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DevOps and Competences for Smart Cities
- Summary of Research Results -

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Agenda

- Project research desing
- Research gaps
- Findings from the quantitative and qualitative research
- Conclusion

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Mission: Supporting SC Administrators in Competence Development

1. Identifying Core Competences (digital and transferable) and Future Job Profiles of City Employees
2. Methodology: Critical Realism, Triangulation descriptive statistics Literature Review/Documentary Analyses as to market demands and supply; Quantitative (Cross- National Survey- SCP: n=63; IT Manager: n=15) & Qualitative (Case Study: 40 Interviews, Focus Groups/Workshops and Participant Observation); Analysis: Descriptive Multivariate Analysis; Content Analysis
3. Result: DevOps Modular Curricula (MOOCs Courses) – According to Job Profiles – with Training Material for Professional Education/Training Pilot Tests in Cyprus, Germany, Greece and Italy
4. Creating a Sustainable Network of International Best Practice- Welcome

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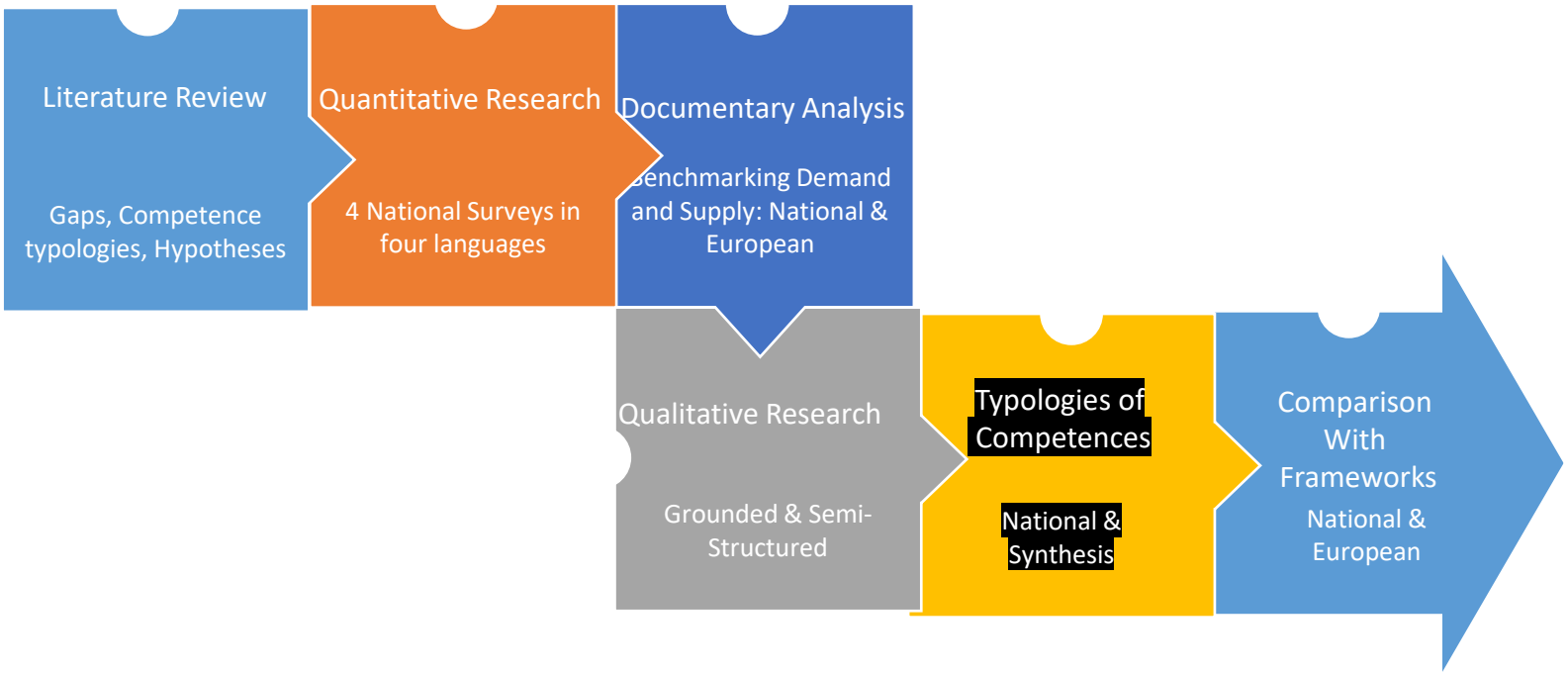
Research Design



