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Smart Service Portfolios: Do the Cities Follow Standards?

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ABSTRACT
Smart services concern the core element of a smart city, since they support the realization of urban "intelligence" in terms of people, economy, governance, environment, mobility and leaving. Smart services aim to enhance quality of life within a city and in this respect to improve "livability". The types and purposes of smart services cannot be easily pre-defined, since they are the outcome of innovation, which cannot be pre-defined either, but instead it is the product of citizens' and businesses' creativity. However, standard bodies that work on smart city definition have described smart city portfolios, which are suggested to city policy makers and potential entrepreneurs. The aim of this paper is to validate whether standardized smart service portfolios are being followed by smart cities in practice. In this regard, a set of more than 70 smart cities are examined and their smart services are matched to these portfolios. The outcomes are extremely important and leave space for future research in this regard.

Keywords
Smart city; smart services; standardization; information cities.

1. INTRODUCTION
Today, smart cities across the globe are being evolved with the contribution of smart solutions, developed by various sciences, which vary from politics and government, to health and education, or to construction and city facilities (water, heat, energy, transportation, etc.). As a result, this complex smart city context has engaged almost all traditional industries and the resulted smart city industry has become dominant and it is expected to exceed U.S. $3 trillion by 2025 [1].

In an attempt to define rules for this new industry [2], standardization bodies have composed competitive standards and suggest technical specifications and guidelines for corresponding solutions' development. Among the elements that these standards try to identify concern [1;3] a) the smart city as a system and corresponding architecture; b) smart city infrastructure (i.e., information and communications technology (ICT), smart buildings, the Internet-of-Things (IoT) etc.); c) smart city services, which concern the "products/services" that the smart city delivers to its stakeholders via its soft or hard facilities[4]; and d) individual components that formulate the smart city ecosystem (i.e., smart transportation, smart water, smart energy etc.).

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The aim of this paper is to clarify whether existing standardization attempts succeed in their purposes. More specifically, it focuses on smart service standardization, it uses the corresponding standard of the International Telecommunications Union (ITU) as a baseline [4], in an attempt to identify the smart service classes and compares them with real smart services that are being offered by a broad number of smart cities. To this end, this paper aims to answer the following research question:

RQ1: do smart service standards reflect practice?

This question is very important to be answered since much effort is being provided on standardization, while cities around the globe are progressively respecting these standards. In this regard, standards have to take into account what happens in practice and vice versa the cities have to realize what the standards suggest for their innovation development.

In an attempt to answer RQ1 a research methodology is followed, which analyzes what types of smart services an amount of 74 documented smart cities [5;6] offer to their citizens as it can be validated on their official websites. The remainder of this article is structured as follows: section 2 concerns the background of this paper, while section 3 contains the outcomes from the websites' analysis. Finally, section 4 contains conclusions and future thoughts.

2. BACKGROUND
Almost all cities can be considered smart, since their "intelligence" is measured with specific indexes [7], which calculate not only urban innovation but their capacity to innovate too. In this respect, several smart city coalitions have been formed around the globe [8] (i.e., Innovation Cities, European Cities etc.) and important practices have been developed. One of the most interesting works is by [5;6;9], who have documented several information cities (Table 1): information or online is a subgroup of smart city [10], which limit their innovation on online smart service delivery.

Table 1. The examined smart city cases [5;6]

	Smart City	Official Website
1	AMSTERDAM (THE NETHERLANDS)	www.amsterdam.nl
2	BALLARAT (AUSTRALIA)	www.ballarat.vic.gov.au
3	BARCELONA (SPAIN)	www.barcelona.cat
4	BEIJING (CHINA)	www.ebeijing.gov.cn
5	BERLIN (GERMANY)	www.berlin.de
6	BESANCON (FRANCE)	www.besancon.fr
7	BIRMINGHAM (U.K.)	www.birmingham.gov.uk
8	BOSTON (U.S.A.)	www.cityofboston.gov
9	BOTTROP (GERMANY)	www.bottrop.de

