28] European Commission, A Digital Single Market Strategy for Europe, COM(2015) 192 final.

[29] European Commission, EU eGovernment Action Plan 2016–2020, COM(2016) 179 final.

[30] Council of the European Union, Tallin Declaration on eGovernment, 2017.

[31] Council of the European Union, Berlin Declaration on Digital Society and Value-Based Digital Government, 2020.

[32] Ines Mergel, Noell Edelmann and Nathalie Hauga, 'Defining digital transformation: Results from expert interviews', *Government Information Quarterly* 36, no 4 (2019).

[33] Péter Fehér, 'A digitális átalakulás módszereinek feltárása a közszolgáltatásokban', *Vezetéstudomány* 49, nos 8–9 (2018), 22–31.

[34] Erzsébet Németh, Tamás Bálint Vargha and Ágnes Katalin Pályi, 'Nemzetközi korrupciós rangsorok tudományos megbízhatósága', *Pénzügyi Szemle* 64, no 3 (2019), 321–337; Tamás Bálint Varga, Erzsébet Németh and Ágnes Katalin Pályi, 'Mit mutatnak a versenyképességi rangsorok?', *Pénzügyi Szemle* 64, no 3 (2019), 352–370.

problems'.[35] More than 93 different comparative governance indicators exist,[36] with a variety of countries involved in their data collections. The frequency of their publication (for example, annually, biannually, or more rarely) is divergent. Between two publications, the methodology behind the same indicator can change radically, which makes it difficult to draw historical conclusions or evaluate their values or rankings. A well-designed, definite ranking is applicable when not only the ranking is objective and disseminated, but also when its methodology is taken into consideration.[37] A ranking system can cause huge publicity and can draw attention to specific issues. It can also encourage quality debates; it can enable the possibility to explore the studying effect. On the other hand, it may also have several disadvantages: the debate can be just about the place in the ranking, and can cause the improvised re-discussion of the long-term strategies.[38]

Besides rankings, international indicators can be used in performance evaluations providing comparisons among countries. In case of public administration, the capabilities and capacities of the applied systems show wide varieties. There is continuous pressure to introduce reforms on public administrations. E-government development and digitalisation is only a part of public administration reforms. The application of new methodologies like big data analysis (for example, at the examination of criminal activity during the Boston Marathon[39]), and experimental research methods in policy-making processes also offer good results.

Achieving improved competitiveness by digitalisation is an important objective of the Hungarian operative program focusing on public administration development. The aggregated results or impacts of the implemented projects can hardly be detected in international rankings exclusively. However, their effectiveness and impact cannot be denied in the level of indicators. There are five worldwide or regional rankings (the Ease of Doing Business, the Digital Economy and Society Index (DESI), the eGovernment Benchmark, the Global Competitiveness Report and the United Nations E-Government Index) which provide indicators to characterise changes in the case of Hungarian public administration development.

35   Alexander Cooley, 'How International Rankings Constitute and Limit Our Understanding of Global Governance Challenges: The Case of Corruption', in *The Palgrave Handbook of Indicators in Global Governance* ed. by Debora Valentina Malito, Gaby Umbach and Nehal Bhuta (Cham: Springer International Publishing, 2018), 62.

36   Robert I Rotberg, *On Governance: What It Is, What It Means and Its Policy Uses* (McGill-Queen's University Press, 2016).

37   Rudolf Giffinger, Gudrun Haindl and Hans Kramar, 'The role of rankings in growing city competition', *Urban Research and Practice* 3, no 3 (2010), 299–312.

38   Matthias Schönert, 'Städteranking und Imagebildung', *BAW Institute für Wirtschaftsforschung, Monatsbericht* 2 (2003).

39   Maureen A Pirog, 'Data will drive innovation in public policy and management research in the next decade', *Journal of Policy Analysis and Management* 33, no 2 (2014), 537–543.

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Correlations among dimensions of the international indicator system can be often observed, for example, the Digital Public Services dimension of DESI shows strong relationship with the Integration dimension.[40]

As the PACSDOP is currently in either the development or implementation phase, several project results, and likewise impacts, are yet to be delivered. Furthermore, international rankings and indexes collect the data from previous years, in our case 2018, 2019, before the Covid-19, which is an important limitation of the paper.

4. INDICATORS FOR CATCHING E-GOVERNMENTAL DEVELOPMENTS IN HUNGARY BETWEEN 2014−2020

Selecting benchmark countries makes it easier to perform comparisons among countries. Analysts have to take into consideration the qualifications and interests of the target audience (who are going to read the evaluations). As mentioned above, the projects of the Hungarian public administration development program financed from the Cohesion Funds of the European Union are under implementation. In this case we can talk about intermediate results or impacts. By historical comparison, there is also a need of setting out a base year, when the effects of the program are not perceptible. In our case this year is 2016. Financed projects stepped into implementation phase the following year. Data collection requires attention: using the report of *Doing Business 2017* means that the data are collected in 2016, *Global Competitiveness Report 2017* means that the data are collected in the first part of the same year, in 2017. As the PACSDOP is partially financed by the European Union, there is a need to emphasise the role of the EU; therefore, the EU28 average is involved in the performance analysis. We are talking about the place between the 28 member states of the European Union in case of rankings.

The eight countries selected for visualisation (keeping in mind relevance) are Estonia (as a country which generally performs well in digitalisation as a consequence of early introduced and well-designed digital reforms), the V4 countries (Slovakia, the Czech Republic, Poland and Hungary) plus Slovenia (as EU countries with similar history and culture) and finally Bulgaria and Romania (as countries that joined the EU together following the 2004 enlargement).

Developing e-government services is of little worth, if citizens and businesses are not committed to use them. Its EU-wide applied indicator is the e-government users, collected by Eurostat. It measures people, aged 16–74 years, who sent completed forms to public authorities over the internet in the previous 12 months. The number of Hungarian users significantly increased from the base year; however, it is still lagging behind most of the EU countries and the EU28 average. Several new services were introduced (for example, the

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[40]   Zoltán Bánhidi, Imre Dobos and András Nemeslaki, 'What the overall Digital Economy and Society Index reveals: A statistical analysis of the DESI EU28 dimensions', *Regional Statistics* 10, no 2 (2020), 42–62.

Hungarian Tax Authority introduced an electronic system of income tax return [eSZJA]) in line with legislative changes to promote e-governmental services. Later on, a greater increase is expected as more development projects enter the implementation phase.
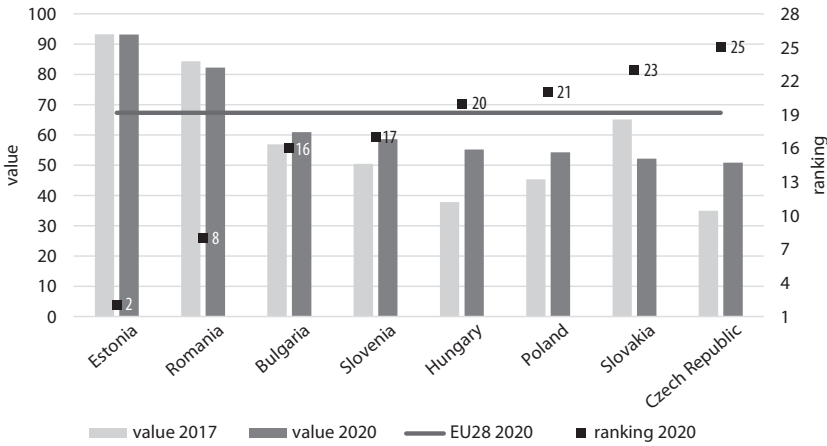
Figure 1 • *The government users (Source: Compiled by the authors based on https://digital-agenda-data.eu)*

Users can choose to use e-governmental service only if it is available and they can easily adopt them. It is measured by the user-centric indicator collected within the eGovernment Benchmark. User centricity improved in all the visualised countries, meaning that governments are committed to improve availability of services and are paying attention to user satisfactions. It can also be assumed that their feedback is more important and taken into consideration by the developers.
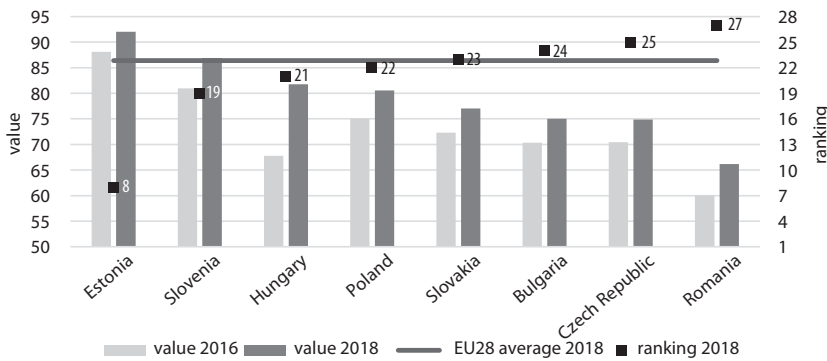
Figure 2 • *User centricity values in the base year (2016) and in the latest available data (2018) (Source: Compiled by the authors based on https://ec.europa.eu/digital-single-market/en/news/egovernment-benchmark-2019-trust-government-increasingly-important-people)*

