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The ICT Adoption in Government Units in the Context of the Sustainable Information Society

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***Abstract*— This study aims to advance information society research and practice by examining and understanding the information and communication technologies (ICT) adoption in government units in the context of the sustainable information society (SIS). A quantitative approach was employed to identify the levels of ICT adoption and sustainability in government units as well as investigate the correlation between the ICT adoption and sustainability. The survey questionnaires were used and data collected from Polish government units were analyzed. The research findings reveal that there are significant statistical differences between the lowest level of information culture and the highest one, namely the levels of ICT management and ICT outlay. Moreover, such differences are also identified between the lowest level of ecological sustainability and higher levels of economic, socio-cultural, and political sustainability. Finally, it is investigated that the ICT quality and information culture have a significant impact on sustainability in government units, whereas the ICT outlay and ICT management do not have such an impact.**

I. Introduction

The sustainable information society (SIS) is a new phase of information society development in which information and communication technologies (ICT) are becoming key enablers of sustainability [1]-[10]. Some areas, where the information society, sustainable development, and ICT come together, are identified and described in many studies [11-17]. All in all, the SIS is a multidimensional concept comprising environmental, economic, cultural, social, and political issues. Society stakeholders, mainly within government units, households, and public administration, could strongly affect the above issues by adopting ICT [10].

In general terms, ICT potential can be approached from two angles: ICT as an industry and ICT as a tool, and viewed as an inherent aspect for the SIS development [10]. As an industry, ICT have become a major economic driver in the hardware, software, telecommunications, and consulting services sectors. ICT as a tool can be used to transform and improve business, everyday life of people, and public governance.

ICT used as a tool to revolutionize public administration is examined in this study. Some researchers identified ICT as one of the most important tools in building sustainable government practices. ICT are expected to have a significant impact on enhancing public information and service provided for all SIS stakeholders and improving the liability and functioning of the government units [18], as well as the transparency and responsiveness of government units [19]. It is contended that ICT enable government units to improve productivity, support innovation, reduce costs, increase the effectiveness of services, and enhance the efficiency of government decision-making [7], [14], [17], [20]. Moreover, the ICT adoption in government units can yield benefits in environmental preservation by increasing energy efficiency and equipment utilization [4] as well as it can influence social development by making information and services available to all stakeholders at a faster rate [7]. All these possibilities make ICT enablers of sustainability in several respects, i.e. environmental protection (ecological sustainability), economic growth (economic sustainability), socio-cultural development (socio-cultural sustainability), and governance (political sustainability) [7], [10].

Ziemba [21], [22], [23] merely proposed a SIS model composed of the ICT adoption and sustainability, and evaluated the contribution of ICT adoption to sustainability in Polish enterprises. Following an extensive review of the literature, it can be stated that it did not uncover any deep studies identifying levels of ICT adoption and sustainability in government units nor there were any findings that interpret how the ICT adoption in government units improves sustainability. Moreover, there is a lack of research on the SIS and correlations between the ICT adoption and sustainability in less developed European countries, which are called transition economies, i.e. the former Eastern Bloc countries, which, since the early 1990s, have been undergoing transition from the command economy model to the free market model [24].

Thus, the motivation for the research is to address this under-investigated topic. The focus of this research is therefore to explore the ICT adoption and sustainability in government units. Its purposes are to identify the levels of ICT adoption and sustainability in government units, and to investigate the impact of ICT adoption on improving sustainability.

The paper is organized as follows. The next section reviews the theoretical foundation for this work and poses research questions. Subsequently, the employed research methods are discussed. The later sections describe the research findings and conclusions.

II. Theoretical Background And Research Question

A. ICT adoption

ICT are defined as a diverse set of software and hardware, to perform together various functions of information creation, storing, processing, preservation and delivery, in a growing diversity of ways [25]. They cover computers, the Internet, and mobile technologies, and mainly applications that can be used to support government units' performance and their relations with the SIS stakeholders. Based on Ross's & Vitale's study [26], the adoption of ICT is defined as ICT design, implementation, stabilization, and continuous improvement. It embraces the whole spectrum of activities from the period when government units justify the need for adopting ICT until the period when government units experience the full potential of ICT and derive benefits from them.