10	BRISTOL (U.S.A.)	www.ci.bristol.ct.us
11	CAPE TOWN (SOUTH AFRICA)	www.capetown.gov.za
12	CHATTANOOGA (U.S.A.)	www.chattanooga.gov
13	CLEVELAND (U.S.A.)	www.city.cleveland.oh.us
14	COPENHAGEN (DENMARK)	www.kk.dk
15	CURITIBA (BRAZIL)	www.curitiba.pr.gov.br
16	DAKOTA COUNTY (U.S.A.)	www.co.dakota.mn.us
17	DUBAI (UAE)	www.dubai.ae/en
18	DUBLIN (IRELAND)	www.dublin.ie
19	DUBLIN (U.S.A.)	www.ci.dublin.ca.us
20	EINDHOVEN (THE NETHERLANDS)	www.eindhoven.nl
21	FRANKFURT (GERMANY)	www.frankfurt.de
22	GDANSK (POLAND)	www.gdansk.pl/en
23	GOLD COAST CITY (AUSTRALIA)	www.goldcoast.qld.gov.au
24	GUJARAT (INDIA)	www.gujaratindia.com
25	HELSINKI (FINLAND)	www.hel.fi
26	HONG KONG (CHINA)	www.gov.hk
27	IPSWICH (AUSTRALIA)	www.ipswich.qld.gov.au
28	ISSY-LES-MOULINEAUX (FRANCE)	www.issy.com
29	JUBAIL (SAUDI ARABIA)	www.rcjy.gov.sa/en-us/jubail/Pages/default.aspx
30	KALUNDBORG (DENMARK)	www.kalundborg.dk
31	LAVASA (INDIA)	www.lavasa.com
32	LONDON (U.K.)	www.cityoflondon.gov.uk
33	LOS ANGELES (U.S.A.)	www.lacity.org
34	LYON (FRANCE)	www.lyon.fr
35	MALAGA (SPAIN)	www.malaga.eu
36	MALMO (SWEDEN)	www.malmo.se
37	MASDAR (UAE)	www.masdar.ae
38	MELBOURNE (AUSTRALIA)	www.melbourne.vic.gov.au
39	MILAN (ITALY)	www.comune.milano.it
40	MONCTON (CANADA)	www.moncton.ca
41	MUNICH (GERMANY)	www.muenchen.de
42	NEW YORK (U.S.A.)	www1.nyc.gov
43	OTTAWA (CANADA)	www.ottawa.ca/en
44	PAREDES (PLANIT VALLEY, PORTUGAL)	www.cm-paredes.pt
45	PARIS (FRANCE)	www.paris.fr
46	PEDRA BRANCA (BRAZIL)	www.cidadepedrabranca.com.br
47	PORTO ALEGRE (BRAZIL)	www.portoalegre.rs.gov.br
48	QUEBEC CITY (CANADA)	www.ville.quebec.qc.ca
49	RECIFE (BRAZIL)	www.recife.pe.gov.br
50	RIVERSIDE (U.S.A.)	www.riversideca.gov
51	ROTTERDAM (THE NETHERLANDS)	www.rotterdam.nl
52	SAN FRANSISCO (U.S.A.)	www.sfgov.org
53	SEOUL (SOUTH KOREA)	www.seoul.go.kr
54	SHANGHAI (CHINA)	www.shanghai.gov.cn
55	SHENYANG (CHINA)	www.shenyang.gov.cn
56	SINGAPORE	www.gov.sg
57	SONGDO (SOUTH KOREA)	www.songdo.com
58	SOPRON (HUNGARY)	www.sopron.hu
59	STOCKHOLM (SWEDEN)	www.international.stockholm.se
60	SUWON (SOUTH KOREA)	www.suwon.go.kr
61	SYDNEY (AYSTRALIA)	www.cityofsydney.nsw.gov.au
62	TALLINN (ESTONIA)	www.tallinn.ee
63	TAOYUAN (TAIWAN)	www.tycg.gov.tw/eng
64	TIANJIN BINHAI (CHINA)	www.bh.gov.cn
65	TOKYO (JAPAN)	www.metro.tokyo.jp
66	TORONTO (CANADA)	www.toronto.ca
67	TRIKALA (GREECE)	www.trikalacity.gr
68	TRONDHEIM (NORWAY)	www.trondheim.no/engelsk
69	URUMQI (CHINA)	www.urumqi.gov.cn
70	VANCOUVER (CANADA)	www.vancouver.ca
71	VIENNA	www.wien.gv.at/english
72	WINDSOR-ESSEX (CANADA)	www.citywindsor.ca
73	WINNIPEG (CANADA)	www.winnipeg.ca
74	WUXI (CHINA)	www.wuxi.gov.cn