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Key concepts & literature sources (except sources for documentary analysis)

Smart City (i.e. dimensions; technical, citizen and people driven philosophy)	Harriso et al. (2010); Pascaleva (2011); Griffinger & Haindlmaier (2010); Ahvenniemi et al. (2017); UN (17 sustainability goals); Barth et al. (2017); Angelidou (2014; 2015); Bas Borsma (2017); Albino, Berardi and Dangelico (2015); Zait (2017); Belanche et al. (2016); Gartner (2018); Hollands (2008;2015); Vanolo (2014);Eichhorn and Tukel (2015); Arnett, German and Hunt (2003); Balmer (2008); Kaufmann, Czinkota and Zakrzeweski (2015); Tratz- Ryan and Finnerty (2018); Courabi et al. (2012); Neirotti et al. (2014), Brandt et al. (2016) and Anthopoulos et al. (2016)
Data, Technologies and Infrastructure	Fontec and Company (n.y); Davies and Abu- Matar (2017); Chamoso et al. (2018)
DevOps	Feijter et al. (2018); DevOps Institute (2019); Lwakatare, Kuvaja and Oivo (2015); Sebastian et al. (2017); Sanapathi, Buchan and Osman (2018)
DevOps Competences	Bang et al. (2013); Wiedemann and Wiesche (2018); Fitsilis, Tsoutsa and Gerogiannis (2018); Hecklau et al. (2016); Bas Borsma (2017); Zait (2017); Minnesota (2016); Betz (2016); DevOps Institute (2019); Feijter et al. (2018);

Table: DevOps Competences for Smart City Administrators; CORP Conference at RWTH Aachen, 2020; Kaufmann, H.R., Bengoa,D., Sandbrink, C., Kokkinaki, A., Kameas, A., Valentini, A., Iatrellis, O.

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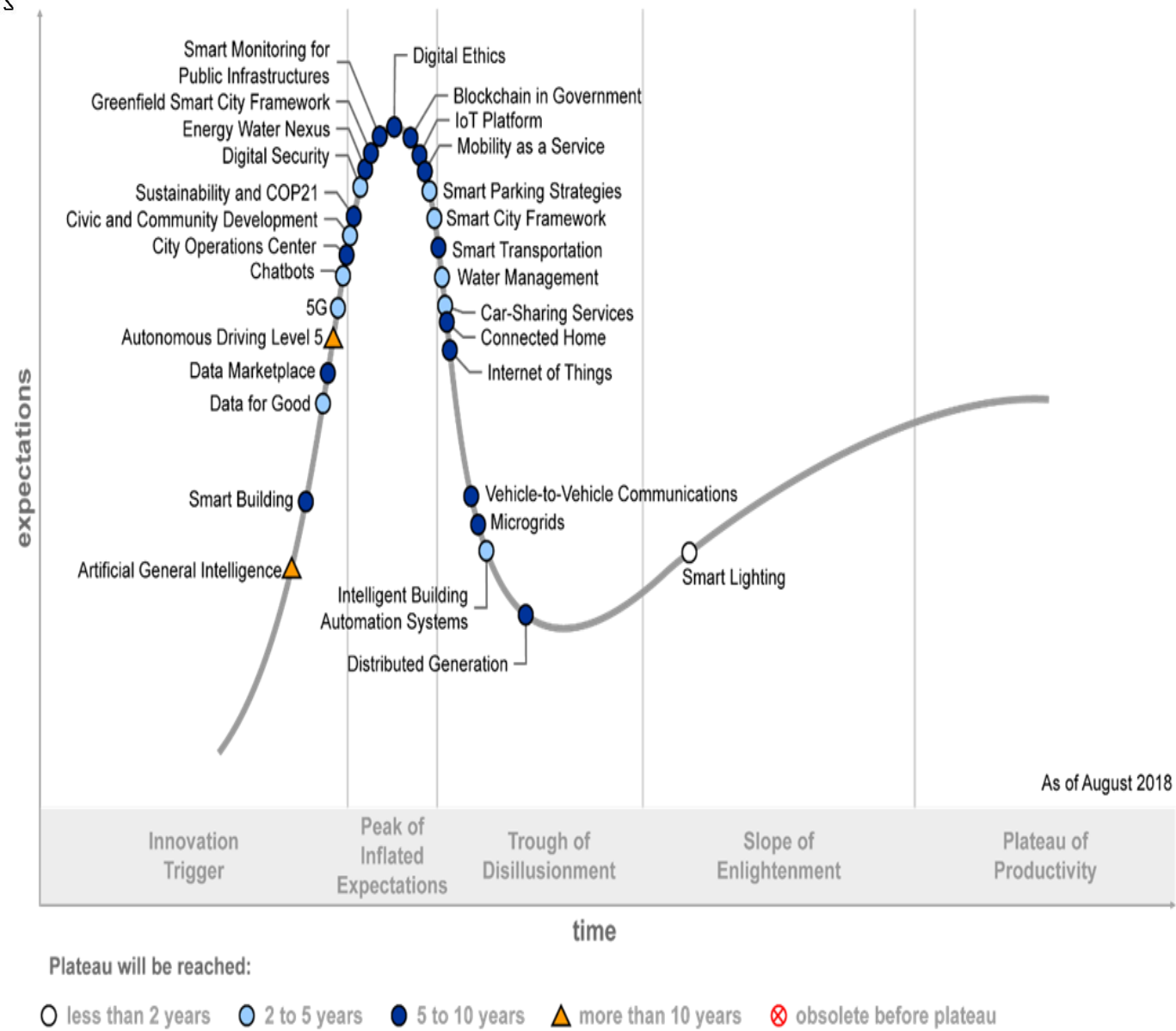
IT response to Dynamic Changes in Smart Cities