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As e-governmental services are developed to provide an easier and more cost-effective way of using public services, it is necessary to save the user's time. This can be reached if the identified user's data are filled automatically if it has previously been provided by the user. This is measured by a mystery shopping technique in various life events, for example, applying for unemployment aid. This indicator can increase, on the one hand, by the development of infrastructure and the interoperability between various data centres, and on the other hand by the satisfaction of citizens – meaning the improvement of user-experience. In case of Hungary, we can find adequate and significant improvement.
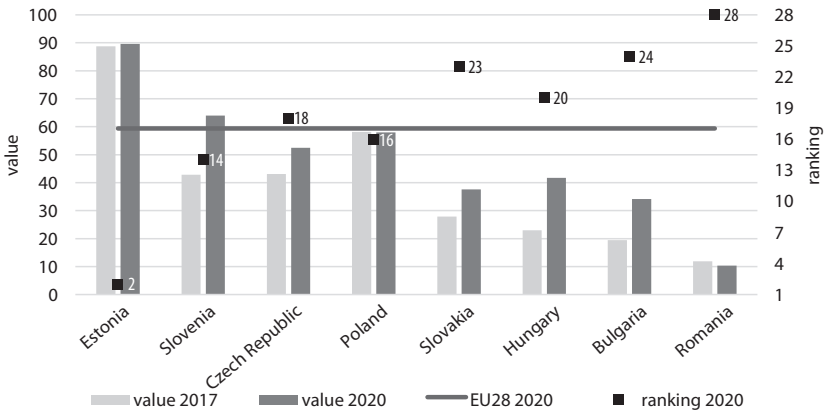
Figure 3 • *Prefilled forms (Source: Compiled by the authors based on https://digital-agenda-data.eu)*

Not only e-government development can be compared internationally, but also some relevant selected sectors. As an illustration, we have chosen the taxation indicator of the Doing Business ranking system. The Hungarian tax system is usually criticised because of its rates and complexity. Several reforms were introduced recently, the rate of taxation was decreased, the tax-system was simplified and the level of digitalisation, like automated income tax returns (partially financed by the EU funds), was improved. All the activities together improved the taxation indicator.

International surveys also provide useful data for making comparisons. The World Economic Forum annually performs the Executive Opinion Survey that provides soft data about competitiveness. Among others it asks: 'In your country, how burdensome is it for companies to comply with public administration's requirements (e.g., permits, regulations, reporting)?' which can be replied with a seven-numbered scale where 1 = extremely burdensome and 7 = not burdensome. The more than 16,000 answers can improve the credibility of the results.[41]

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[41]   Klaus Schwab, *The Global Competitiveness Report 2019* (Cologny–Geneva: World Economic Forum, 2019).
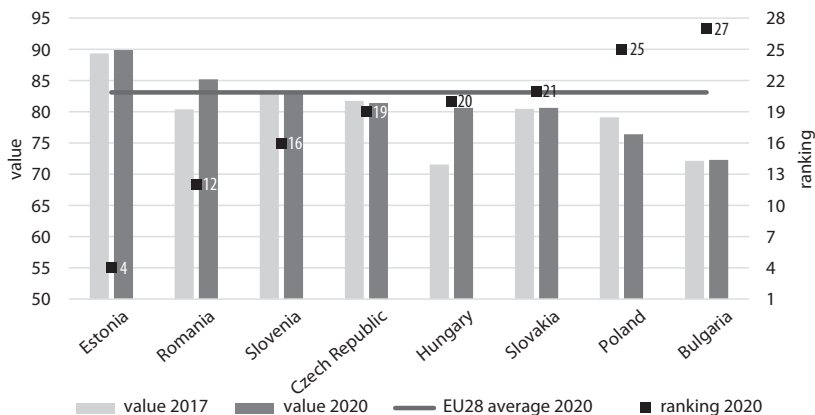
Figure 4 • *The values in 2017 (as base year) and in 2020 (as midterm year) and the ranking of taxation in 2020 (Source: Compiled by the authors based on www.doingbusiness.com)*
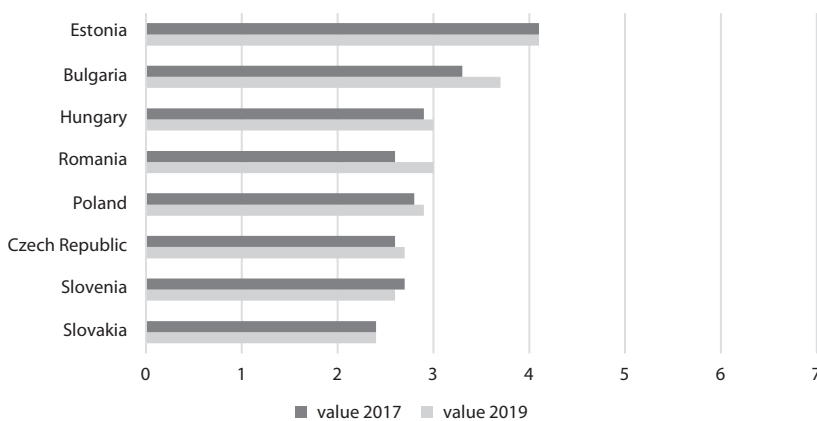
Figure 5 • *The burden of government regulation (Source: Compiled by the authors based on Schwab, 2019.)*

The digital public services for businesses indicator reveals the share of online available public services required for starting a business and for conducting regular business operations. Scoring is higher for fully online services provided through portal services which provide only information, but have to be completed offline. This DESI component is based on the mystery shopping data collection methodology of the eGovernment Benchmark report and includes 6 life events. Figure 6 shows that services provided for businesses are mostly developed (in many cases their use is obligatory), although the score of countries in the region is lower than the EU average. All countries show improvement since the base-year,

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with Bulgaria's score reaching the EU28 average. Hungary's score increased significantly, ranking third in the region, almost reaching the EU 28 average.
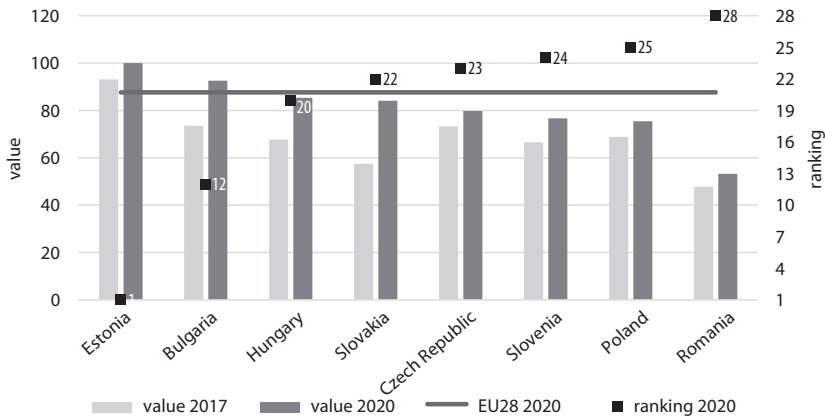
Figure 6 • *Values of E-government Services for Business in 2017 and in 2020 (Source: Compiled by the authors based on https://digital-agenda-data.eu/charts/desi-components)*