On the other hand, standardization bodies attempt to oblige an order to the quite "complex" smart city domain and important specification documents and guidelines have been formed. Among the most important standards, ITU has recently published the Smart-Sustainable Cities Focus-Group (SSC FG) results [4], which demonstrate among others the 10 types of smart services that a smart city can deliver: Smart Water, Smart Energy, Smart Transportation, Smart Healthcare, Safety/Emergency, Education and Tourism, Smart Waste Management, Smart Buildings, e-government and e-business.

3. RESEARCH METHODOLOGY

This paper investigated the official websites of the smart cities presented on (Table 1) and performs an analysis on the smart services they offer. These cases were analyzed during August and December 2015 with regard to their smart services, without limited to the online offered services, but locating all the types of smart services that the city offers or plans to offer according to specific undertaken initiatives. The identified smart services were documented and classified in the ITU smart service groups presented earlier. To that end, this investigation tried to locate city's innovative initiatives for water management and quality control (smart water); for energy efficiency, management or renewable energy (smart energy) etc.

However, not all the offered services could be assigned to the ITU smart service groups and this paper was obliged to extend them in order to classify the identified smart services properly. More specifically, Education & Tourism group had to be split to the corresponding education and tourism classes respectively, so that the classification would become much clearer. Additionally, smart healthcare had to split to smart health and smart care, since many cases focused to care-related services only (i.e., initiatives for elderly communities). Similarly, some extra groups of services had to be added that concerned Giffinger et al. [7] indexes: a) economy; b) people; c) planning; d) physical environmental and e) living services. This analysis resulted to 17 classes, the first 12 of which concern the above ITU smart service classes and structured the columns of (Table 2).

The classification of the identified smart services was based on the indexes that Giffinger et al. [7] introduced for smart city ranking. Some service aggregation was based on some agreements that the authors made regarding the above ranking, like the following:

1. Services and initiatives for communities with special needs like *jobless, elderly, accessibility* and *equity* were grouped to *smart care* category.
2. Vocational *training* services were assigned to *smart education* class.
3. *Heritage services* like shelter finding and corresponding loan provision and protection were assigned to smart *economy* class, since urban economic growth is significantly based on real estate business.
4. Several types of consulting services (i.e., for *business training* and *business installation and growth*) were assigned to corresponding categories (i.e., *smart education* and *smart economy* respectively).
5. *Volunteer* and *cultural* activities were considered to belong to *People* class.
6. *Metro-WiFi infrastructure* and *pet related* services were grouped in the *smart living* class.