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



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Research Gaps

- Connection between Smart City Applications and DevOps from a Citizen Perspective and/or IT Perspective is missing
- Integrated Skill Portfolio (IoT & DevOps Related Skills & Transferable Skills) differentiated by Planners, IT Managers and IT Officers didn‘t exists
- Academic Models for Smart City Planning are missing

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Hypotheses confirmed

1. Citizen and Identity Driven Strategies Require Different Competences than Technology Driven Strategies
2. There is a relationship between a Citizen and Identity Driven Approach and DevOps Related Decisions
3. There is a Relationship between Different SC Administrative Profiles and Required General/Transversal And IT Specific Competences (not significant; but strongly implied by frequency tables)
4. There is a Relationship between SC Services and DevOps Related & Transferal Competences
5. SC Administrative Competences Will Differ According to Their Level of External Co-operation
6. Different SC Services require Different Software Architectures and IT Specific Competences

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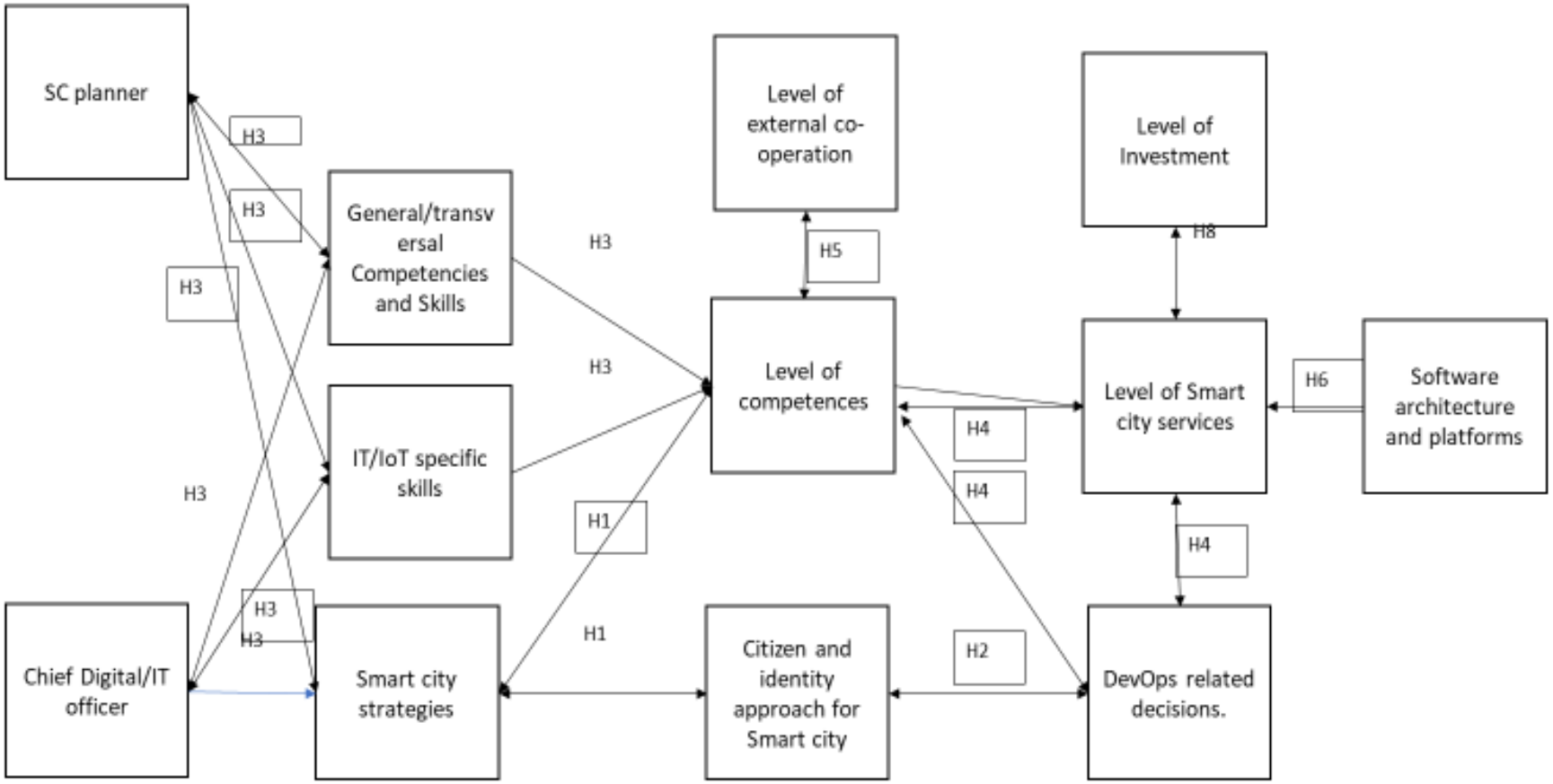
DevOps Research Model



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Competences

1. Transversal/general management competences

1.1. SC Planners: mandatory

1.2. IT Manager: mandatory – similar to SC Planners

1.3. IT Officers: Differentiated with national differences

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Competences

2. General IT Management competences

2.1. SC Planners: to be differentiated; more optional
2.2. IT Managers: mandatory
2.3. IT Officers: mandatory

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Competences

3. DevOps related competences

3.1. SC Planners: optional – only introductory knowledge is mandatory

3.2. IT Managers: mandatory

1.3. IT Officers: mandatory

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Competences

4. Specific SC related competences

4.1. SC Planners: mandatory
4.2. IT Managers: mandatory
4.3. IT Officers: to be differentiated, more optional

Interesting: unanimously attributed mandatory importance for all profiles: citizen centric perspective.