The Online Service Index (OSI) is one of the three equal weighted components of the United Nations E-Government Index (EGDI). The OSI is specifically measuring e-government services, while the other two components focus on telecommunication infrastructure and human capacity. Dataset is available since 2003 and it is calculated based on a normalised value in the range 0 to 1. The OSI is a composite indicator, it is based on data collected from an extensive online service questionnaire (QSQ) by volunteer researchers reviewing and assessing the availability and quality of key digital public services. The questions are grouped in three main areas on the availability of information about something, such as laws, policies, legislation or expenditures; on the existence of a feature such as contact information, e-government platform for procurement or open data; on ability to do something on the website, that is, run a transaction. OSI values are not to be considered absolute measurements; rather, they capture the online performance of countries relative to each other at a specific time. High score is an indication of current best practices rather than perfection. Thus, conclusions should be drawn accordingly. Figure 7 shows that online services are mostly developed and increased significantly in the past four years with the exception of Slovenia. Countries having high OSI already face difficulties in such global measurements to improve. All countries score around regional average only Estonia remains an outliner. Hungary's score increased; however, it is the only one among the 8 that experienced a drop of EGDI ranking from 45 in 2016 to 52 in 2020 due to its relative underperforming to benchmark countries in all three components of EGDI.
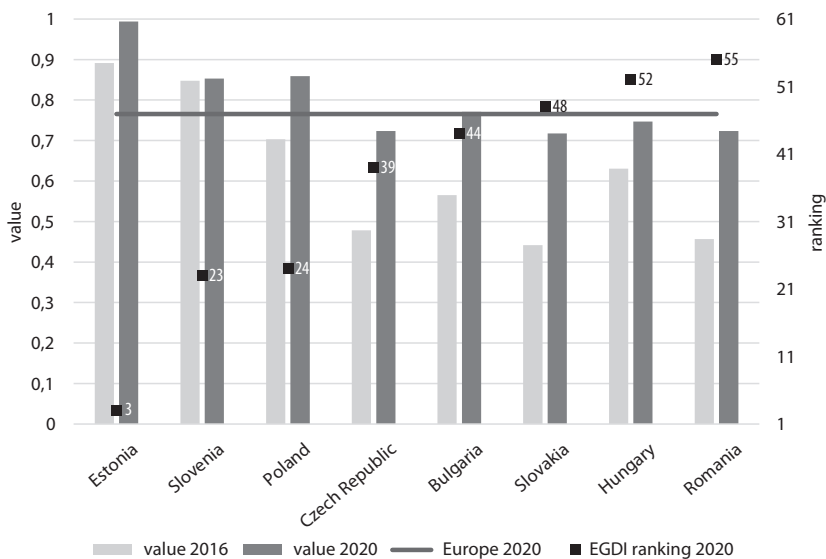
Figure 7 • *Values of Online Service Index (OSI) of the United Nations E-Government Index in 2016 and in 2020 (Source: Compiled by the authors based on https://publicadministration. un.org/egovkb/Data-Center)*
(Note: Europe 2020 means in this case the average of the EU28 countries, Iceland, Norway, Switzerland, Lichtenstein, the Russian Federation and Belarus; the EGDI Ranking contains the 193 UN Member States.[42])

5. CONCLUSIONS

There is a continuous reform process in public administration with the support of and in parallel with the common politics of the European Union. Not only the development of the infrastructural background matters, but also the usability and willingness of the application of citizens and various actors in the business sector.

The selected international indicators evaluating the performance of the Hungarian public administration development program are various; some of them are based on hard data (for example, government users) while others on soft data (administrative burden). These constraints should be taken into consideration by evaluators. The example of taxation presented shows that the changes of an indicator can be caused by several factors, like changes in legislation, or technological development, and so on. The process of making evaluation is a balance of costs and benefits, which means that the more precision

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[42]   United Nations, 'E-Government Survey 2020, Digital Government in the Decade of Action for Sustainable Development', 2020.

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an evaluation required, the more resource is needed (more costly), and the value of the intervention should also be in line with that cost. One of the main future theoretical challenges is how evaluators and policy makers should overcome the present weakness of indicators. In order to develop better indicators, more primer data collections focusing on real user needs and development goals in digitalisation could provide information for more analysis and sharing good practices and drive digital innovations as well.

According to the selected indicators, the performance of the Hungarian public administration improved and most probably is going to improve in the future. There are several projects in the implementation phase of the PACSDOP waiting for results and outcomes to evolve. An indicator showing an increase does not necessarily mean that the country will gain places in the rankings. It shows only the direction and an increase relative to others, while other countries can improve their performance more rapidly and effectively.

Public administration reforms in the digital age coincide with substantial e-government development. Its impacts are possible to be monitored and assessed well with international indicators benchmarking progress with other countries with similar geographical, socioeconomic and historical backgrounds – which also is of utmost importance for regional and national competitiveness.

Relevant international indicators revealed by the research datasets show minor improvements in e-government services between the 2016 baseline year to the most recent data. In case of Hungary, all indicator values increased in the given period, however, not always accompanied by an increase in country ranking.

Both regional and Hungarian DESI scores, including digital public services dimension, have improved, recognising the growing importance of digital capacities and services not only in the private, but also in the public sector. With regard to e-government indicators in the field of national and global competitiveness, the conclusion is similar: results are better in absolute, but not in relative terms.

It is also important to keep in mind that not all the impacts of a project can be measured and other impacts can bring numbers down. A normative way of thinking can limit the borders of discovery and significant factors can lurk in the background.

The international comparison in 2021 can reveal whether the Hungarian public administration managed to catch up in e-governmental procedure or further developments are needed. According to the data, some improvement can be observed, but Hungary is still placed in the lower positions in the rankings. This sheds light on an important practical challenge that despite the significant investment spent on digitalisation of public services, the relative position of Hungary has not improved significantly. However, not only Hungary is investing in ICT, others maybe investing more or with better results, which could also be a lesson to learn.

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E-GOVERNMENT SERVICE ADOPTION THROUGH THE LENS OF THE KNOWLEDGE GAP

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The aim of the paper is to raise some issues in relation to the technology adoption-based e-government acceptance models and that the knowledge gap theory can be applied to the use of online public administration services: higher status equals not only wider and more sophisticated usage of ICT tools, but also more knowledge about public administration procedures themselves, which can result in various channel-preferences and routines among the users of different public services. Using data from the multivariable Good State Public Administration Opinion Survey, the paper shows that the knowledge gap clearly exists in terms of public administration-related knowledge. Based on this finding, the paper recommends that the currently marginally used 'necessary knowledge about public administration procedures' factor should be more widely incorporated in e-government adoption models, as it can have a significant effect on adoption, or alter the effect of other constructs in these models.

1. INTRODUCTION

Researchers have studied the factors that influence citizen adoption of e-government in various countries for decades. Gupta, Singh, and Bashkar state in their short review of the term 'adoption of e-government' that the central element of the term is the intention or willingness to use e-government services.[1] The line of research using this approach mainly focused on governmental websites/services for information provision and digital transactions as information technology systems and consider 'e-government' a more or less homogenous service and concept. However, Kumar et al. claimed that e-government adoption is multidimensional: it contains the frequency of usage (one-time vs. regular usage), the scope of usage (one type of service vs. many services, information provision vs. transaction) and most importantly, 'preference of the online medium over other mediums of transactions with government'.[2] Dealing with public administration requires knowledge about various procedures, not only computer systems (for example, cases might require authentication, payment and specific documents). Based on the theory of the knowledge gap, this paper reviews the main constructs and models from e-government adoption literature and argues that to reach higher levels of digital service take-up based on the help of currently used models, more fine tuning in public administration-specific models may be required.

2. THE RICH RESEARCH FIELD OF ADOPTION OF E-GOVERNMENT SERVICES AS A TECHNOLOGY

The adoption of different e-government services is one of the focal points of the rapidly expanding scientific literature on e-government. Van Dijk et al. gave a good summary of the relevant theoretical frameworks that have been widely used in recent decades to describe and understand the proliferation of e-services (or even the lack thereof) in the early stages of e-government development:[3]
  – The Theory of Diffusion of Innovations (DOI)[4]
  – Technology Acceptance Model (TAM)[5]

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1   Kriti Priya Gupta, Swati Singh and Preeti Bhaskar, 'Citizen adoption of e-government: a literature review and conceptual framework', *Electronic Government, An International Journal* 12, no 2 (2012), 160–185.

2   Vinod Kumar, Bhasker Mukerji, Irfan Butt and Ajax Persaud, 'Factors for successful e-government adoption: a conceptual framework', *Electronic Journal of E-Government* 5, no 1 (2007), 63–76.

3   Jan AGM Van Dijk, Oscar Peters and Wolfgang Ebbers, 'Explaining the acceptance and use of government Internet services: A multivariate analysis of 2006 survey data in the Netherlands', *Government Information Quarterly* 25, no 3 (2008), 379–399.

4   Everett M Rogers, *Diffusion of Innovations* (5th edition) (New York: Free Press, 2003).

5   Fred D Davis, 'Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology', *MIS Quarterly* 13, no 3 (1989), 319–340.

