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DevOps Competences for Smart City Administrators

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1 ABSTRACT

A fledgling and still scattered knowledge stream on multi-disciplinary Smart city phenomena is developing. For the development of smart cities intellectual minds and a synthesis of quite diverse competences are required to shape cities to becoming smart with the overall objective to ever more improve the quality of life of its citizens in the most efficient and sustainable way. Both, the master minds and operators behind this development need to embark on an intensive change process, unlearn ingrained behavioral patterns and internalize an innovative competence set. This research is aiming to address the shortage of both, digital and transferrable skills that are needed for the various smart cities' sectors differentiated by more strategic roles of Smart City Planner and Chief Digital Officer as well as the more operational IT Officer. This study addresses the gap of competences by providing preliminary quantitative and qualitative research findings of the still ongoing DevOps project.

Keywords: Chief Digital Officer, Smart City Planner, Technical Competences, Transversal Competences, Smart Cities

2 INTRODUCTION

The ever increasing popularity and speed of the Smart City movement is reflected by the results of a Bosch initiated study revealing that the Smart City (SC) market grows at a yearly rate of 19% amounting to an investment volume of 800 bio US$ (Boehne, 2018). A further recent study by Berger (2019) with SC decision makers and experts in 50 mid-sized cities asked, for example, about the key success factors of SC projects. A well- defined strategy and guidance achieved with 58% the highest frequency level. Contradictory to the primacy of strategy and guidance, only 20% of the asked city representatives had a strategy pointing to a still existing research gap.

The aim of this research is to differentiate perspectives and competencies between SC planners, chief digital officer and IT officers. In order to successfully cope with this intensive change and digital transformation process and prepare for an effective and efficient future Smart City development, the administrators must thoroughly understand the complexity of smart city areas, new digital technologies facilitating the SC development and map newly required technical and transversal capabilities with newly emerging job profiles. Aiming to support strategic and operational SC administrators, the DevOps project, supported by ERASMUS + Sector Skills Alliances, (Project No.: 601015-EPP-1-2018-1-EL-EPPKA2-SSA Erasmus+ Program) KA2: Cooperation for innovation and the exchange of good practices-Sector Skills Alliances) addresses the gap between today's and future's skills demands of municipal workforce by emphasizing on the exploitation of emerging employment paradigms such as DevOps (http://devops.teilar.gr/). The final aim of the project is the development of VET MOOCs curricula to impart newly required technical and transversal competences and skills provided on a Moodle platform. The project, furthermore, aims to create an international community of best practice. It strives to cover the following identified research gaps:

a. lack of explanation of the nexus between Smart City Applications, DevOps (Agile Software Development) differentiated by a Citizen driven or Technology driven perspective.

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b. Lack of a, so far, not existing integrated Competence/Skill Portfolio (IoT & DevOps Related Skills & Transferable Skills) from a Citizen Perspective differentiated by Planners and Chief Digital and IT Officers.

c. Lack of academic models for individualized or standardized Smart City Planning differentiated by European countries.

The research is designed to achieve the following objectives:

(1) To investigate how the SC philosophy (citizen/identity driven, or technology driven or both) influences the competences of SC team members.

(2) To investigate how the SC philosophy (citizen/identity driven, or technology driven or both) influences SC service priorities and DevOps related decisions.

(3) To research to what extent different SC administrative profiles (Smart City Planner, Chief Digital Officer and IT Officer) require different IT/IoT specific and general/transversal competences.

(4) To identify to what extent different SC Service priorities, require different competences (specifically as to DevOps) and training.

(5) To explore the situations when Smart Cities prefer either to work independently or to co-operate with external partners.

(6) To develop a conceptual model explaining the nature of relationships between the three foci of the project.

3 DEFINITION OF A SMART CITY

The interest in SCs was sparked exponentially only in 2010. Harrison et al. (2010) specifically described a SC as an instrumented, interconnected and intelligent city (van den Bosch, 2017; Unhelkar, 2008; Celino and Kotoulas, 2013). The operations follow the main mission of SCs which is to improve the quality of live for its citizens pursuing the purpose of sustainability (Ahvenniemi et al., 2017). The 17 Sustainable Development Goals of the UN Agenda 2030 serve as a normative sustainability framework (United Nations, n.y.). Expanding on the technological focus of the aforementioned definition, the preconditions for a SC to flourish refer to the existence of a knowledge society (Barth et al., 2017), an open innovation System (Paskaleva, 2011), a user friendly connected infrastructure (Albino et al., 2015), the use and smart integration of resource endowments/equipment and activities (http://www.smart-cities.eu/model.html, in: Griffinger und Haindlmaier, 2010) and, last but not least, self- decisive, independent and conscious citizens (Griffinger and Haindlmaier, 2010; http://www.smart-cities.eu/model.html, in: Griffinger und Haindlmaier, 2010). Hence, Smart Cities must ensure congruency between needs and knowledge of citizens and community at large, investments, social and ecological sustainability, digitalization, urban responsibility and technology (Angelidou, 2015; Bas Borsma, 2017).