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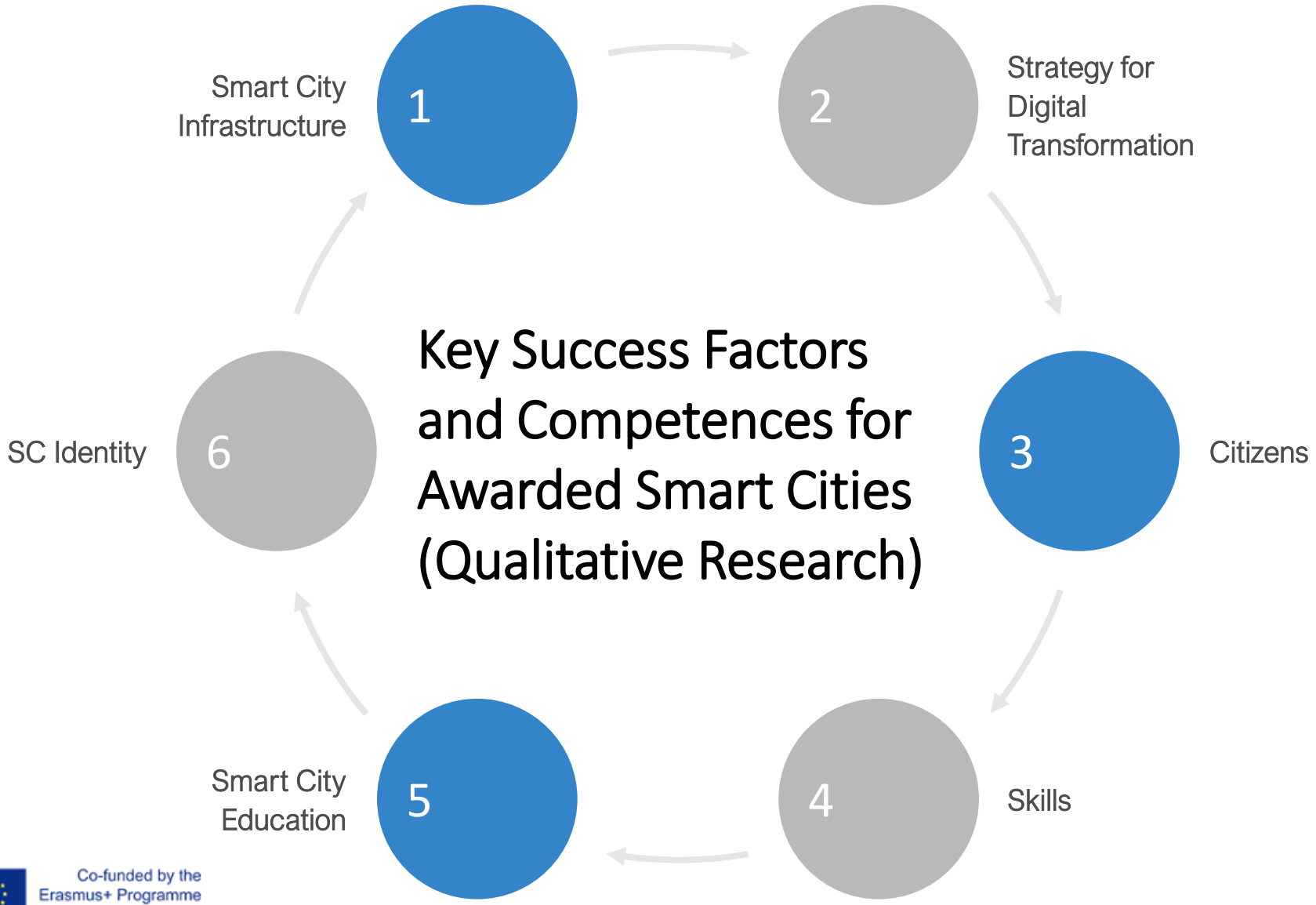

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Examples of qualitative findings

Category: Smart City Infrastructure:

"**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)"… Investing in data as the gold dust of the millenium not often found in admin (R4 from Florence).

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Other exemplary qualitative findings

Category: Strategy for Digital Transformation

Interdisciplinary conceptual framework: “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” (R6) supported by (R8).

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Other exemplary qualitative findings

Category: Citizens

“Fun" forms of involvement of the population at all levels (R6)… “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”

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Other exemplary qualitative findings

Category: Skills

IT systems and digital skills are emerging and therefore, management becomes more complex and traditional management skills are changing too (R5, R6, R8).