Based on a stream of research, Ziemba [27] advanced a model of SIS in which the ICT adoption construct is composed of four sub-constructs: ICT outlay (Out), information culture (Cul), ICT management (Man), and ICT quality (Qua). A detailed analysis allows for specifying primary variables which can be used to measure identified sub-constructs and the ICT adoption as a whole. These variables are presented in Table 1. The sub-construct of ICT outlay includes the government units' financial capabilities and expenditure on the ICT adoption, as well as funding from the European funds. The information culture sub-construct embraces digital and socio-cultural competences of government units' employees and managers, constant improvement of these competences, personal mastery and creativity of employees, and incentive systems encouraging employees to adopt ICT. The ICT management sub-construct comprises the alignment between information society strategy and ICT adoption, top management support for ICT projects, as well as the adoption of newest management concepts and standard ICT solutions developed at the national level. It also includes the implementation of legal regulations associated with the ICT adoption, regulations on ICT and information security and protection. The ICT quality sub-construct consists of the quality, interoperability, and security of back- and front-office information systems, quality of hardware, maturity of e-public services, and the adoption of electronic document management system, electronic delivery box, as well as ERP and BI systems. The construct asserted that the four sub-constructs were interrelated and critical to the design of the ICT adoption in government units in the context of the SIS.

B. Sustainability

The definition of sustainable development employed throughout this paper relates to a development in which the

Table I.
Primary variables of ICT adoption and sustainability constructs

Primary variables of the ICT adoption construct				Primary variables of the sustainability construct	
Out1	Financial capabilities	**Man18**	Management concepts adoption	**Ecl1**	Sustainability in ICT
Out2	Expenditure on ICT	**Man19**	Information security regulations	**Ecl2**	Sustainability by ICT
Out3	Funding acquired from the European funds	**Man20**	ICT regulations	**Eco3**	Reducing cost
Cul4	Managers' ICT competences	**Man21**	ICT public project	**Eco4**	Developing and increasing in the number and maturity of e-public services
Cul5	Employees' ICT competences	**Man22**	Adoption of standard ICT solutions developed at the national level	**Eco5**	Increasing effective and efficient management and decision-making
Cul6	Managers' permanent education	**Man23**	Competitive ICT market	**Eco6**	Increasing efficiency and effectiveness of customer service
Cul7	Employees' permanent education	**Qua24**	ICT infrastructure quality	**Eco7**	Increasing transparency of operations and employee responsibility
Cul8	Employees' personal mastery	**Qua25**	Back-office system quality	**Eco8**	Increasing efficiency and effectiveness of work organization
Cul9	Managers' socio-cultural competences	**Qua26**	Front-office system quality	**Eco9**	Increasing satisfaction with public services
Cul10	Employees' socio-cultural competences	**Qua27**	Interoperability of back- and front-office system	**Soc10**	Improving competences
Cul11	Employees' creativity	**Qua28**	Back-office system security	**Soc11**	Improving working environment
Cul12	Incentive systems	**Qua29**	Front-office system security	**Soc12**	Increasing safety of society members
Man13	Alignment between information society strategy and ICT adoption	**Qua30**	E-public service maturity	**Soc13**	Reducing social exclusion
Man14	Supporting management models with ICT	**Qua31**	ERP system adoption	**Pol14**	Increasing e-democracy
Man15	ICT management procedure	**Qua32**	EDMS (electronic document management system) adoption	**Pol15**	Increasing and facilitating access to public services
Man16	ICT project team	**Qua33**	Adoption of an electronic delivery box	---	---
Man17	Top management support	**Qua34**	BI (business intelligence) system adoption	---	---

Source: own elaboration.

needs of present generations are met without compromising the chances of future generations to meet their own needs [28]. According to Schauer [7], sustainable development has four dimensions which are ecological, social, economic, and cultural sustainability. Fuchs's [29] conceptualization of sustainability in the information society resonates with the Schauer's approach. He examined five dimensions of sustainability, i.e. ecological sustainability (enhancement of the natural environment), technological sustainability (usability of technologies), economic sustainability (wealth for all), political sustainability (participation), and cultural sustainability (wisdom). It is therefore expected that sustainability within government units comprises four kinds of sustainability: ecological, economic, socio-culture, and political. Such an approach was verified and confirmed by Ziemba [27].