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– Social Learning Theory[67]
– The Theory of Technology Domestication[8]
– The Theory of Reasoned Action (TRA),[9] or the Theory of Planned Behaviour (TPB)[10]

As Aranyossy put it, in the past decade the use of the UTAUT model (Unified Theory of Acceptance and Use of Technology) gained acceptance in e-government literature;[11] however, the TAM and the DOI are also still popular among researchers who seek to construct technology acceptance models.[12] Rana, Dwivedi and Williams compared the various IS/IT adoption research models being used in e-government adoption. Their findings indicated that TAM was used the most frequently, followed by DOI (in a somewhat reduced way, as the constructs compatibility, complexity and relative advantage were mainly in use across various studies), and also all the constructs of the UTAUT model (except facilitating conditions), were used quite regularly.[13]

The UTAUT model was developed by Venkatesh et al., with the integration of eight other models (the already mentioned TRA, TAM, TPB, DOI and Combined TAM-TPB, the Motivational Model [MM], the Model of PC Utilisation [MPCU] and the Social Cognitive Theory [SCT]).[14] The UTAUT amalgamates earlier constructs to form a comprehensive model that 'appeared to be significant direct determinants of intention or usage in one or more of the individual models'. The model includes four predictors: performance expectancy (PE, defined as the degree to which an individual believes that using the system will help him or her to improve in job performance), effort expectancy (EE, defined as the degree

6   Albert Bandura, *Social Foundations of Thought and Action: A Social Cognitive Theory* (Englewood Cliffs NJ: Prentice-Hall, 1986).

7   Robert Larose, Dana Mastro and Matthew S Eastin, 'Understanding Internet Usage: A social cognitive approach to uses and gratifications', *Social Science Computer Review* 19, no 4 (2001), 395–413.

8   Roger Silverstone and Leslie Haddon, 'Design and the domestication of information and communication technologies: Technical change and everyday life', in *Communication by design: The politics of information and communication technologies,* ed. by Roger Silverstone and Robin Mansell (Oxford: Oxford University Press 1996).

9   Martin Fishbein and Icek Ajzen, *Beliefs, Attitude, Intention and Behavior: An Introduction to Theory and Research* (Reading, MA: Addison-Wesley, 1975).

10   Icek Ajzen, 'From Intentions to Actions: A Theory of Planned Behavior', in *Action Control: From Cognition to Behavior,* ed. by Julius Kühl and Jürgen Beckmann (Berlin–Heidelberg: Springer, 1985).

11   Márta Aranyossy, 'Citizen adoption of e-government services: Evidence from Hungary', in *31st Bled eConference Digital Transformation: Meeting the Challenges: 17–20 June 2018, Bled, Slovenia, Conference Proceedings,* ed. by Adreja Pucihar, Mirjana Kljajić Borštnar, Pascal Ravesteijn, Jurgen Seitz and Roger Bons (Maribor: University of Maribor Press, 2018), 27–46.

12   For a summary of e-government adoption research using different technology acceptance models or the main constructs from them, see for example Gupta et al., 'Citizen adoption of e-government', or Khaled Ahmed Al Mansoori, *Use of a Modified UTAUT Model to Investigate Emirati Citizens' Adoption of e-Government in Abu Dhabi* (PhD Thesis, University of Wollogong MBA, Faculty of Business, 2007).

13   Nripendra P Rana, Yogesh K Dwivedi and Michael D Williams, 'Evaluating alternative theoretical models for examining citizen centric adoption of e-government', *Transforming Government: People, Process and Policy* 7, no 1 (2013), 27–49.

14   Viswanath Venkatesh, Michael G Morris, Gordon B Davis and Fred D Davis, 'User Acceptance of Information Technology: Toward a Unified View', *MIS Quarterly* 27, no 3 (2003), 425–478.

of ease associated with the use of the system), social influence (SI, defined as the degree to which an individual perceives that people of importance believe he or she should use the new system), and facilitating conditions (FC, defined as the degree to which an individual believes that an organisational and technical infrastructure exists to support the use of the system). As Figure 1 shows, the model also contains two outcomes (Behavioural Intention [BI] and Use Behaviour [UB]) and four moderator variables (gender, age, experience and voluntariness of use).
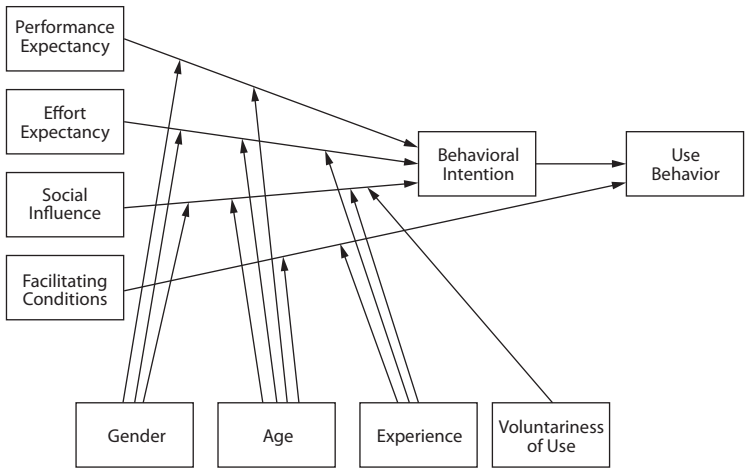
Figure 1 • *The UTAUT research model (Source: Venkatesh et al. 2003.)*

Numerous studies have used this model or a modified version of it in the context of e-government (also in Eastern Europe[15][16]); however, as Venkatesh et al. noted, UTAUT was developed to understand behavioural intention to use a technology and technology usage primarily in organisational context, primarily by employees.[17] The UTAUT model has been extended to new contexts, with e-government adoption being one of them. Tailoring UTAUT to the e-government context necessitated certain modifications so that some original items were (partially) rephrased and/or new items were added. The items in the constructs often used or proposed by various studies are usually general statements related narrowly to computer-related activities (for example, PE: *this government website…
…increases my efficiency, …is useful for me, …enables me to accomplish task more quickly,*

15   Anastasia Voutinioti, 'Determinants of User Adoption of e-Government Services in Greece and the role of Citizen Service Centres', *Procedia Technology* 8 (2013), 238–244.
16   Edin Osmanbegović and Zijad Lugavić, 'Influencing factors of e-government services adoption in Bosnia and Herzegovina', *Economic Review – Journal of Economics and Business* 16, no 2 (2018), 39–51.
17   Viswanath Venkatesh, James Y L Thong and Xin Xu, 'Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology', *MIS Quarterly* 36, no 1 (2012), 157–178.

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using E-Government services would increase my overall productivity; EE: *…is clear and understandable, is easy to use, …is flexible, …is complicated;* FC: *I have the resources necessary to use e-Government services, e-Government services are compatible with other technologies I use, the necessary assistance is available for using this e-government website),* but at times the specific nature of e-government can be traced in items which suggests that interaction with public administration takes place mainly face-to-face (or in limited cases by telephone, or post) or online (PE: *I think interacting with the government face to face would be preferable to interacting online;* EE: *I would find it easier to talk face to face with someone rather than use online services;* FC: *the necessary assistance for using the e-government website is available at CSCs* [Citizen Service Centres]). There are statements that go far beyond technology or the understanding of technology (PE: *my interaction with e-Government services would be clear and understandable;* FC: *I have the knowledge necessary to use e-Government services, I would not like to carry out my business with government online*), into the realm of habits or more general knowledge (item examples are from the research of Alawadhi and Morris,[18] Voutinioti[19] and Al Mansoori[20]). One may question whether these constructs are perfectly applicable to the context of public administration, and retain the validity of the original model.

The UTAUT2 model (building on the past extensions to UTAUT) paid particular attention to consumer use context rather than organisational focus, but e-government does not occur as a consumer experience in the strictest sense of the word. Therefore, two out of the three new constructs incorporated in the model (hedonic motivation and price value) are difficult to implement in this domain. Hedonic motivation is about deriving pleasure from using a system, and there can be little doubt that few citizens use e-government systems for their pleasure. Price-value is about the trade-offs between costs and benefits associated with usage of the technology, but in most public administration processes, the price is the same for every channel, or the costs associated with face-to-face encounters (for example, traveling time) are hard to measure. (However, examples and initiatives can be found for financial incentives to encourage citizens to use public services through the internet.) Much previous research using UTAUT2 to examine e-government adoption does not consider these factors.[21] Habit was also added to UTAUT. The construct is treated as a self-reported perception about the level of automation involved in a task, and can be also complicated to adapt in the context of e-government (as the original construct is consisted

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18 Suha AlAwadhi and Anne Morris, 'The Use of the UTAUT Model in the Adoption of E-Government Services in Kuwait', in *Proceedings of the 41st Annual Hawaii International Conference on System Sciences (HICSS 2008),* 219–219.