(R3) Multidisciplinary Learning: “Develop digital skills together with relational soft skills and knowledge of communication and finance” (R3)

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Other exemplary qualitative findings

Category: Education

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 (R1)

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Synthesis: Typologies of Competences

	Smart City Planner		SC IT Head		SC IT Officer	
Transversal skills	**Mandatory**	**Optional**	**Mandatory**	**Optional**	**Mandatory**	**Optional**
TRANSVERSAL SKILLS						
1. Creativity	XXXX		XXXX		XXX	X
2. Entrepreneurial Thinking	XXXX		XXXX		XXXX	X
3. Ability to work in a Team (**including co-operating in an ad-hoc fashion; being co-operative**)	XXXX		XXXX		XXXX	
4. Social Skills	XXXX		XXXX		XXXX	
5. Ambiguity Tolerance	XXX	X	XXX		X	XXX
6. Motivation to Learn (& **Continuous Learning**)	XXXX		XXXX		XXXX	
7. Emotional Intelligence	XXXX		XXXX			XXXX
8. Strategic Vision & Strategy Development (**including switching from operational to strategic competences**)	XXXX		XXXX		X	XXX
9. Intercultural Skills	XXXX		XXX	X	X	XXX
10. Project and Process Management **(including Broad & Deep Process understanding due to complexity)**	XXXX		XXXX		XXXX	
11. Design Thinking	XXXX		XXXX		XXXX	
12. Decision Making	XXXX		XXXX		XXX	X

1.Table synthesizing competences from all national reports

Greece, Cyprus, Italy, Germany

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Synthesis: Typologies of Competences

13. Problem Solving **(& Conflict Solving)**	XXXX		XXXX		XXXX	
14. Leadership and Management Skills (**including change management, new thinking)**	XXXX		XXXX		XX	XX
15. Stakeholder management	XXXX		XXXX		XX	XX
16. Sustainable Development	XXXX		XXXX		XX	XX
17. Knowledge Management	XXX	X	XXXX		XXXX	
18. Advanced Presentation skills (**including Digital Twins; Smart city guidance material)**	XXXX		XXXX		XXXX	
19. Communication skills (including on a political level- lobbyism or corporate diplomacy)	X		X		X	
20. Networking (including ‚community of best practice', i.e. Morgenstadt City of the Future; Data for Good (AI); high level of external co-operation; high level of training demand; create relationships; social skills)	X		X			X
21. Analytic and systematic skills	X		X		X	
22. Balancing transversal and digital skills	X		X		X	
23. Patience	X		X		X	
24. Research	X		X			X

1.Table synthesizing competences from all national reports

Greece, Cyprus, Italy, Germany

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Synthesis: Typologies of Competences

GENERAL IT MANAGEMENT KNOWLEDGE						
1. Software development life cycles	X	XXX	XXXX		XXX	
2. Agile methods	X	XXX	XXX		XXX	
3. IT Quality Assurance	XXXX		XXXX		XXX	
4. IT security	XXX	X	XXXX		XXX	
5. System and software architecture	XXX	X	XXXX		XXX	
6. Introduction to Cloud computing	XXX	X	XXXX		XXX	
7. Introduction to Internet of things (IoT) (**including IoT Architect, IoT security specialist; augmenting existing skills with IoT**)	XXXX		XXXX		XXX	
8. Introduction to data analytics **(big data management)**	XXX	X	XXXX		XXX	
9. Introduction to Artificial Intelligence **(different levels of AI)**	XX	XX	XXX		XXX	
10. Risk Management	XXXX		XXXX		XX	X
11. Digital Marketing	XXXX		XXXX		X	XX
12. Microservices	X		X		X	
13. Multi- Agent Systems	X		X		X	
14. Spatial Data Infrastructure (Integration between geo-spatial and traditional IT technologies)	X		X		X	
15. Platform Development	X		X		X	
16. Mobile Development	X		X		X	
17. Business Transformation	X		X			X
18. Media Skills & ICT Hybrid Media literacy	X		X		X	

1.Table synthesizing competences from all national reports

Greece, Cyprus, Italy, Germany

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Synthesis: Typologies of Competences