Regarding government units, the ecological sustainability (Ecl) is the ability of government units to maintain rates of renewable resource harvest, pollution creation, and non-renewable resource depletion by means of conservation and proper use of air, water, and land resources [30], [31]. Economic sustainability (Eco) means that the government units gain competitive edge, reduce costs, organize work in a better and more efficient way, increase the number and maturity of public services delivered electronically, and boost government shareholders' value by adopting sustainable practices and improved public decision-making [14], [15], [31]. Socio-cultural sustainability (Soc) is based on the socio-cultural aspects that need to be sustained, e.g. trust, common meaning, diversity, capacity for learning and capacity for self-organization [28]. It is seen as dependent on social networks, making community contributions, creating a sense of place and offering community stability and security [32]. Political sustainability (Pol) rests on the basic values of democracy and partnership relations between government units and other SIS stakeholders. It is related to government openness, transparency and responsiveness, as well as democratic public decision-making [32], [33], [34]. Table 1 presents the description of all specified sustainability sub-constructs and variables measuring them.

C. The impact of ICT adoption on sustainability

Some studies show that ICT adoption affects sustainability. Schauer [7] stated that ICT contribute to ecological, social, cultural, and economic sustainability. Hilty and others [35] asserted that ICT can facilitate sustainability by creating the kind of economic activity that harmonizes nature with human and social welfare in the long term. Johnston [36] referred to the ICT impact on sustainability, pointing out to the need for greater investment in more effective public services and public administration as well as more active promotion of 'eco-efficient' technologies and their use.

In general, ICT for ecological sustainability comprises sustainability in ICT and sustainability by ICT [4]. Sustainability in ICT is related to greater sustainability of ICT goods and services over their whole life cycle, which is achieved by limiting energy and material flows connected with them. Then, sustainability by ICT manifests itself by creating, enabling, and encouraging sustainable patterns of production and consumption by means of ICT. ICT are crucial driving force in achieving durable, harmonious and flexible economic benefits in government units [31], [37]. The adoption of ICT can improve their efficiency and effectiveness. ICT are bound to play an increasingly prominent role in enabling socio-cultural sustainability, e.g. they can increase employment, facilitate learning and work, promote culture, reduce social exclusion [38]. ICT are used to deliver public services electronically to SIS stakeholders [38], [39]. The work by Grunwald [40] pointed out that ICT can play an important role in supporting cooperation, networking and partnership relations between government units and households. Furthermore, ICT can also allow for strengthening democracy by their adoption for improving political transparency and citizen's participation in democratic decision-making [39].

D. Research questions

Motivated by these above concerns, the SIS is a multidimensional concept encompassing two constructs: the ICT adoption and sustainability, as well as correlations between them. The sustainability construct composed of ecological, economic, socio-cultural, and political sustainability can be strongly influenced by the ICT adoption that encompasses ICT outlay, information culture, ICT management, and ICT quality.

In other study Ziemba [41] assessed the quality of the two constructs by examining the construct reliability [42], convergent and discriminant validity [43], [44]. The following measures were calculated: the loadings of each item of each component, composite reliability (CR) of all sub-constructs, average variance extracted (AVE) of all sub-constructs, Cronabch's Alpha of all sub-constructs**,** correlations between the sub-constructs, the square root of AVE for each component. Overall, the results successfully established the reliability, convergent validity, and discriminant validity of the proposed constructs and their sub-constructs [41].

The present study focuses on addressing the following research question:

RQ1: What is the level of ICT adoption in Polish government units?

RQ2: What is the level of sustainability in Polish government units?

RQ3: Does the ICT adoption influence sustainability in Polish government units?

III. Research Methodology

A. Research instrument

The Likert-type instrument (a questionnaire) was developed. The task of respondents was to assess the primary variables describing:

- The four sub-constructs of the ICT adoption construct, i.e. the ICT outlay (Out), information culture (Cul), ICT management (Man), and ICT quality (Qua) (Table 1). The respondents answered the question: *Using a scale of 1 to 5, state to what extent do you agree that the following situations and phenomena result in the efficient and effective ICT adoption in your government unit?* The scale's descriptions were: 5 – strongly agree, 4 – rather agree, 3 – neither agree nor disagree, 2 – rather disagree, 1 – strongly disagree; and
- The four sub-constructs of the sustainability construct, i.e. ecological (Ecl), economic (Eco), socio-cultural (Soc), and political sustainability (Pol) (Table 1). The respondents answered the question: *Using a scale of 1 to 5, evaluate the following benefits for your government units resulting from the efficient and effective ICT adoption?* The scale's descriptions were: 5 – strongly large, 4 – rather large, 3 – neither large nor disagree, 2 – rather small, 1 – strongly small.