19 Anastasia Voutinioti, 'Determinants of User Adoption of e-Government Services in Greece and the role of Citizen Service Centres'.

20 Al Mansoori, *Use of a Modified UTAUT Model.*

21 Aranyossy, 'Citizen adoption of e-government services: Evidence from Hungary'; Nemer Aburumman and Róbert Szilágyi, 'Factors Affecting Acceptance of Government: Using Extended UTAUT2', *Journal of EcoAgriTourism* 16, no 1 (2020), 62–69.

of three items: *mobile internet is has become a habit for me, I am addicted to using mobile internet, I must use mobile internet*).

Attempts have also been made to define e-government-specific models instead of extending or modifying existing ones. Shareef et al. developed an e-government specific adoption model (Figure 2) because in their opinion, TAM, DOI, TPB cannot capture and specify the complete essence of the e-Gov adoption behaviour of private individuals (however, the model is a good summary of the relevant factors from *all* the models mentioned earlier, but rephrased and extended with some domain-specific factors).[22] The e-Government Adoption Model (GAM) also takes into account service maturity levels, which is an important distinction: the authors concluded that the e-government adoption behaviour also differs based on service maturity levels, which means the acceptance of services have to be analysed in a dynamic environment, where the functional characteristics of organisational, technological, economic and social perspectives of e-government differ. In other words, adoption of different services is affected by their maturity (and supposedly their complexity).
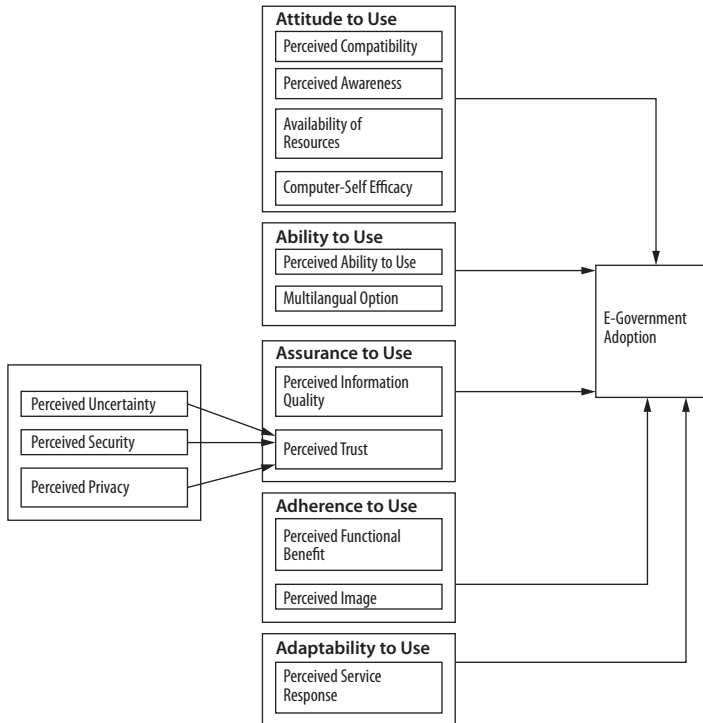
Figure 2 • *The e-Government Adoption Model (Source: Shareef et al. 2011.)*

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[22]   Mahmud Akhter Shareef, Vinod Kumar, Uma Kumar and Yogesh Dwivedi, 'E-Government adoption model (GAM): differing service maturity levels', *Government Information Quarterly* 28, no 1 (2011), 17–35.

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If we take a closer look at the constructs, one additional and important element which can be seen is trust. The presence of trust is not surprising. In the literature dealing with e-government take up, almost every specific model contains, adds or develops some kind of trust-related construct, which is regarded as a separate dimension in most,[23] although trust is defined and measured in various ways (for example, trust of the government, trust of the internet, trust of the system, trust of authentication, privacy issues, and so on). Early research by Wang examined factors affecting the proliferation of an electronic tax return system in Taiwan.[24] The research was based on the TAM model, but expanded it with a 'perceived credibility' dimension. The general tendency is to incorporate different constructions of trust into the explanatory variables in the use of acceptance models. Lean et al.[25] tested a model based on the work of Carter and Bélanger[26] and Suh and Han.[27] The study integrates constructs from TAM and DOI which have been moderated by a culture variable (uncertainty avoidance) and a trust model in five dimensions (Figure 3). Belanche, Casaló and Flavián also proposed to integrate trust and personal values into the Technology Acceptance Model.[28]

Individual, personal characteristics have always been an important part of acceptance models, although there are only a few studies that look beyond constructs related to technology (which is not surprising in the end as the purpose of the used models is to explain technology acceptance). Nevertheless, other, more public administration-related factors may affect the various technology adoption measures. There are only a few constructs which appear in different related models about this topic. As can be seen in Figure 3, Lean et al. placed uncertainty avoidance in the model, which attempted to show discomfort related to complicated administrative matters and fear of possible errors and sanctions (even if its effect was not significant in their case).[29] However, similar constructs have been considered in UTAUT, such as self-efficacy, anxiety and attitude, but these were dropped from the model after the first iteration.[30] However, we can argue that there are differences between adopting job-related IT in an organisation and adopting e-government.

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23 For example Aranyossy, 'Citizen adoption of e-government services: Evidence from Hungary'; Aburumman and Szilágyi, 'Factors Affecting Acceptance of Government: Using Extended UTAUT2', or Voutinioti, 'Determinants of User Adoption of e-Government Services in Greece and the role of Citizen Service Centres'.

24 Yi-Shun Wang, 'The adoption of electronic tax filing systems: an empirical study', *Government Information Quarterly* 20, no 4 (2003), 333–352.

25 Ooh Kim Lean, Suhaiza Zailani, T Ramayah and Yudi Fernando, 'Factors influencing intention to use e-government services among citizens in Malaysia', *International Journal of Information Management* 29, no 6 (2009), 458–475.

26 Lemuria Carter and France Belanger, 'The utilization of e-government services: Citizen trust, innovation and acceptance factors', *Information Systems Journal* 15, no 1 (2005), 5–25.

27 Bomil Suh and Ingoo Han, 'The impact of customer trust and perception of security control on the acceptance of electronic commerce', *International Journal of Electronic Commerce* 7, no 3 (2003), 135–161.

28 Daniel Belanche, Luis V Casaló and Carlos Flavián, 'Integrating trust and personal values into the Technology Acceptance Model: The case of e-government services adoption', *Cuadernos de Economía y Dirección de la Empresa* 15, no 4 (2012), 192–204.

29 Lean et al., 'Factors influencing intention to use e-government services among citizens in Malaysia'.

30 Venkatesh et al., 'User Acceptance of Information Technology: Toward a Unified View'.
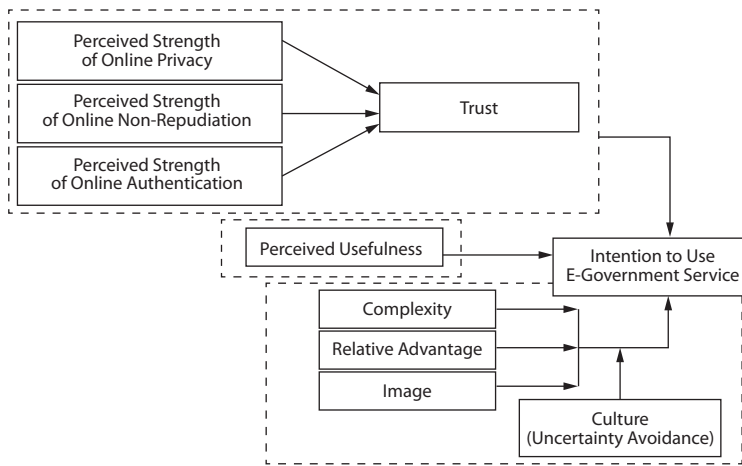
Figure 3 • *Theoretical framework used by Lean et al. (Source: Lean et al. 2009.)*

Seo and Bernsen were among the few who implemented the knowledge of public administration procedures as an enabling factor while they investigated the attitudes of non-users versus users toward e-government services in two locales. Starting from the original definition of self-efficacy, their hypothesis was that people prefer traditional, over-the-counter government services if they are unfamiliar with and insecure about certain procedures (because they do not understand the procedure, the terms used in the documents, and so on) as in that way they can gain support and guidance through the process. The basic knowledge about procedures can empower people to perform relevant tasks. Seo and Bernsen create the factor 'perceived necessary knowledge'[31] and define it as *'the knowledge one perceives to be required in understanding related terms and following a given procedure'.*[32] The construct is a determinant of 'perceived behavioural control' by Ajzen[33] and, as Seo and Bernsen put it, it is important to include factors beyond perceived usefulness and perceived ease of use, because a person is not without limitation (s)he forms an intention to act: limited capabilities, time or environmental resources can limit the freedom or ability to act (and the self-efficacy factor can be seen as being an antecedent of perceived behavioural control). The research conducted by Dimitrova and Chen among American internet users has shown a strong relationship with the experience and technical skills of internet use and the use of e-government, and also show that personal

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[31]   The construct of perceived necessary knowledge contained three items: 'I had (expect to have) the knowledge necessary to follow the procedures of municipality eServices', 'I had (expect to have) the knowledge to interact through municipality eServices', 'I had (expect to have) the knowledge necessary to understand the underlying procedures and mentioned terminology in the municipality eServices'.