The performed analysis indicate how each city enters smart city competition [10] with alternative service offering and many innovative approaches have been documented. All adjustments are presented on (Table 2), while some particular findings concern the following; Amsterdam developed Ijburg district (*Planning*), consisting of 4 artificial islands, which extends existing urban space and creates new smart districts; Ballarat offers donation services to support new habitants, while it releases lands to be used for business purposes with the Ballarat West Employment Zone (BWEZ) initiative (*Planning*); Barcelona offers empty apartment renting services (*Tourism*), creates smart blocks (*Planning*) for enhancing calm streets where urban planning and environmental activities are held. Beijing emphasizes on government services with citizen smart cards. Berlin supports new business installation with various business packages, innovation and start-up centers (*Economy*). Besancon engages citizens with initiatives like elderly council and discrimination campaigns (*People*). Boston performs city renovation (*Living*). Cape Town introduced local business engagement in order to enhance local tourism product and it structures new urban area development (Oude Molen) with Moddergat River Project. Copenhagen differentiates with digital safety cards (NemID). Dubai on the other hand, is famous for its business free zones, policies and infrastructure that simplify enterprise installation. Frankfurt offers almost all types of smart services but it focuses on smart energy, on which it assigns even tourism services (i.e., KLIMAtours with regard to visits on energy efficient large buildings). Gold Coast City emphasized on smart transportation with the use of various smart card systems. Gujarat is the first Indian city with climate-change monitoring center and focused on corresponding initiatives (*Environment*). Issy-Les-Moulineaux in Paris has developed the Smartcity+ mobile application, via which has enabled collaboration between groups of common interests (i.e., elderly people). Jubail develops a city from scratch (Jubail II) that embeds all types of smart services. Lavasa renovated most of its landscape for tourism and business attraction (*Economy*). London offers sets of mobile services to its visitors and habitants. City of Los Angeles encourages business installation (*Economy*) with various activities like the Empowerment Zone. Masdar has developed smart building prototypes that its businesses export (*Economy*). Melbourne was rated the most livable city in 2015 and appears to mostly offer care, energy and waste management services. Milan offers almost all smart services but it worth mentioning the use of an economic index (iSEE) to filter the eligible to care services citizens and the plan for sustainable mobility (PUMS). Munich founded a corresponding municipal company (SWM) to monitor climate-change effects. The City of New York offers a significant smart service portfolio like the City Record Online, the citizen identity (IDNYC) and the WasteMatch via a set of online applications that enable access to care and government services, environmental sensitivity and waste management respectively. Paredes scores a significant record with innovative initiatives for environmental protection (*Environment*) -like the PlanIT Valley action plan- and for creative communities. Paris develops plans for sustainability (*Planning*) with its "Paris intelligente et durable" initiative. Recife encourage local economic growth (*Economy*) with various initiatives like local technicians' support. Several efforts for new and innovative business growth (*Economy*) were identified in Quebec City, which concern digital entertainment, optical and information technology. Riverside among its various initiatives planned the "Smart Riverside" project, with which empowers living with technology (*Living*). San Francisco among its smart initiatives it enabled the "Adopt-a-Street" programme, with which it empowers social cohesion, engagement and environmental protection (*Living* and *Environment*). Seoul is famous for its planning activities for sustainable growth, living improvement and climate change (*Planning*), which were confirmed with this study (2030 Seoul Master Plan, participation in the C40 city coalition for climate change, the new Songdo city from scratch, which embedded all types of smart services and sustainable living). Similarly, Suwon in South Korea is an excellent e-government case with multiple digital public service provision. Shanghai develops the Pudong New District to boost foreign investments, while it has drafted a smart city plan to attract business relocation (*Planning* and *Economy*. Singapore differentiates with the eCitizen portal for e-government service provision. Sopron developed its synonymous "Sopron Innovation Park" to empower new business growth (*Economy*). Stockholm is famous for its environmental performance (*Environment*), while it performs excellent in its sustainable planning (*Planning*), with its Vision 2030 for sustainable growth; Söderort Vision for regional development; Kista Science city for knowledge econmy; The new Slussen for cultural and touristic service provision; Hagastaden district renovation; and the Royal Seaport renovation to enhance trade and business growth. Similarly, Syndey has its Sustainable Sydney 2030 master plan, with lots of specified targets for environmental enhancement, energy efficiency and city renovation; Open Sydney for touristic and cultural growth; past Sydney Local Environmental Plan 2012 that enabled green building installation and urban farming. Tallinn has a good smart education exemplar with its e-School interactive learning environment. Taoyuan encourages business installation in its 29 industrial zones (*Economy*), which supports with digital public service provision. Similarly, Tianjin offers free trade zones in its ports, it has developed the Binhai new area for new business installation (*Economy*), while it participates in the Sino-Singapore-Tianjin Eco-City coalition (*Planning*) for sustainable and eco-friendly growth. Toronto has its action plan for sustainable growth too (*Planning*), while it enhances creativity (*Economy*) with various initiatives like the StreetARToronto. Trikala installed crucial smart infrastructure during the last decade (*Living*), with regard to transportation and touristic enhancement, which transformed it to an attractive touristic place. Trondheim is a suitable place for the energy industrial sector (*Economy*). Vancouver performs excellent in planning (*Planning*), with its action plan for sustainable living, energy efficiency and emission