B. Research subjects and procedures

In April 2016, the pilot study was conducted to verify the draft of survey questionnaire. Seven experts participated in the pilot study, i.e. five researchers from an information society and business informatics, and two employees of the Silesian Centre of Information Society in Katowice (ŚCSI). ŚCSI is a government unit that is responsible for information society development in the Silesian Province in Poland. Finishing touches were put into the questionnaire, especially of a formal and technical nature. No substantive amendments were required.

The study examined government units from the Silesian Province in Poland. The region was chosen due to its continuous and creative transformations related to restructuring and reducing the role of heavy industry in the development of research and science, supporting innovation, using *know-how* and transferring new technologies, as well as increasing importance of services. In response to the changing socio-economic and technological environment intensive work on the development of the information society has been carried out in the region for several years. In the next development strategies of the information society it was and is assumed that the potential of the region, especially in the design, provision and use of advanced information and communication technologies will be increased [ŚCSI]. All this means that the results of this research can be reflected in innovative efforts to build a SIS in the region and, at the same time, constitute *a modus operandi* for other regions throughout the country and in other countries.

Selecting a sample is a fundamental element of a positivistic study [45]. A random sample was used for statistical consideration to provide representative data. A survey questionnaire was submitted to all 185 government units in the Silesian Province.

The subjects were advised that their participation in completing the survey was voluntary. At the same time, they were assured anonymity and guaranteed that their responses would be kept confidential.

C. Data collection

Having applied the Computer Assisted Web Interview and employed the ŚCSI platform, the survey questionnaire was uploaded to the website. The data were collected between 30 May 2016 and 15 July 2016. After screening the responses and excluding outliers, there was a final sample of 118 usable, correct, and complete responses. It means that 64% of all government units from the Silesian Province completed their responses fairly, in all respects. The sample ensured that the error margin for the 95% confidence interval was 5%.

Table 2 provides details about government units' size, and their participation in SKEAP project. This project was carried out by the municipal and district authorities of the Silesian Province in 2005-2008. The project's result was the Electronic Communication System for Public Administration called SEKAP [46]. It enables government units to provide e-public services at different levels of maturity to all society stakeholders. It could be presumed that these government units which participated in SEKAP more skillfully entered into the ICT adoption than those which did not.

TABLE II.
ANALYSIS OF GOVERNMENT UNITS' PROFILES (N=118)

Characteristics	Frequency	Percentage
Number of employees		
less than 50 (small)	51	43.22%
50 and above (large)	67	56.78%
SEKAP partner		
yes	91	77.12%
no	27	22.88%

Source: own elaboration.

D. Data analysis

The data were stored in Microsoft Excel format and subsequently analyzed using Statistica package and Microsoft Excel in two stages. The first stage assessed the levels of the ICT adoption and sustainability, and the second

stage examined the significance of construct correlations and provided regression analysis.

In the first stage, the descriptive statistical analysis was employed to describe the levels of the ICT adoption and sustainability in government units. The following statistics were calculated: mean, median (MDN), first quartile (Q25), third quartile (Q75), mode, variance (VAR), standard deviation (SD), coefficient of variation (CV), skewness (SK), and coefficient of kurtosis (CK). Further, the analysis of variance (Anova Kruskala-Wallisa) was used to determine if there were statistically significant differences between distributions of scores for the ICT adoption and sustainability sub-constructs. Additionally, the Pearson Chi-square test of independence was employed to determine whether there is an association between the sub-constructs of ICT adoption/sustainability, and the size/the SEKAP participation of government units (i.e. whether the sub-constructs and the size are independent or related as well as the sub-constructs and the participation of government units are independent or related).