[32]   DongBack Seo and Michel Bernsen, 'Comparing attitudes toward e-government of non-users versus users in a rural and urban municipality', *Government Information Quarterly* 33, no 2 (2016), 270–282.

[33]   Icek Ajzen, 'The theory of planned behaviour', *Organizational Behavior and Human Decision Processes* 50, no 2 (1991), 179–211.

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attitudes toward uncertainty affect adoption.[34] Familiarity with processes ('Prior interest in government', measured by earlier contacts with government officials in the past) was also a significant factor. This leads us to the knowledge gap theory which can contribute to formulating a more precise model of e-government service adoption.

3. KNOWLEDGE GAP THEORY – IS IT VALID FOR KNOWLEDGE ABOUT PUBLIC ADMINISTRATION ISSUES?

The core statement of the knowledge gap theory is that there is a discrepancy in people's level of knowledge about issues (or as Wexler has recently stated, knowledge about the world[35]), which varies according to their socioeconomic status (SES) and it is caused by the different ways of engagement with mass media content. The theory was formulated in the early 1970s by Tichenor, Donohue and Olien: 'As the infusion of mass media information into a social system increases, higher socioeconomic status segments tend to acquire this information faster than lower socioeconomic-status population segments so that the gap in knowledge between the two tends to increase rather than decrease.' The theory also gave five reasons why the knowledge gap exists: 1. communication skills (more education improves reading and memory skills); 2. stored information/prior, already existing knowledge; 3. relevant social contact (higher status people have more diverse social connections); 4. personal media reference (lower status people may be looking for less domains in the media); 5. resource structure (certain sources are targeted for their specific audiences).[36] Natalia Wrexler's latest book ("The Knowledge Gap"[37]) is somehow rebuilding the concept, examining the root causes behind it, through the example of the education system in the USA.

Two narrative reviews of knowledge gap-related literature, Gaziano[38] and a meta-analysis of 46 knowledge gap studies,[39] proves the existence of a knowledge gap. The analysis carried out by Hwang and Jeong also shows that the magnitude of this SES-knowledge relationship varies across different studies ranging from relatively weak to relatively strong, and moderated by the topic of knowledge. The review found that in case of the knowledge of social-political issues, the knowledge gap is wider in comparison to other topics (for

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34   Daniela V Dimitrova and Yu-Che Chen, 'Profiling the Adopters of E-Government Information and Services: The Influence of Psychological Characteristics, Civic Mindedness, and Information Channels', *Social Science Computer Review* 24, no 2 (2006), 172–188.

35   Natalie Wexler, *The Knowledge Gap* (New York: Avery, 2019).

36   Phillip J Tichenor, George A Donohue and Clarice N Olien, 'Mass media flow and differential growth in knowledge', *Public Opinion Quarterly* 34, no 2 (1970), 159–170.

37   Wexler, *The Knowledge Gap.*

38   Cecilie Gaziano, 'The knowledge gap: An analytical review of media effects', *Communication Research* 10, no 4 (1983), 447–486; Cecilie Gaziano, 'Forecast 2000: Widening knowledge gaps', *Journalism & Mass Communication Quarterly* 74, no 2 (1997), 237–264.

39   Yoori Hwang and Se-Hoon Jeong, 'Revisiting the knowledge gap hypothesis: A meta-analysis of thirty-five years of research', *Journalism & Mass Communication Quarterly* 86, no 3 (2009), 513–532.

example, health and science knowledge). Social-political issues are not the same as public administration issues, but it can be stated that the latter may also be counted under the domains that are more difficult to grasp and therefore where the knowledge gap may be more obvious.

Bonfadelli examined the knowledge gap theory in the internet era and found that the internet may have a direct or indirect impact on every member of society as a whole, but those with a higher status also use it more quickly and efficiently, and states that the knowledge gaps in digital media use may be more extreme than gaps in the uses of traditional mass media.[40] It can also be observed in the so-called 'second-level digital divides', which refers to the gaps in usage skills that can persist after the divides of physical internet access have been overcome.[41] Hargittai and Hsieh state that digital inequality can refer both to how existing social inequalities can affect the adoption and use of digital technologies, but also how differential uses of the Internet can influence social stratification.[42] While Hwang and Jeong found that there were no significant differences in the magnitude of the knowledge gap between the two time points in classical knowledge gap studies, this may change with the proliferation of interactive, digital media.[43]

As demonstrated in the literature above, the examination of knowledge gaps in e-government service adoption can contribute to the comprehensive understanding of the phenomenon, and offers a wider context and provides the opportunity to fine-tune e-government adoption models. In order to do so, it is important to make the case that a knowledge gap exists among the public with regards to public administration knowledge.

4. METHODOLOGY

The empirical basis of the research is the Good State Public Administration Opinion Survey (GSPAOS), which was carried out in Hungary in the middle of 2017 by Szociometrum Social Science Research. The survey questions were tested on a representative sample of the adult (age 18+) Hungarian population. The sampling method was multistage, proportionally stratified probability sampling, while the database was also corrected ex post with matrix weighting procedure in respect to age, gender, region, settlement type and education. The survey contained 70 questions, some with many sub-questions, to explore many aspects of public opinion on public administration including the digitalisation of different procedures. Among others, the survey provided the opportunity to use a large (n = 2506)

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[40] Heinz Bonfadelli, 'The Internet and Knowledge Gaps: A Theoretical and Empirical Investigation', *European Journal of Communication* 17, no 1 (2002), 65–84.

[41] Eszter Hargittai, 'Second-level digital divide: differences in people's online skills', *First Monday* 7, no 4 (2002).

[42] Eszter Hargittai and Yuli P Hsieh, 'Digital Inequality', in *The Oxford Handbook of Internet Studies,* ed. by William H Dutton (Oxford: Oxford University Press, 2013), 129–150.

[43] Hwang and Jeong, 'Revisiting the knowledge gap hypothesis: A meta-analysis of thirty-five years of research'.

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representative database, with data about citizens' usage and experience of different areas of e-government services, their channel preferences and the obstacles they face while dealing with public administration procedures.

During the construction of the questionnaire for the survey (as the first of its kind), there was no intention to build or test any adoption models; however, many constructs that were presented earlier in the literature section of this paper can be examined. For this paper, three main constructs were built using the items from the questionnaire: trust in the internet (using questions relating to the intention of giving personal/financial data on the internet), the difficulty of dealing with public administration (containing items relating to perceived difficulties with communicating and with filling out forms, which can also be treated as subscales) and intensity and variety of internet use. As Hwang and Jeong put it, the measurement of knowledge (belief-type, awareness-type, factual-type) was also found to be a significant moderator of the knowledge gap in various studies.[44] The difficulty of dealing with public administration constructs is based on perceived capabilities and therefore, of a less factual-type. In that way the results may show a narrower gap. The original questions/items and the reliability of the scales (Cronbach's Alpha) are included in Table 1. The questions were measured on a Likert scale and were used for factor analysis to calculate the constructs (as they can be viewed as an interval scale[45]).

Table 1 • *The questions/items and answer options used for the constructs of this study (Source: Good State Public Administration Opinion Survey 2017.)*

Trust in the Internet, privacy (Cronbach's Alpha: 0.849)	Answer option
I never give my bank account data while shopping online.	1 – perfectly true …. 4 – not true at all
I do not register on online platforms unless I have to.	1 – perfectly true …. 4 – not true at all
I am averse to giving my personal information on the Internet.	1 – perfectly true …. 4 – not true at all
There are some personal data of mine that I would not give even while registering on state organisations' websites.	1 – perfectly true …. 4 – not true at all
Difficulty of dealing with public administration (Cronbach's Alpha: 0.918)	
Official communication (Cronbach's Alpha: 0.895)	
How difficult is for you when conducting a formal/official telephone conversation?	1 – I am unable to do it …. 4 – I am easily capable of doing it
How difficult is for you to write an official letter?	1 – I am unable to do it …. 4 – I am easily capable of doing it
How difficult is for you to articulate your case in person with customer services?	1 – I am unable to do it …. 4 – I am easily capable of doing it

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44   Hwang and Jeong, 'Revisiting the knowledge gap hypothesis: A meta-analysis of thirty-five years of research'.
45   James Carifio and Rocco J Perla, 'Ten common misunderstandings, misconceptions, persistent myths and urban legends about Likert scales and Likert response formats and their antidotes', *Journal of Social Sciences* 3, no 3 (2007), 106–116.