control, while it has separated the city in zones according to different uses. Vienna is a famous case too, which utilized European funding for several environmental-related actions (*Environment*), while its smart city plan (*Planning*) -among others- engaged the city in several networks of experts. Similarly, Windsor-Essex has developed its plan for environmental protection (*Environment*), while it offers the Biddingo smart application for online trading. Finally, Winnipeg encourages new business development (*Economy*) with several programmes (labeled i.e., Eureka, AssentWorks etc.), while it offers several e-government services.

The above analysis returned very useful findings, which exceed the above innovation discovery per city. More specifically, although the purpose of this paper was not to compare cities' performance, Besancon, Birmingham and London appeared to lead the race regarding smart service provision, followed by Eindhoven and Malmo. With regard to the types of the offered smart services, "smart care", "smart transportation" and "e-government" attract special cities' attention, while "smart buildings" is the weakest class, followed by "e-business", "smart water" and "smart health". The most important outcome, is that ITU classification lacks in incorporating all types of smart services, since the extra classes that this study proposed, enclosed almost equal smart services (652) to the ones classified in ITU's groups (762). This last finding shows that existing smart service classification has to be reconsidered and to focus on smart services that are related to smart economy, environmental protection, smart planning, smart people and smart living. All these findings provide with answer the RQ1 and prove that existing smart service standardization does not reflect effectively what really happens in practice and requires improvement. This finding should not be surprising since smart cities have been evolved since 1997, while smart city standards have started appearing in 2013 [1; 11], which means that standards cannot enclose all the existing smart service solutions. However, standards have to respect what happens in practice and update accordingly.

The final finding concerns the types of services that smart cities appear to offer. More specifically, the comparison of the results shows that smart cities prioritize establishing local economic growth (Smart Economy: 318) and taking particular care (Smart Care: 209) of communities with special needs (unemployment, youth, elderly people, accessibility and young families). Environmental protection and climate change follows (Smart Environment: 133), even if we consider that smart water, smart energy and smart buildings deal with the same issue. Cities' smart environmental performance needs to increase in order for urban sustainability vision to be achieved.

4. CONCLUSIONS

This paper investigated a critical issue regarding whether smart service standardization is effective and represents what really happens in practice. This problem came up from the fact that almost all standardization bodies have developed or are under the process of developing smart city standards in an attempt to control smart city solutions. In this respect, this paper ground the research question RQ1 regarding the performance of smart service standardization. In order to answer RQ1 this article performed an investigation on the official websites of 74 smart cities around the world and attempted to locate the number and types of existing smart services.

The results from the investigation show that smart cities prioritize smart economy and smart care, while smart environment follows. This finding shows that existing standardization partially succeeds in its purposes and it has to be reconsidered with regard to smart service specification. Moreover, smart city race is a reality and it is expected to grow since the smart city industry grows too.

Some future thoughts concern the detailed specification of the types of smart services that appeared to attract mostly the attention of cities and the forces that lie behind them. Moreover, although an efficient number of smart cities were explored, there are too many more that could improve the above findings. Finally, the types of cities (new versus existing) have to be considered too and correlated to the offered smart services.

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Table 2. Smart City Website Analysis Findings