In the second stage, the correlation and regression analysis [47] were used to estimate the correlations between a dependent variable (sustainability and its various kinds) and one or more independent variables (ICT outlay, information culture, ICT management, and ICT quality). The coefficient of determination, denoted R^2 and advanced R^2, determines the productiveness of the proposed theoretical model. Falk and Miller [47] recommended that R^2 values should be equal to or greater than 0.10 in order to be deemed adequate for the variance explained of a particular endogenous sub-construct.

IV. Research Findings

A. The level of ICT adoption in government units

In order to answer the research question *RQ1: What is the level of ICT adoption in Polish government units?*, a detailed descriptive analysis was conducted. The results are presented in Table 3.

It has been found that the average levels of ICT adoption sub-constructs ranged from 3.29 to 3.62 (on a 5-point scale from 1.00 to 5.00). Median values were in the range between 3.22 and 3.67. On average, the level of ICT management was the highest, followed by the level of ICT outlay. The level of information culture was the lowest. The levels of the ICT adoption sub-constructs were above their average levels in most government units.

TABLE III.
THE LEVELS OF ICT ADOPTION AND SUSTAINABILITY IN GOVERNMENT UNITS

Sub-constructs	Mean	Q25	MDN	Q75	VAR	SD	CV in %	SK	CK
ICT adoption sub-constructs									
Out	3.50	3.00	3.67	4.00	0.68	0.82	23.50	-0.38	-0.20
Cul	3.29	2.89	3.22	3.89	0.41	0.64	19.46	-0.27	-0.33
Man	3.62	3.27	3.59	4.09	0.29	0.54	14.99	-0.35	0.09
Qua	3.45	3.09	3.55	3.82	0.25	0.50	14.38	-0.21	-0.59
Sustainability sub-constructs									
Ecl	2.83	2.50	3.00	3.00	0.63	0.79	27.98	0.06	0.91
Eco	3.13	2.71	3.14	3.57	0.46	0.68	21.70	-0.25	0.17
Soc	3.15	2.75	3.25	3.50	0.43	0.66	20.88	-0.64	0.70
Pol	3.19	3.00	3.00	4.00	0.60	0.77	24.21	0.06	-0.17

Source: own elaboration.

The values of h-Kruskala-Wallisa H(3, N=472)=17.861 and p=0.001) and Chi-square statistic (Chi-square=10.112, df=3, p=0.018), and finally *post-hoc* analysis confirmed significant differences between the distribution of scores for the information culture and the distributions of scores for the ICT management (p=0.000) and ICT outlay (p =0.024). In addition, the Pearson Chi-square test of independence (α=0.05) allowed for indicating that there were not statistically significant relations between the size of government units and the levels of ICT outlay, information culture, ICT management, and ICT quality. Such a relation was also not confirmed between the SEKAP participation of government units and the levels of all ICT adoption sub-constructs within them.

B. The level of sustainability in government units

In order to answer the research question *RQ2: What is the level of sustainability in Polish government units?*, a detailed descriptive analysis was conducted. The results are presented in Table 3.

It has been found that the average levels of sustainability sub-constructs ranged from 2.83 to 3.19 (on a 5-point scale from 1.00 to 5.00). Median values were in the range between 3.00 and 3.25. On average, the level of political sustainability was the highest, followed by socio-cultural sustainability. The level of ecological sustainability was the lowest. The levels of economic and socio-cultural sustainability were above their average levels in most government units, whereas the levels of ecological and political – below their average levels.

The values of h-Kruskala-Wallisa (H(3, N=472)=20.256, p=0.000) and (Chi-square=43.034, df=3, p=0.000), and finally *post-hoc* analysis confirmed significant differences between the distributions of scores for ecological sustainability and the distributions of scores for economic (p=0.003), socio-cultural (p=0.001, and political (p=0.002) sustainability. In addition, the Pearson Chi-square test of independence (α=0.05) allowed for indicating that there was statistically significant relation between socio-cultural sustainability and the size of government, as well the SEKAP participation of government units. The average level of socio-cultural sustainability was higher in small government units and in those government units which were not a SEKAP partner.

C. The contribution of ICT adoption to sustainability

Table 4 shows the results of the correlations between:

- the ICT adoption sub-constructs and the sub-constructs of sustainability; and
- the ICT adoption sub-constructs and the total sustainability construct (Y).