How difficult is for you to prepare a power of attorney?	1 – I am unable to do it …. 4 – I am easily capable of doing it
How difficult is it for you to commission a lawyer?	1 – I am unable to do it …. 4 – I am easily capable of doing it
Filling out forms (Cronbach's Alpha: 0.889)	
It is characteristic of me that I have difficulties in filling out official forms.	1 – perfectly true …. 4 – not true at all
It is characteristic of me that I have difficulties in understanding official forms.	1 – perfectly true …. 4 – not true at all
It is characteristic of me that I have difficulties in filling out the necessary data in official forms.	1 – perfectly true …. 4 – not true at all
It is characteristic of me that I have difficulties if I have to justify the data filled in official forms.	1 – perfectly true …. 4 – not true at all
It is characteristic of me that I usually ask for help in filling out official forms.	1 – perfectly true …. 4 – not true at all
Intensity and variety of internet use (Cronbach's Alpha: 0.802)	
How often do you carry out the following activities?	
searching online	1 – never …. 4 – almost every day
reading news online	1 – never …. 4 – almost every day
e-mail	1 – never …. 4 – almost every day
online messaging	1 – never …. 4 – almost every day
using social media sites	1 – never …. 4 – almost every day
VOIP	1 – never …. 4 – almost every day
learning activities online	1 – never …. 4 – almost every day
shopping online	1 – never …. 4 – almost every day
selling online	1 – never …. 4 – almost every day
online banking	1 – never …. 4 – almost every day
managing public utilities	1 – never …. 4 – almost every day

5. RESULTS – WHERE IS THE KNOWLEDGE GAP?

Our hypothesis is that the existence of the knowledge gap can be observed not only in the usage patterns of the internet, but also in the perceived capability to deal with public administration procedures (as a construct for examining public administration-related knowledge). Both constructs were calculated in two ways in order to give a deeper understanding: for public administration knowledge, two subscales were also created (communicating with public administration, managing official forms), and the variety and intensity of internet use were further divided into basic, communicational and transactional factors (these distinctions can also be seen in Table 1, with different background colour). To prove the existence of the knowledge gap, we examined our constructs against education, as the main predictor of socioeconomic status (Figure 4 and 5).

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The literature dealing with the secondary digital divide states that education significantly affects internet usage habits, and this finding can be clearly seen in the results (Figure 4). There are huge discrepancies between people who have or have not at least completed secondary level education (among all internet users in the sample), and people with higher education can make the most out of the internet.
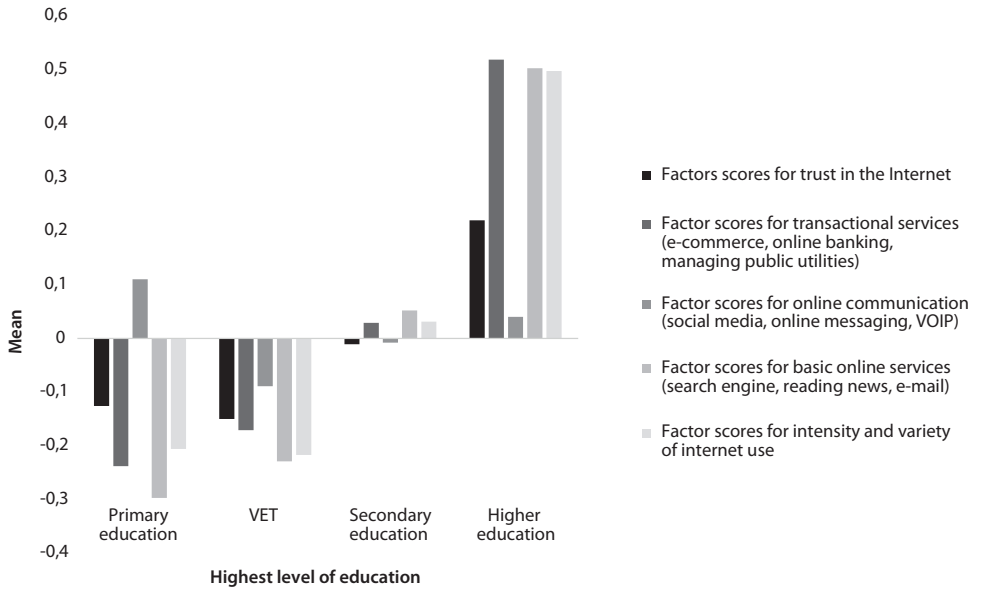
Figure 4 • *Trust in the internet and the intensity and variety of internet use (in three categories and summarised) between educational groups, N = 1651 (Source: Good State Public Administration Opinion Survey 2017.)*

One important and unexpected thing is that people with only a primary education use social sites and other forms of online communication rather actively (while not pursuing any other activities on the internet frequently). It may provide an opportunity to target customer service to a customer base that is hard to achieve with digital means of communication. Trust in the internet is showing the same patterns and moving together with the variety and intensity of internet use (this is partially caused by experience with transactional services in general). It shows that computer self-efficacy, a major factor in almost every e-government adoption model, is also deeply rooted in socioeconomic factors.

This finding is also in line with the models which incorporate education as a moderating factor, strongly mediating information technology-related usage – but this is also true in terms of public administration knowledge/capabilities. The only difference is that a smoother, cascading transition can be observed (Figure 5) between the educational group. The more educated someone is, the less difficulties (s)he has while communicating with public administration or managing/filling out forms (there is no major distinction

between communication and transactions, if somebody finds discomfort in dealing with public administration, it is mainly about the whole experience). Therefore, people who are less educated require more aid in dealing with their public service-related issues, as they find filling out forms and communicating with officials much more difficult. We can state that the knowledge gap clearly (and significantly) exists with regard to public administration-related knowledge.
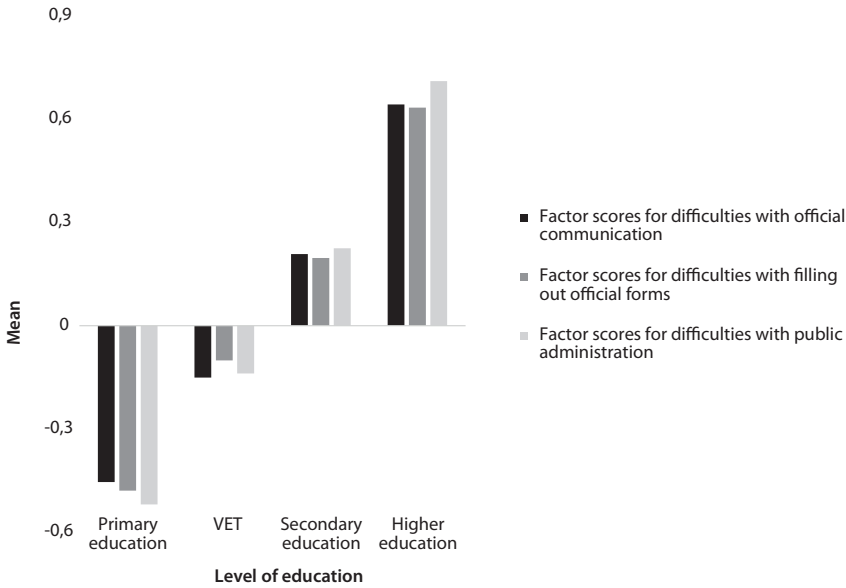
Figure 5 • *The difficulties with public administration (communication, managing forms and summarised) between educational groups, N = 2380 (Source: Good State Public Administration Opinion Survey 2017.)*

According to questions (which were selected from items in the questionnaire covering channel-preferences with comparing the different options in pairs, and also the avoidance of certain channels, for example, online, person, post, telephone) on people's channel preferences (Table 2) we can state that 60 per cent of the regular internet user respondents said that they try to avoid e-government services if possible, and 74 per cent of them said that they prefer personal contact to the internet. There are many factors that can contribute to these preferences (the heavy development of one-stop-shop Governmental Windows, the quality and quantity of currently available e-government services, and so on), but we can argue that the knowledge gap also plays a significant role.