4 CITIZEN AND/OR TECHNOLOGY DRIVEN SMART CITIES

Following Angelidou (2015), two main sub- categories for smart cities may be found in the literature: the technology-oriented class and the people-oriented one. Within the technology-oriented direction, the term “smart cities” was examined primarily in relation to potential improvements on city services in relation to ICT developments, infrastructure and the greater ecosystem. Within this approach, smart SC technologies are providing the foundation for initiatives of strategic importance to be developed (Angelidou, 2014). The people-oriented approach places priority on the role of human resources, at individual or community level (Albino, Berardi and Dangelico 2015). Here, mostly social, economic and environmental sustainability issues are addressed implying the heightened importance of socio-technicality and of the richness of diversity of perspectives among involved stakeholders (i.e. citizens, businesses, NGOs or governmental agencies).In line with Angelidou (2015), Zait (2017) sees a predominance of soft smart SC dimensions such as human and social capital over the hard SC dimensions as they affect all other SC dimensions.

Taking the people orientated version into account, sociological factors such as urban attachment, belongingness or social and environmental relationships have a high impact on urban services (Belanche et al., 2016; Angelidou, 2014). According to Zait (2017), SC are currently assessing and developing their idiosyncratic identity. The emphasis on citizen engagement or civic culture in this context is supported by Gartner (2018): “Smart city initiatives are no longer about optimized traffic patterns, parking management,

efficient lighting and improvements to public works. The way forward today is a community-driven, bottom-up approach where citizens are an integral part of designing and developing smart cities, and not a top-down policy with city leaders focusing on technology platforms alone," said Bettina Tratz-Ryan research vice president at Gartner" (Gartner, 2018). However, literature suggests that the importance of citizens in the development of smart cities is often overlooked (Hollands, 2008; Hollands, 2015; Vanolo, 2014).

The importance of urban attachment, belongingness or the quality of social and environmental relationships point to consider sociological theory when developing S.C. Relating exemplarily to identity, Arnett's, German's, and Hunt's (2003) pioneering work calls for providing additional social benefits to customers or - in the case of smart cities- citizens, beyond a merely economic exchange relationship, as a logical consequence of the integration of the sociological identity theory. Identity focuses on the human factor in a conceptual and methodological context, and can be regarded as both, a desirable finality (i.e. social identity or livelihoods of smart cities) and a mechanism to achieve it, as the central internal and external communication platform (Balmer, 2008; Kaufmann, Czinkota and Zakrzewski, 2015).

Relating technological developments to smart city service domains, Tratz- Ryan and Finnerty (2018), in an interesting longitudinal study, portray an life cycle of technological progress. According to these authors this life cycle consists of five phases: innovation trigger, peak of inflated expectations, trough of disillusionment, slope of enlightenment and plateau of productivity. In their 2018 study, the authors hold that none of the SC technologies, so far, has reached the plateau of productivity stage. Only Smart Lighting has reached the slope of enlightenment stage predicted to reach the plateau in less than 2 years. The most innovative technological off springs, on the other hand, are Artificial General Intelligence and Autonomous driving level (both still requiring more than 10 years to end up in the plateau stage), smart building, data for good, data market place and 5 G, all occupying the Innovation Trigger stage (Tratz- Ryan ad Finnerty, 2018).

Summarizing, whilst a focus on technologies may increase efficiency in designing IS systems, it may ignore or neglect more complex social, organizational and technical factors (Eichhorn and Tukel, 2015). A fair balance of the two directions is endeavored by the DevOps project.

5 DEVOPS

Specially, the analytics, application and participation (citizen centric) perspectives imply the enhanced importance of software development. SC which need to become more flexible to react to rapid environmental changes, competitive and citizen centric, require innovative, albeit under researched, agile software development approaches, such as DevOps. The literature review revealed a still existing gap of explanatory research in this knowledge stream. For example, Feijter et al. (2018) point to the lack of a clear overview of practices aiding the DevOps adoption. A definition of DevOps knowledge is provided by the DevOps Institute (2019, p.15): "Working towards a common goal that enables the fast flow of planned work into production while achieving world-class stability, reliability, availability, and security".

To shorten the time to market for the software product, DevOps is assembled from the words „Development" and „Operations ". In software development, this method is used as an acronym combining the software development (Dev) and software implementation/production (Ops) phase (Lwakatare, Kuvaja and Oivo (2015) requiring integrated work flows of IT operative and DevOps focused IT teams within one business unit to facilitate and speed-up the continuous deployment of new software features (Sebastian et al. 2017). From a business perspective, DevOps is better predisposed to address customer needs in short cycle times (Lwakatare, Kuvaja and Oivo, 2015) than other software development approaches. A framework describing elements and outcomes of DevOps as well as problems addressed by DevOps by Lwakatare, Kuvaja and Oivo (2015) provides a basic insight into the functioning of the DevOps approach.

Furthermore, Senapathi, Buchan and Osman (2018, p. 5) provide a framework suggesting that DevOps leads to improved user experience. A high level of agility in product and services and a rapid deployment of fixes through frequent continuous deployment of new features result in being more responsive to customer needs. In addition, by avoiding infrastructure delays and late problems by the eliminations of the dev and ops team silos, a higher level of team productivity is created supported by more team control over deployment and more automation. In tandem, improved user experience and higher team productivity result in higher levels of competitive advantage.