TABLE IV.
CORRELATIONS AMONG SUB-CONSTRUCTS OF ICT ADOPTION AND TOTAL SUSTAINABILITY AND ITS SUB-CONSTRUCTS

Sub-constructs	Ecl	Eco	Soc	Pol	Y
Out	0.055 p=0.553	0.146 p=0.115	0.192	0.064 p=0.494	0.154 p=0.960
Cul	0.174 p=0.059	0.416	0.467	0.338	0.446
Man	0.157 p=0.089	0.467	0.439	0.371	0.467
Qua	0.208	0.542	0.406	0.321	0.498

Source: own elaboration.

The correlation coefficients for the sub-constructs of ICT adoption and the sub-constructs of sustainability were significantly different from zero (p=0.000 < 0.05=α), with the exception of one correlation between the ICT outlay and ecological (p=0.553), economic (p=0.115), and political (p = 0.494) sustainability, between information culture and ecological sustainability (p=0.059), as well as between the ICT management and ecological sustainability (p=0.089). In other cases there was a positive linear correlation. In addition, the three sub-constructs of the ICT adoption construct, i.e. the ICT quality, information culture, and ICT management had a significant association with the total sustainability construct (Y). Such an association was not indicated between the ICT outlay and total sustainability (p=0.960).

The correlations analysis was sought into the linear regression. In the first and second steps of building the regression model, the following results were established. For the sub-constructs of ICT outlay (p=0.125) and ICT management (p=205), p-values were higher than the accepted level of significance (α=0.05). There is not enough evidence at the 0.05 significance level to conclude that there is a linear relationship between the level of ICT outlay and the level of sustainability as well as between the level of ICT management and the level of sustainability in the examined population. Therefore, these sub-constructs were removed from the regression model and then the correct model was received (Table 5).

TABLE V.
CORRELATIONS AMONG COMPONENTS OF ICT ADOPTION AND THE TOTAL SUSTAINABILITY AND ITS COMPONENTS

Sub-constructs	Standardized coefficients		Unstandardized coefficients		t(115)	Signif. p
	Beta	Stand. error	Beta	Stand. error		
R=0.552; R^2=0.305; Adv.R^2=0.293 (F(2.115)=25.247; p<0.0000);Standard error of estimation:0.504;N=118						
Constant			0.726	0.342	2.121	0.036
Cul	0.272	0.088	0.255	0.083	3.083	0.003
Qua	0.370	0.088	0.448	0.107	4.200	0.000

Source: own elaboration.

Two sub-constructs of the ICT adoption construct, i.e. the ICT quality and information culture explained 31% of the variance in sustainability (F2.115=25.247; p<0.0000). These sub-constructs predicted sustainability significantly well. The examination of coefficients indicated that the sub-constructs had a positive significant impact on sustainability. The effect of ICT quality was stronger than of the information culture.

Then, the relationship between the ICT adoption and sustainability may be written:

$$\hat{Y} = 0.726 + 0.255*Cul + 0.448*Qua$$

where:
$\hat{Y}$p – the theoretical level of sustainability in government units, including ecological, economic, socio-cultural, and political sustainability;
Cul – the level of information culture in government units;
Qua – the level of ICT quality in government units.

Generally, the estimated model is correct and there is no reason to reject it. It allows for understanding of the ICT adoption contribution to sustainability in government units. It gives an answer to the question – whether the growth in

levels of ICT outlay, information culture, ICT management, and ICT quality in government units determines an increase in the level of sustainability of the information society. The above results successfully established the significant and positive contribution of information culture and ICT quality to sustainability. Such a contribution was not confirmed between the ICT outlay and sustainability and between ICT management and sustainability.

V. Conclusions

A. Research contribution

This work contributes to existing research on the SIS, in particular the contribution of ICT adoption to sustainability by:

- indicating and describing the level of ICT adoption in government units, especially the levels of ICT outlay, information culture, ICT management, and ICT quality;
- indicating and describing the level of sustainability in government units, especially the levels of ecological, economic, socio-cultural, and political sustainability; and
- investigating how the ICT adoption in government units, i.e. the ICT outlay, information culture, ICT management, and ICT quality contribute to sustainability comprising its four types, i.e. ecological, economic, socio-cultural, and political.