SERVICE OPERATION						
1. ITIL service strategy	XX	XX	XX	XX	XX	XX
2. ITIL service design	XX	XX	XX	XX	XX	XX
3. ITIL service transition	X	XXX	X	XX	XX	XX
4. ITIL service operation	XXX	XX	XX	XX	XX	XX
SMART CITIES RELATED						
1. Smart cities platforms	XXXX		XXXX		XXXX	
2. Smart cities business models	XXXX		XXXX		XX	XX
3. Smart cities operating procedures	XXXX		XXXX		XXXX	
4. Smart cities legal framework	XXXX		XXXX			XXXX
5. Smart city sustainability	XXXX		XXXX		XX	XX
6. Smart city standards	XXXX		XXXX		XX	XX
7. Smart city resilience	XXXX		XXXX		XX	XX
8. Urban management	XXXX		XXX	X	X	XXX
9.Smart cities services **(high competence gaps; suggested new focus: smart health due to corona crisis indicated by virtual presentation of CORP Conference at the RWTH University Aachen)**	XXXX		XXXX		XXXX	
10. Smart city identity (differentiation as to: size of cities; cities and regions)	X		X			X
11. SC Governance (finance & investment)	X		X			X
12. Co-ordinating SC Stakeholders	X		X			X
13.Citizen Driven/Citizen Orientation/User Experience Design **‚Digital Sovereignty '; Citizens as co- deciders and co-creators; make employees aware that citizens must be ‚digitally affin'; including marginalized groups**	XXXX		XXXX		XXXX	

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1.Table synthesizing competences from all national reports

Greece, Cyprus, Italy, Germany

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Comparison with European Competence Frameworks

Table comparing competences from all national reports with European Competence Frameworks

		Smart City Planner		SC IT Manager		SC IT Officer		
[1]	M stands for Mandatory, and O for Optional	M	O	M	O	M	O	Comments
Transversal Skills								
1	Creativity	x		x		x		e_CF - Innovating Product/Service development; EntreCopm- Creativity;
2	Entrepreneurial Thinking	x		x		x		e_CF- Taking the initiative; SCP: EntreComp- Spotting opportunities; EntreComp framework defines this skill as "corporate entrepreneurship and social entrepreneurship“
3	Ability to work in a Team (including co-operating in an ad-hoc fashion; being co-operative)	x		x		x		EntreComp framework defines this skill as „Working with others
4	Social Skills	x		x		x		EntreComp Framework defines this skill as „Mobilizing Others“
5	Ambiguity Tolerance	x		x			X	EntreComp framework defines this skill as „Coping with uncertainty, ambiguity and risk“
6	Motivation to Learn (& Continuous Learning)	x		x		x		EntreComp framework defines this skill as „Motivation and Perseverance and Learning through experience
7	Emotional Intelligence	x		x			X	e_CF- self-awareness and self-efficacy
8	Strategic Vision & Strategy Development (including switching from operational to strategic competences)	x		x			X	e_CF Business Plan Development; EntreComp- Vision
9	Intercultural Skills	x		x			x	DevOps competence

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Summary of Comparison between DevOps and European Frameworks

- The European Competence Frameworks do not distinguish between mandatory and optional competences for the different profiles.

- The European competence frameworks e_CF and EntreComp share most of the transversal competences with the DevOps project; innovative DevOps competences are Intercultural Skills, Decision Making, Networking, Balanced Transversal and Digital Skills and Patience.

- With one exception (Monitoring competences), specific DevOps related competences are not provided by European Competence Frameworks.

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Summary of Comparison between DevOps and European Frameworks

- Regarding General IT Management Competences, the European Competence Frameworks seem to cover more the traditional ones rather than newly to be developed competences (such as agile methods) provided by DevOps.

- As to Smart Cities related competences, European frameworks consider only one factor, which is Smart City Governance.

- Beyond 'user support', European frameworks do not reflect a central citizen centered philosophy as enhanced by the DevOps project.

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Conclusions

- Paramount: Balancing transversal and digital competences
- Transversal competences mandatory for both SCPs and IT Managers
- Separate training for IT Officers (different competence set, i.e. more optional transversal competences)
- DevOps includes all transversal competences taught by European VET providers, but, importantly, adds new ones: ambiguity tolerance, EI, Strategic Vision, Intercultural Skills, Leadership & Management, Stakeholder Management, Knowledge Management, Advanced Presentation Skills

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Thank you very much for your attention

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