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6 DEVOPS COMPETENCES FOR SC ADMINISTRATORS

This research synthesizes a wide range of literature and frameworks for a DevOps competence typology. As to be expected in this innovative research stream much literature is from grey sources and many models are of conceptual or exploratory nature. One framework guiding this research was that of Wiedemann and Wiesche (2018) with seven seven skill categories (full-stack development, analysis, functional, decision-making, social, testing, and advisory skills) and additional 36 skill- sub-categories. One key finding of this research strongly points to the integration of technical and general/transversal management skills/competences. A further skill categorization is provided by Fitsilis, Tsoutsa, & Gerogiannis (2018) differentiating by technical, behavioral and contextual sills. Another framework which seemed suitable to be validated resulted from the conceptual work of Hecklau et al. (2016). They clustered the competences into a holistic competence model consisting of 4 categories and 26 sub-categories. The researchers suggest an applicability of the model in terms of an 'industry 4.0 readiness check' by displaying multivariate data into a two-dimensional radar chart. The key characteristics of the Industry 4.0 phenomenon in terms of increased interconnectivity, real time data exchange, machine learning based on artificial intelligence implying self-controlling production systems suggested the relevance of the model to be validated. Expanding on the model of Hecklau and al. (2016), especially in terms of contextual skills Fitsilis, Tsoutsa, & Gerogiannis (2018, p.132) suggest that training of technical, transversal and contextual skills should be differentiated by the respective industry sector, software development and operations lifecycles, proficiency, up to date digital technological developments and job profiles.

The importance of innovation stimulation and start-up acceleration was underlined by Bas Boorsma (2017). In addition, civilizational competences to operationalize the soft SC dimensions which are forwarded by Zait (2017) are suggested to be added to the competence pool. Civilization competences comprise entrepreneurial culture, discoursive culture, civic culture and daily culture. Furthermore, Minnesota (2016) points to still existing training gaps relating to specific aspects in the technological competence category: skills related to product design in relation to product discovery; skills on user experience design and on software architecture; covering IoT topics. Moreover, Betz (2016) relates to gaps of digital competences currently not covered by curricula: product management related ones; software lifecycle related ones; infrastructure and operation related ones; resource management related ones and cultural ones. DevOps practitioners (DevOps Institute, 2019) highlight key categories of skills to be agreed upon by three levels of employees: C-level executives leading the business or IT strategy; management and IT team and project leaders; and individual skill contributors. They differentiate between must have, nice to have and optional skills, a method also applied for this research. A descriptive research of the Institute shows that process skills and knowledge as well automation skills are must-have (>50%) skills whilst soft skills are a must have for C-Level employees and team and project leaders. It is interesting that team interaction patterns for software delivery at scale are regarded a very important success/fail factor by the DevOps practitioners. Besides focusing on internal stakeholders, Feijter et al. (2018) suggest including external stakeholders, such as customers and software/components providers, when adopting DevOps. The researchers suggest a DevOps competence model based on three primary perspectives: Culture and Collaboration are paramount important and regarded as the 'roof of the house"; Product, Process and Quality mainly relating to a DTAP street (development, testing, acceptance and production environments); Foundation focusing on configuration management, architecture and infrastructure. A research by Bang et al. (2013) support the findings of Feijter et al. (2018) holding that knowledge and abilities on agile software development methodologies (in particular, Scrum) support the following four perspectives of DevOps: Collaboration Culture; Automation; Knowledge (architecture, cloud computing, threat modelling); Sharing of knowledge (product and sprint backlogs). A study in the Italian setting was conducted by Minchelucci, Marco and Tanda (2016). Based on a low response rate, the researchers chose an exploratory qualitative study and an exploratory factor analysis to analyze the quantitative data. Five factors appeared: technical skills including management of innovation and territorial planning; knowledge of private and public laws about procurement, innovation management, public private partnerships, and open data; soft skills relating to general management, relationship and mediation as well as leadership and personality; financial tools and economic principles and general management basic skills such as familiarity with ICT, knowledge of foreign languages and professional experiences.

Derived from the literature, exemplarily from the perspective of the Smart City Planner, a total number of 102 competences in 8 categories (specific technical, general technical/transversal, methodological, social/transversal, personal/transversal, legal, city planning, civilizational) were included in the initial survey. A conceptual framework to be empirically tested (Figure 1) was developed from the literature.

7 METHODOLOGY

From an ontological and epistemological stance, the research is based on the philosophy of Critical Realism triangulating an initial quantitative research with qualitative findings using four European countries (Germany, Italy, Greece, Cyprus) as study settings. Due to the still emerging and scattered body of knowledge in this research stream, a narrative literature review was regarded preferable. The research was designed in three stages: initially, surveys with fully structured questions were developed and via the Unipark system distributed to SC administrators in the four countries. The data were analyzed via SPSS. Informed by the survey data, interviews and focus groups were conducted in the four countries sampling SC administrators and related other strategic members of the SC ecosystem. The qualitative data will be analysed via content analysis supported by NVivo software. The analysis of the quantitative data, at this very stage, is still in progress. Notwithstanding very intensive personal efforts of the researchers in pretesting and personally contacting SC decision makers and experts either on conferences or via Smart City associations, a low response rate to the online questionnaire (i.e. 63 for the SC Planner: Cyprus 5, Germany 9, Greece 20, Italy 28, Romania 1) could only be achieved. Regarding the whole sample across all countries frequency analysis, correlation, regression analysis and factor analysis was applied. Additional, due to the existing knowledge gap, a more exploratory and qualitative stage followed. Initially, based on three very general questions 9 interviews with senior decision makers of successful smart cities (i.e. awards) were conducted.