Firstly, this study indicated significant statistical differences in the level of information culture and the level of ICT management in the Polish surveyed government units. On average, ICT management was at the highest level, whereas the lowest level was specific to information culture, followed by the ICT quality. It means that government units should focus their efforts particularly on improving information culture and ICT quality. Based on the detailed analysis of primary variables, it can be pointed out that the ICT management in government units is rather the result of top-down regulations than the efficient management, e.g. through the implementation of modern management concepts already employed in business. There were also indicated no statistically significant relations between the size of government units and the levels of ICT outlay, information culture, ICT management, and ICT quality.

Secondly, the outcomes showed significant statistical differences in the level of ecological and the levels of economic, socio-cultural, and political sustainability in the Polish surveyed government units. On average, ecological sustainability was at the lowest level, whereas the highest level was specific to political sustainability. The levels of socio-cultural and economic were only minimally lower to the political sustainability. Generally, the levels of all kinds of sustainability are low. It means that government units reap insignificant ecological, economic, socio-cultural, and political benefits from adopting ICT.

Thirdly, it was indicated that the ICT quality and information culture significantly and positively contribute to sustainability in government units. However, the effect of the ICT quality was stronger than of information culture.

With regard to the presented results, it is reasonable to conclude that this study expands the existing research on the SIS provided by Schauer [7], Fuchs [1], [2], Hilty et al. [4], [5], Guillemette, Paré [14, [15], and Curry and Donnellan [12], [13] by presenting the levels of ICT adoption and sustainability as well as identifying how the ICT adoption influence sustainability. The research outputs are also complementary with findings related to the effect of ICT adoption on sustainability in enterprises [21], [22], [23] and households [48]. Summarizing up-to-date research findings, it can therefore be concluded that the ICT quality, ICT management, and information culture within enterprises and households have a significant impact on sustainability, whereas in government units only the ICT quality and information culture influence sustainability. In addition, the ICT outlay does not have any impact on sustainability both in enterprises, households, and government units. On average, the levels of ICT adoption and sustainability in government units were lower than such levels in enterprises and households.

B. Research implication for research and practice

The research findings of this study can be used by scholars to improve and expand the research on the SIS. Researchers may use the proposed methodology to do similar analyses with different sample groups in other countries, and many comparisons between different countries can be drawn. Moreover, the methodology constitutes a very comprehensive basis for identifying the levels of ICT adoption and sustainability, as well as the correlations between the two constructs, but researchers may develop, verify and improve this methodology and its implementation.

This study offers several implications for government units. They may find the results appealing and useful in enhancing the adoption of ICT, experiencing the full potential of ICT and deriving various benefits from the ICT adoption. The findings suggest some framework comprising various kinds of benefits like ecological, economic, socio-cultural, and political that can be obtained thanks to the ICT adoption. In addition, they recommend some guidelines on how to effectively and efficiently adopt ICT in order to obtain those benefits. It is evident from the findings that government units should pay utmost attention to the improvement of information culture and ICT quality. In particular, this research can be largely useful for the transition economies in Central and Eastern Europe. This is because the countries are similar with regard to analogous geopolitical situation, their joint history, traditions, culture and values, the quality of ICT infrastructure, as well as building democratic state structures and a free-market

economy, and participating in the European integration process.

All in all, the research results might provide a partial explanation to the issue of how government units can participate in the creation of sustainable development and sustainable information society.

C. Research limitations and future works

As with many other studies, this study has its limitations. First, the ICT adoption and sustainability constructs are new constructs that have yet to be further explored and exposed to repeated empirical validation. Second, the sample included Polish government units only, especially from the Silesian Province. The study sample precludes statistical generalization of the results from the Silesian government units to government units in other Polish provinces. After all, caution should be taken when generalizing the findings to other regions and countries. Finally, the research subjects were limited to government units and it is therefore only the viewpoint of government units toward the ICT adoption for achieving sustainability in the information society.

Additional research must be performed to better understand the SIS, the ICT adoption and sustainability construct, and the correlations between the ICT adoption and sustainability. First, further validation of the levels of ICT adoption and sustainability should be carried out for a larger sample comprising government units from different Polish provinces. Second, the methodology of the ICT adoption, sustainability, and SIS measurement should be explored in greater depth. A composite index for the SIS with sub-indexes of ICT adoption and sustainability in government units should be explored. In addition comparisons between government units and enterprises [21], [22], [23] may be made.

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