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Table 2 • *Channel preferences of internet users in the sample (Source: Good State Public Administration Opinion Survey 2017.)*

	I try to avoid using online governmental services if possible (N = 1667)	I would rather contact public administration in person than on the Internet (N = 1660)
Entirely true	36%	52%
Mainly true	24%	22%
Mainly not true	20%	16%
Not true at all	19%	10%

As the intensity and variety of internet usage and difficulties with public administration case handling are also highly correlating factors, we could state that on the one hand, one is predicting the other (meaning that e-government is the assumed first choice only for an intensely internet-using fragment of the population with wider knowledge about public administration) and on the other hand, e-government services – in order to gain more attention and usage – need to be not only easy-to-use, but have to provide guidance and hide potential complexity from the user (Figure 5).
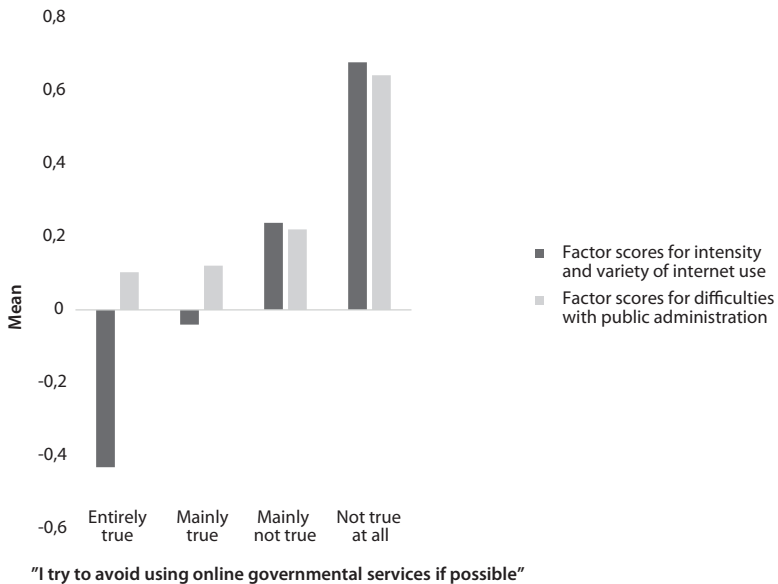
Figure 6 • *The avoidance of e-government services and factor scores of internet use and PA knowledge, N = 1603 (Source: Good State Public Administration Opinion Survey 2017.)*

6. DISCUSSION – WHAT THE KNOWLEDGE GAP CAN SAY ABOUT E-GOVERNMENT ACCEPTANCE MODELS

Based on the results of the GSPAOS, it can be concluded that the knowledge gap manifests itself in the citizens' perceived ability to deal with public administration. It highlights that e-government adoption is not only about adopting new technology, but also about dealing with unfamiliar procedures, lack of self-efficacy, and possibly discomfort and anxiety. One of the main characteristics of public administration procedures is their mandatory nature, which can be associated with no tolerance of mistakes (so that a mistake can have significant consequences for the client), thus uncertainty has to be avoided. Facilitating conditions (support to the use of a system) is included in most e-government adoption models (usually in a simplified manner), and they are regarded as a positive influence on e-government adoption, but in some cases it may also result in the opposite: if someone has to ask for support and if support is available, it is much easier (and in the absence of procedural knowledge can also be perceived much more safe) to ask for help to do the transaction rather than asking for help to deal with the online service (particularly in situations where a network of physical customer service centres are available, for example, the Governmental Windows in Hungary).

Earlier experience (and habit) is an important part of the models in almost all cases, but, in most studies, this construct is defined as experience with technology, and, in some research, this construct is rephrased as experience with the internet/computers explicitly. In some rare instances in the literature review, familiarity with procedures, or perceived necessary knowledge, can also serve as a moderator in the adoption process. One of the main results of the GSPAOS survey was that one third of the respondents (32.5 per cent) had not been involved in any public administration procedure and people have only dealt with 1.3 cases on average in the last three years before the survey. This demonstrates the fact that e-government services can hardly be 'killer applications' because of their rarity. For many citizens, the regular experience (or routine) with public administration is lacking, and it may also be reflected in different effort expectancy and compatibility constructs, especially if they are phrased in the questionnaires in a way that can mean both technology-related efforts or understandings related to the case. The GAM model partially and implicitly contains this aspect in the perceived information quality construct (information at the website is up-to-date, relevant and easy to understand). Another potential factor in this aspect can be the difference between the online services of public administration and other businesses. They can differ in logic or, as some research concluded,[46] not live up to the

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[46] Forrest V Morgeson and Sunil Mithas, 'Does E-Government Measure Up to E-Business? Comparing End User Perceptions of U.S. Federal Government and E-Business Web Sites', *Public Administration Review* 69, no 4 (2009), 740–752; Patrice M Mareschal and Joel P Rudin, 'E-Government Versus E-Business: A Comparison of Online Recruitment in the Public and Private Sectors', *The American Review of Public Administration* 41, no 4 (2011), 453–467.

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state-of-art, as governmental websites tended to be less user-friendly and informative than their private-sector counterparts.

The GAM model concluded that e-government adoption behaviour also changes based on service maturity levels, and as service maturity usually implies growing complexity as well, it may mean that using one general model to describe the e-government adoption factors can result in overly general findings, not detailed enough to justify actions and decisions in order to boost take up of the services. For example, if a case needs authentication or digitally signed documents (where adopting digital signature or any other specific technology might also be needed), then the technological, economic, personal and social perspectives might be notably different. Models ought to be tailored and fine-tuned for a set of services that are comparable in complexity.

Education (as a moderator) has been added to many UTAUT-based or other e-government adoption models, but it could (and because of the strong relationship that proved in many researches and also in GSPAOS data it does) moderate not only the effect of the IT system/website-related factors, but impact perceived necessary procedural knowledge also, which can change the dynamics among different factors. Age is another widely used moderator in different models, based on the assumption that elderly individuals encounter greater problems when coping with IT systems, but there is, however, a second trend that can be seen from GSPAOS data that is somewhat counterintuitive: middle-aged people (those between the ages 40 and 50) have the most cases with public administration, generating more experience (and possibly insight) with the procedures, which can potentially boost their intention (or self-efficacy and perceived behavioural control) to rely on digital services (or at least reduce their anxiety). The impact may be relatively minor on the model level, but this kind of information can help to identify smaller groups of citizens that may be easier to involve (with the help of small incentives or behavioural insights).

As earlier noted, in order to boost e-government adoption, services need to not just be easy to use or 'state-of-the-art', but hide the potential complexity of the procedures from the user, too (current automation trends provide solutions in case of procedures that can be fully automated). Also, the quality of information services into the models may make a contribution to capture this aspect. Berlilana and Hariguna merged the UTAUT framework with the ISQ model (which is aimed at determining the quality of an information system in order to provide the anticipated results required by the user), and they stated that to achieve e-government that has good qualities, it requires usability and credibility[47] – in other words, it has to be able to persuade users that they can avoid any unintended consequence in the future.

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[47]   Berlilana, Taqwa Hariguna and Nurfaizah, 'Understanding of Public Behavioral Intent to Use e-Government Service: An Extended of Unified Theory of Acceptance Use of Technology and Information System Quality', *Procedia Computer Science* 124 (2017), 585–592.

7. CONCLUSIONS

In these times, when a significant amount of public funding is used to develop e-government services (sometimes in parallel with customer service offices and physical one-stop-shops), to understand how the knowledge gap (and other factors) affects e-government adoption or channel preferences, it is essential to optimally use resources. Using the representative database from the Good State Public Administration Opinion Survey, the paper showed that a wide knowledge gap exists among Hungarian citizens in terms of public administration-related knowledge and consequently how they can deal with procedures relating to official forms and in communicating their cases. These gaps (together with the discrepancies in internet use) significantly influence the choice of channel for managing administrative issues. In current e-government adoption models, the necessary knowledge about the phenomenon of public administration procedures is marginally incorporated, but this paper argues that it can have a significant effect on adoption, or alter the constructs in these models.

In knowledge gap research, seeing only a given point of time and one issue is only sufficient to say that the gap does or does not exist. Further research is needed in order to compare the knowledge gap over time (widening, stagnating or shrinking) and also to examine not e-government as a whole but rather different cases or groups of cases as they have different publicity and media coverage (for example, the introduction of the widely advertised, proactive Electronic Personal Income Tax Return service in Hungary), and also ought to be tailored and for a set of services that are comparable in complexity. All in all, the knowledge about public administration procedures is an important contributor of e-government adoption and can be used to examine the channel preferences of people that could help to optimise resources in public administration.

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