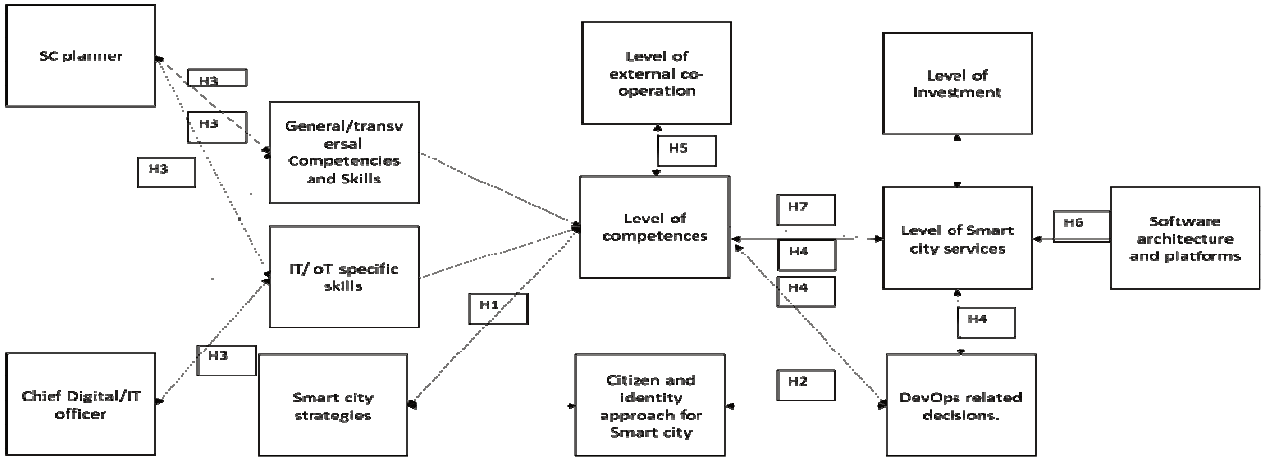

Figure 1 Initial conceptual framework

8 EXEMPLARY RESULTS OF THE FREQUENCY ANALYSIS

Key results of frequency analysis across all countries are

- Regarding the overall SC strategic approach, the majority tends to be more technology orientated (33%) compared to citizen orientated (28,6%) whilst only 9.5% focus on a people (HR) orientated approach. The majority (47,6%) prefers a combined technology, citizen, process and people driven approach.
- More specifically as to the citizen driven approach, 93,7% prefer a co-decision process.
- Regarding the most preferred citizen related goals, respectively 47,6% refer to the creation of a regional innovation resource pool followed by urban attachment of citizens (42.9%).
- Regarding the most important issues to help citizens, the majority (71%) mentioned to provide access to services followed by protecting citizens' physical and cyber security (56,5%).
- The majority (63,5%) does not already use collaboration or networking tools to enhance the SC ecosystem relations.

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- The main challenges encountered in the SC development process relate to coordinating the SC ecosystem (55,6%), followed by developing strategies (52,4%) and skill gaps (50,8%).
- 85,7% of the respondents, so far, have not adopted any method and set of indicators to monitor the SC performances from an ICT perspective.
- In the future, the SC anticipate adding value mainly to the SC service domain of transport and mobility (58,3%), followed by economy and society (48,7%), natural resources and energy (47,5) and smart building and smart homes (47,3%). The biggest leap between current and future focus is, again, in the field of transport and mobility (38,9) followed by smart building and smart homes (38,7%) and smart governance (36,2%).
- Looking at the future focus on SC service domains in more detail, the respondents mentioned telecommunication networks, pollution control, health care (74,6% respectively), public security and cultural heritage (respectively 73%), waste management (69,8%) and human capital management (68,3%).
- Asked for the perceived lowest competence levels as to the SC service domains, the respondents referred to smart grids (71,4%), power grids (65,1), smart logistics/infrastructure (63,4%), smart mobility information (62,3%), energy management systems (61,9).
- To fully address SC citizens' requirements, the majority (55,6%) calls for SC guidance material followed by regulations/legislation (50,8%) and codes of practice (46%).
- Regarding exchanging best practice, only 47,6% know SC that have a smart city strategy.
- Regarding investing into citizens' perspectives, a high majority of 74,6% state that they do not have the research know how, whilst 73% already have SC units dealing with social problems.
- 63% do not implement specific measures (i.e. training) to raise awareness of personnel on the need of smart citizens to be technologically and digitally savvy.
- Most respondents still apply classical programming (50.8%) followed by web- programming (33.3%), agile development life cycle (19%) and DevOps (17.5%) when deciding to purchase or adapt software. As to external co-operation with DevOps team representatives, the main contact persons are developers (38.1%), followed by product owners (25.4%) and testers (11.1%). The most often applied KPI to measure the efficiency of a DevOps team are quality performance (55.6%), followed by innovation and hard skills (38.1% respectively, soft skills (34.9%), delivery time (25.4%), scope (23.8%) and budget (17.5%).
- Only 25.4% are expecting to co-operate with an external DevOps team in the future, whilst 44.9% are not expecting it, and 28.1% are indeterminate. In the same vein, only 22.2% are expecting to integrating DevOps competence into their team, whilst 38.1% are not expecting it, and 33.3% are still indeterminate.
- Consultants (44.4%) and online/distance learning are the most preferred training course providers.
- Asked on the respective requested competences for the profiles of Smart City Planner and Chief Digital/Information officer and co-operation and training demand in this context, the following table highlights exemplarily the respective 3 ones most often mentioned:

Competences	Smart City Planner	Chief Digital/IT officer	Co-operation with external partners	Training demand
Specific Technical Competences	-Teamwork (57,1%) -Urban Innovation (50,8%) - User Experience Design (44,4%)	- Big Data Management (57.1%) - Software Architecture (50.8%) - Coding (50.8%)	- Mobile Development (55.6%) - IT &Cyber Security (50.8%) -Artificial Intelligence (50.7%)	-IoT specific knowledge (49.2%) -DevOps (44.4%) -Machine Learning & Deep Learning (42.9%)

Table 1 DevOps Specific Technical Competences

Transversal or generic Competences	Smart City Planner	Chief Digital Officer	Required from External IT experts, consulting service provider, University
General technical/ Transversal	-Technical skills to switch from operational to strategic tasks (54%) - Broad & Deep Process - Understanding (complexity) (49.2%) - Geospatial competences (38.1%)	- Geospatial competences (54%) - IT security (49.2%) - IT media/IoT specific skills (42.9%)	- ICT Hybrid Media literacy (41.3%) - IoT Supportive skills (41.3%) - Combining IoT supportive skills with existing skills (39.7%)
Methodological	-Creativity (44.4%) -Design Thinking (44.4&) -Efficiency Orientation (41.3%)	-Efficiency Orientation (41.3%) - Analytical Skills (34.9%) - Problem solving (34.9%)	-Research Skills & Continuous Learning (41.3%) - Entrepreneurial Thinking (34.9%) - Creativity (33.3%)
Social	-Ability to merge different skills (47.6%) - Resilience (46%) -Co-operative (46%)	-Networking (44.4%) -Ability to work in a Team (44.4%) -Create Relationships (44.4%)	-Language Skills (42.9%) -Intercultural Skills (31.7%) -Resilience (30.2%) -Networking (27%) -Ability to work in a team (27%)
Personal	-Sustainable Mindset (47.6%) -Strategic Vision (44.4%) -Open-Minded (42.9%)	- Flexibility (39.7%) - Compliance (39.7) -Leadership (every employee is a leader (38.1%)	- Motivation to learn (31.7%) - Sustainable Mindset (28.6%) - Ambiguity Tolerance (25.4%)
Legal	-Public Procurement (36,5%) -Contractual Public Private Partnerships (33.3%) - Legal notions regarding Big Data Management (31.7%) -Data Security (30.2%)	- Data Security (36.5%) - Legal notions regarding Big Data Management (34.9%) - Public Procurement (31.7%) - Contractual Public Private Partnerships (28.6%)	- Data Security (33,3%) - Contractual Public Private Partnerships (31.7%) - Public Procurement (27%) - Legal notions regarding Big Data Management (23.8%)
Smart City Planning	-Territorial Planning (49.2%) -Urban Innovation (41.3%) - Management of Urban Facilities (31.7%)	-Territorial Planning (28.6%) -Management of Urban Facilities (27%) -Urban Innovation 25.4%)	- Management of Urban Facilities (38.1%) - Urban Innovation (33.3%) - Territorial Planning (28.6%)
Civilizational Competences	Engaging Citizens (38.1%	Engaging Citizens (27%)	Engaging Citizens (27%)

Table 2 DevOps Transversal Competences

9 QUALITATIVE RESEARCH

Three countries have been targeted for these initial interviews. The respondents were from Greece (R1,R2, R7, R8), from Italy (R3,R4) and Germany (R5, R6, R9).The in-depth interviews consisted on main three main questions: 1.which key success factors are making your city a ‘smart city of the future’.2. what are the most important management skills and IT skills identified in your ‘City of the Future’?.3.how would you describe the unique identity of your city?. After the analysis has been conducted, for question 1, three main

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categories have been identified: the smart city infrastructure, the strategy and its citizens. For question 2, the category of skills and education were identified; for the last question 3. the category city identity revealed the main aspects.

9.1 Smart City Infrastructure

For this category (R1,R2, R3 and R4) agreed on the importance of having in place the right infrastructure to support and promote the implementation of a smart city. (R1) explained that in their SC committee 'all city bodies, chambers, universities and institutes of technology are involved to guarantee the commitment of action. Special emphasis has been placed on the development of collaborative platforms. (R2) refers, for example, to educational and technological institution platforms. (R3, R4) related more to internal and external stakeholder platforms for joint planning activities. (R3) explain how the Roman capital administration 'uses the stakeholders for the construction of ecosystems for the creation of smart systems by investing in projects such as Pago PA, City Data Platform, CRM, SPID (Digital Identity Public System) and CIE Electronic Identity Card) which represents enabling technologies for services in a Smart city perspective'. Another example also coming from Italy refers to Florence: (R4) stating that 'it was immediately understood that there could not exist a smart city without the involvement of the participating companies, which are the driving force behind most public services in the city. Thanks to the presence of an association that includes them all in Tuscany (Cispel Toscana), it was possible to lead all public utilities in the city's innovation processes.

These processes have been described and implemented with Triennial Action Plans in which many systemic actions have been realized, possible only with a strong city cohesion of all the innovation stakeholders. Similarly, (R6) explained that 'the decision-making process will change and be based much more on valid and relevant information. Connectivity and Networks between Administration, Stakeholder and Citizens of the Smart City have to be established and will be emerging.