CityID	Water	Energy	Transportation	Health	Care	Safety/ Emergency	Education	Tourism	Waste	Buildings	eGov	eBus.	Economy	People	Planning	Environment	Living	
1.			3			2		3				1	3	2	1			**15**
2.	1	1	2		4	1	3		1		1		3	2	1	1	1	**22**
3.			2		2		2	2	1				11	1	2	3	1	**27**
4.	1	1	5		1	1	2				2	1	2			2		**18**
5.								3				1	10	1				**15**
6.	2	2	7	4	8		4		1		1		12	5	2	5		**53**
7.			3		6	6	2	1	7		6	5	5	5	3	2	1	**52**
8.					6	1			1		1		4				1	**14**
9.	1				5		1						3			2	1	**13**
10.					1			1	1		2		2			1	1	**9**
11.			2				1	1			3		3		2		1	**13**
12.			2						1				5	1				**9**
13.				1	2	2	4		4		1		5				2	**21**
14.			3		1	1			1		2		4				3	**15**
15.			1		8		3	1	1				2					**16**
16.				3	6	3	1		3	1	5		5			1		**28**
17.			1		6			1			1	1	9					**19**
18.					1		1		2			2	4			1		**11**
19.	1		1			1	1		1		1		3			5	2	**16**
20.		1	2		3		1	1	2		2					1		**13**
21.		3	2		6	3	6	2	1	1	3	2	8	6	2	3	1	**49**
22.	1				5		1	1	1		1	1	5		1	3	1	**21**
23.	1		4		2								3			2	3	**15**
24.					1						2		3			2		**8**
25.			3		6		1				2		6					**18**
26.	1	2	1	1	5		1	1	1	2	6		6			3	2	**32**
27.		1	3		1	2	1	1	2		1		3	1	1	4	4	**25**
28.		1	5	2	3		1		1	1	1	1	3	3		4		**26**
29.	1						1				2	1	2	1		7		**15**
30.		1		1	4	1			1		2	1	9	1	1	4		**26**
31.							1	5										**6**
32.			9		11	2	2	5	5		3	1	5	2		4	1	**50**
33.			1		7	2		1	2		2		6		1	2	2	**26**
34.			2	4	8			2	1				4			5	3	**29**
35.		1			4	1	1	2			5	1	7			1	1	**24**
36.	1	3	2		7	1	2	2	1	1	2		7		1	12	2	**44**
37.		2					2			2	1		6			2		**15**

38.		3	3		7			1	3		2		2	1		1	2	**25**
39.			3	1	8		2	2	1		3	1	3	2	2	6	3	**37**
40.	1	1	1		2				1		1				1	4	2	**14**
41.			2		1								7			4		**14**
42.					2			1	2		3		3	1	1	1	1	**15**
43.	1			1	3			1	1				4					**11**
44.					2			1			2		3	2	2	2		**14**
45.					1			1					7		1		1	**11**
46.			3												2			**5**
47.			1		2			1	1		1		1					**7**
48.					1	2			1				7	2		2		**15**
49.			1		2	1	1	1	1				4	1		2	1	**15**
50.	1	2	2		3	1		1	1	2	1		6	1	2	1	1	**25**
51.	1				2			2					4	1	1	1		**12**
52.		1	1		2					2			1	1		2		**10**
53.			1		1			2	1		1		7	2	3	2	1	**21**
54.				1	1		1						3		3	1		**10**
55.								1					6	1		1	1	**10**
56.			1	1	2		1				2		5	1		1	1	**15**
57.	2	2	1	1			1		2	2			3	1	2		3	**20**
58.							1	2					2	3		1		**9**
59.			1		4		3	1			1		2	2	7	2	1	**24**
60.	1	1	1	1	4		1				6		3		2			**20**
61.			2		5				3	2			3	2	6	3	1	**27**
62.	1						1	1					7			1		**11**
63.	1		1		4	1		1	1		1		4					**14**
64.								1			3		3		1			**8**
65.					1	1	1	1			2		5		3	1	4	**19**
66.	1	1	1	1	4				1		1		4	3	1	3		**21**
67.			2		1			3			2						2	**10**
68.			1		5		1	1	1				3	1		3		**16**
69.				1	2	1	1	1					4			1		**11**
70.	1	1	2	1	1	1			1	2	2		3	2	4	1		**22**
71.			2	1	2		1						4	2	3	3	2	**20**
72.			1		2			1	1		1	1	3	1	2	1	2	**16**
73.						1	1	2	1		2		7	2	1		3	**20**
74.					2		2						7		1			**12**
Totals	**22**	**31**	**100**	**26**	**209**	**39**	**65**	**66**	**67**	**18**	**98**	**21**	**318**	**66**	**69**	**133**	**66**	