Finally, it was highlighted the resource's potential by having synergies between the different stakeholders. An example of this synergy is utilized in the case of Florence as explained by (R4): synergy between the Municipality, Chamber of Commerce and the Region. Florence utilities the reclamation and alignment of data with the master data of the Municipality (e.g.: reclamation of more than 200,000 addresses in Alia, periodic alignment of the data of the water and sewage infrastructure of Publiacqua and the gas infrastructure of Toscana Energia with the municipal SIT). Apart from this synergy consortium (R4) explains the work they are currently involved in supported by the government 'the governance path leads us to the launch of the Smart City Control Room. The data are the gold dust of the new millennium, it is used by the largest multinationals to increase their business. They are now known to all, but not so obvious it is to find in the Public Administration who, concretely, invests and develops on data'.

9.2 SC Strategy

For (R6) a comprehensive framework needs to be taken into account 'to be understood, planned and managed through balanced and innovative management and IT skills: this framework consists of the political, social, technological, urban planning and economic dimensions of a Smart City. Opportunities and risks of the two central smart-city competence fields of digitization and urbanization must be managed in a balanced manner.

(R1) coming from the municipality of Heraklion in Crete (Greece) indicated their pioneer spirit, already 10 years ago, they were the first municipality in Greece developing a comprehensive strategy to digitize the municipality.(R4) focuses on the important of the SC vision and explains that 'Florence has always approached digital innovation with a strategic vision of the city system, exploiting synergies and promoting cooperation and participation among all the stakeholders of Florence. In the Manifesto for Firenze Digitale in 2014, the main values of innovation in the city were affirmed with an act of Council: sharing the main digital assets (data, infrastructures for digital identity and electronic payments, public WiFi, sensors) and cooperation in jointly promoting the various innovation initiatives of the various institutions and public utilities on a city scale. In the Smart City Plan

(http://www.spesconsulting.com/sites/default/files/Firenze%20Smart%20City%20Plan.pdf)

we have included the vision on the city to 2015, 2030 and 2050, with indicators and guidelines for the development of the Florence Smart City on different areas (Integrated Planning, Public Administration

Improvement, Energy Efficiency, Mobility, ICT means and tools for innovation, Prosperity for the sustainability of the Plan, Communication)'.

9.3 SC Citizens

For (R9) it starts with a strong top down involvement from the town's lord major with his broad team to integrate the citizens. They need to convince them to participate in this great change and to win their commitment. (R4) explains that the main focus on engagement with citizens is always looking for new "fun" forms of involvement of the population at all levels, so that the relationship with the public administration becomes more and more a pleasant. Moreover, he explains that 'only in Florence it has been possible to start the firenzesemplice.it System that allows to put the citizen back at the center and to get out of the logic of "it is not my responsibility", giving way to anyone in live chat to ask for information about any utilities service, Chamber or the Region of Tuscany. For (R7) the adoption of technology by citizens would be the key success factor.

9.4 SC Skills

For (R5, R6, R8) IT systems and digital skills are emerging and therefore, management becomes more complex and traditional management skills are changing too. (R3) support this statement and add the need from the public administration to develop these digital skills together with relational soft skills and knowledge of communication and finance leading to a more multidisciplinary learning. (R4) explained the Florence digital transformation, 'since 2018 Florence is the second smart city in Italy and the first for Digital Transformation according to ForumPA's iCityRank (https://www.forumpa.it/citta-territori/icity-rank-2019-milano-firenze-e-bologna-sono-le-citta-piu-smart-ditalia/). A synthesis of more than 100 indicators (based on more than 250 variables) that, aggregated in the final ICity Rank index, allow to draw up the final ranking of the 107 capital cities. Florence is the city most capable of fully exploiting the potential offered by digital technology, followed by Bologna and Milan. The Tuscan capital obtains the highest score in four indicators (municipal apps, digital openness, public wi-fi and digital transparency) and excellent performance in four others (broadband access, IoT and network technologies, availability of online services, social PA), demonstrating an overall approach that involves not only the municipal administration but all the stakeholders operating in the urban context. (R8) highlights the strength of the Larissa municipality in the field of IT service and project management competences. For (R7) the important skill rely on 'openness' . To be able to turn SILO systems which didn't communicate between them e.g. municipalities, public administration, ministries etc. into an open Big Data management. In addition, for him a smart city is a 'city that thinks' therefore skills to understand and work with artificial intelligence are very relevant. (R9) sheds light on 'patience' as the process involve the integration of masses and therefore time is required. In addition, he regards good communication skills, also communicating at a political level as very important. Finally, knowledge about how the town works an its needs is relevant.

9.5 SC Education

In relation to education and training (R4) explained how the citizens where involved. 'The citizens participated in every process, both in the co-design phase the firenzesemplice.it system was shared in a senior center with the "digital grandparents" of Florence) and in the learning and training phase on the new digital services possible in Florence. They created by the integration of data and processes at the city level. In 2018 (R1) explains that Heraklion was selected by the EU as one of the 27 most powerful digital cities in Europe. This gave them the opportunity to get seminars on how to build a smart city. The training was financially supported by the EU.

9.6 SC City identity

This category focuses on the identification of city aspect which characterized a town. For example (R1 and R5) indicate elements like a SC culture development, having great business development opportunities, technology and IT in other words having a strong and innovative region companies contribute to the implementation. (R3 and R5) highlighted elements more related to the uniqueness of the town e.g. the historical tradition of the town, being a touristic or cultural center or having extensive sport opportunities contributes to the town identity. (R6) provides the concrete example of Berlin being regarded as 'the world-famous capital of modern Germany stands for world-class architecture, culture, night-life and a challenging

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history in the middle of Europe and the world'. (R9) underlines the Mannheim entrepreneurial spirit by having one of the biggest innovation centers in Germany together with a vibrant music (pop academy), culture and international environment. Finally (R8) offers a more holistic perspective stressing that 'the combination of policies and technology in finding solutions that serve the coexistence of the human and natural capital of our city. It is the harmoniously coexistence between the two factors.

10 CONCLUSION

The multitude of technical and transversal/general competences required for this unprecedented SC system transformation found by this study reflects the immense challenge for SC administrators requiring high levels of open-mindedness, motivation to learn, ability to change, creativity, efficiency and speed, as well as interdisciplinarity and cross- functionality on all levels. To accomplish this competence build-up is the mission of the DevOps for SC project by typologizing SC competences according to different newly emerging administrator profiles and by imparting them via MOOCs courses. The holistic character of the competence pool has been confirmed by the research to be crucial to cover the still existing strategy and skill gaps. Competence gaps and significant training demand both, in technical and transversal competences have been signaled, and, specifically, the attitude towards DevOps seems to be rather indeterminate and reluctant with the SC still focusing on more traditional software development approaches. Also, the continuous existence of a strategy gap has repeatedly become apparent. Whilst a combined technology, citizen, people and process orientated approach is preferred by most of the respondents, an even stronger citizen orientated philosophy when embarking on the SC strategy development is recommended. The still ongoing multivariate analysis stage of this research will certainly contribute to better explaining the interrelationships of concepts involved. The findings, so far, imply a lacking body of knowledge. Therefore, specifically, from the perspective of the SC administrators, the knowledge field still seems to require in-depth qualitative research. A promising route to follow for SC administrators is to join communities of international best practice to complement cognitive learning with affective and experiential learning approaches.

11 DISCLAIMER

The European Commission's support for the production of this publication does not constitute an endorsement of the contents, which reflect the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

12 REFERENCES

Ahvenniemi, H., Huovila, A., Seppa, I.P. and Airaksinen, M. (2017). What are the differences between sustainable and smart cities?. Cities, Vol. 60, pp. 234-245

Aaker, D.A., & Day, G. S. (1990). Marketing research (4th ed.). New York: Wiley

Albino V., Berardi. U, Dangelico. RM. (2015). Smart cities: definitions, dimensions, performance, and initiatives. Journal of Urban Technology, Vol.22. Issue 1, pp. 3–21

Angelidou, M. (2014). Smart city policies: A spatial approach. Cities, Issue 41, pp.3-11.

Angelidou, M. (2015). Smart cities: A conjuncture of four forces. Cities, Issue 47, pp. 95-106.

Arnett, D.B., German, S.D., & Hunt, S.D. (2003). The identity salience model of relationship marketing success: The case of nonprofit marketing. Journal of Marketing, Vol. 67, Issue 2, pp. 89-105.

Bang, S. K., Chung, S., Choh, Y. & Dupuis, M. (2013). A Grounded Theory Analysis of Modern Web Applications: Knowledge, Skills, and Abilities for DevOps, In Proceedings of the 2nd Annual Conference on Research in Information Technology, ACM, New York, 2013, pp. 61–62.

Barth, J., Fietkiewicz, K.J, Gremm, J., Hartmann, S., Henkel, M., Ilhan, A., Mainka, A., Meschede, C., Peters, I., tock, W.G. (2017). Informationswissenschaft in der Urbanistik. Wissenschaft & Praxis Vol. 68, Issue 5-6, pp. 365-377

Balmer, J. M. T. (2008). Identity based views of the corporation. European Journal of Marketing, Vol. 42, Issue 9/10, pp. 879–906.

Belanche, D., Casaló, L. V., & Orús, C. (2016). City attachment and use of urban services: Benefits for smart cities. Cities, Issue 50, pp. 75-81.

Berger, R. (2019). Europäische Städte wollen in Smart City-Lösungen investieren - alleine in Deutschland über 4 Milliarden Euro jährlich. Accessed at: https://www.presseportal.de/pm/32053/4375844 on 12.02.2020

Boehne, T. (2018). CES 2018: Bosch setzt auf das Geschäft mit der smarten Stadt. Accessed at: https://www.bosch-presse.de/pressportal/de/de/ces-2018-bosch-setzt-auf-das-geschaeft-mit-der-smarten-stadt-139136.html on 10.01.2020

Boorsma, B. (2017). A new digital deal. Boekscout BV. The Netherlands.

Celino, I. & Kotoulas, S. (2013). Smart Cities (Guest editors' introduction). IEEE Internet Comput. Vol. 17, Issue 6, pp. 8–11.

Cohen, L. & Manion, L. (1989). Research Methods in Education. London: Routledge.

Chamoso, P., González-Briones, A., Rodríguez, S. & Corchado, J., (2018). Tendencies of Technologies and Platforms in Smart Cities: A State-of-the-Art Review.Wireless Communications and Mobile Computing. Volume 2018. Article ID 3086854. 17 pages. ttps://doi.org/10.1155/2018/3086854.

Davies, J. & Abu Matar, M. (2017). Data Driven Reference Architecture for Smart City Ecosystems. 10.1109/UIC-ATC.2017.8397556.

DevOps Institute (2019). Upskilling: Enterprise DevOps Skills Report 2019. Accessed at: http://tiny.cc/DevOpsInstituteReport2019 on 10 December 2019.

Eichhorn BR, Tukel OI. (2015) A review of user involvement in information system projects. International Journal of Information Technology Project Management 6:26–53

Feijter, R. de, Overbeek, S., Vliet, R. van, Jagroep, E. & Brinkkemper, S. (2018). Important Gap: no clear overview of practices aiding the DevOps adoptionDevOps Competences and Maturity for Software Producing Organizations, In Proceedings of the Enterprise, Business-Process and Information Systems Modeling (BPMDS, EMMSAD & CAiSE Conferences), Tallinn, Estonia, June 11-12, 2018, Lecture Notes in Business Information Processing, pp. 244-259.

Fitsilis, P., Tsoutsa, P., & Gerogiannis, V. (2018). Industry 4.0: Required Personnel Competences. International Scientific Journal "Industry 4.0". Year III. Issue 3, pp. 130-133. WEB ISSN 2534-997X; PRINT ISSN 2534-8582

Fostec and Company (n.Y). Big Data &Analyse. Accessed at: https://www.fostec.com/de/kompetenzen/market-intelligence/big-data/ on 10. December 2020.

Gartner Institute (2018). Gartner Says Citizen Engagement Is Critical to the Success of Smart Cities. Accessed at: https://www.gartner.com/en/newsroom/press-releases/2018-03-07-gartner-says-citizen-engagement-is-critical-to-the-success-of-smart-cities on 11.02.2020.

Harrison, C., Eckman, B., Hamilton, R., Hartswick, P., Kalagnanam, J., Paraszczak, J. and Williams, P., (2010). Foundations for smarter cities. IBM Journal of Research and Development. Vol. 54, Issue 4, pp. 1-16.

Hecklau, F., Galeitzke, M., Flachs, S., & Kohl, H. (2016). Holistic approach for human resource management in Industry 4.0. Procedia CIRP, Vol. 54, pp. 1-6.

Hollands, RG. (2008). Will the real smart city please stand up? Intelligent, progressive or entrepreneurial?. City Issue 12, pp.303–320

Hollands, RG (2015) Critical interventions into the corporate smart city. Cambridge Journal of Regions Economy and Society Vol. 8, pp. 61–77

Kaufmann, H.R., Czinkota, M. & Zakrzewski, M. (2015). System Health from Inside- A Polish Case Study. Industrial Marketing Management. Vol. 51, pp. 69-78.

Lwakatare L.E., Kuvaja P., Oivo M. (2015). Dimensions of DevOps. In: Lassenius C., Dingsøyr T., Paasivaara M. (eds) Agile Processes in Software Engineering and Extreme Programming. XP 2015. Lecture Notes in Business Information Processing, Vol 212. Springer, Cham

Minchelucci, F. V., Marco, A. de & Tanda, A. (2016). Defining the Role of the Smart-City Manager: An Analysis of Responsibilities and Skills, Journal of Urban Technology, Vol. 23, pp. 23–42.

Minnesota, A. I. (2016). Renewing the IT Curriculum: Responding to Agile, Devops, and Digital Transformation. St. Paul, MN.

Paskaleva, K.A. (2011). The smart city: A nexus for open innovation?. Intelligent Building International, Vol 3, Issue 3, pp. 153-171

Sebastian, I, Ross, J.W., Beath, C, Mocker, M., Moloney, K.G, Fonstad; N.O. (2017). How Big Old Companies Navigate Digital Transformation. MIS Quarterly Executive, Vol 16, Issue 3pp. 197- 213.

Senapathi, M., Buchan, J. & Osman, H. (20189. DevOps Capabilities, Practices, and Challenges: Insights from a Case Study.EASE'18: Proceedings of the 22nd International Conference on Evaluation and Assessment in Software Engineering 2018 June , pp. 57–67

Tratz-Ryan, B. & Finnerty, B. (2018). Dynamic Changes in Smart Cities: Hype Cycle for Smart City Technologies and Solutions. Gartner. ID: G00340460

Unhelkar, B. (2008). Mobile Business. Handbook of Research in Mobile Business, 2nd Edition: technical, methodological and social perspectives. IGI Global. USA

United Nations. N.Y. Sustainable Development Goals. Accessed at: https://sustainabledevelopment.un.org/?menu=1300 on 14. January 2020.

Van den Bosch, H. (2017). Governance and economy. Smart city: smart story? In: Smart City Hub. Accessed at: https://smartcityhub.com/governance-economy/smart-city-smart-story/ on 15. January 2020

Vanolo A (2014) Smart mentality: the smart city as disciplinary strategy. Urban Studies Journal Vol. 51, pp. 883–898

Wiedemann, A. & Wiesche, M. (2018). Are you ready for DevOps? Required skills set for DevOps Teams. Research Paper. https://aisel.aisnet.org/ecis2018_rp/123

Zait, A. (2017), Exploring the role of civilizational competences for smart cities' development, Transforming Government: People, Process and Policy, Vol. 11, Issue 3, pp. 377-392.

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