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Competences of smart city planners: the Alpha and Omega

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Objectives

Revisiting previous research in the course of the DevOps project 'DevOps Competences for Smart Cities' (Kaufmann et al., 2020)

- Reviewing the literature on the interrelationship between SC competencies, priorities and collaboration.
- To derive at explanations of the nature of the relationship between the three factors by expanding on previous findings of the DevOps project (Kaufmann et al., 2020) by additional descriptive and explanatory analysis.
- To develop a hypothesized framework on the triptych to suggest avenues for future research.

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Research Design

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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

   Literature Review/Documentary Analyses as to market demands and supply;

   Quantitative (Cross- National Survey- SCP: n=60; CDOs: n=15)

   & Qualitative (Case Study: 40 Interviews, Focus Groups/Workshops and Participant Observation); Analysis: PLS-SEM 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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What is DevOps? Just take a minute

- https://www.youtube.com/watch?v=Xrgk023l4lI

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Hypotheses

- There is a Relationship between Different SC Administrative Profiles and required General/Transversal, General IT, IT Specific and SC specific Competences, SC Service (so far not significant; but strongly implied by frequency tables)

- There is a Relationship between SC Services and DevOps Related & Transferal Competences

- SC Administrative Competences will differ according to their level of External Co-operation

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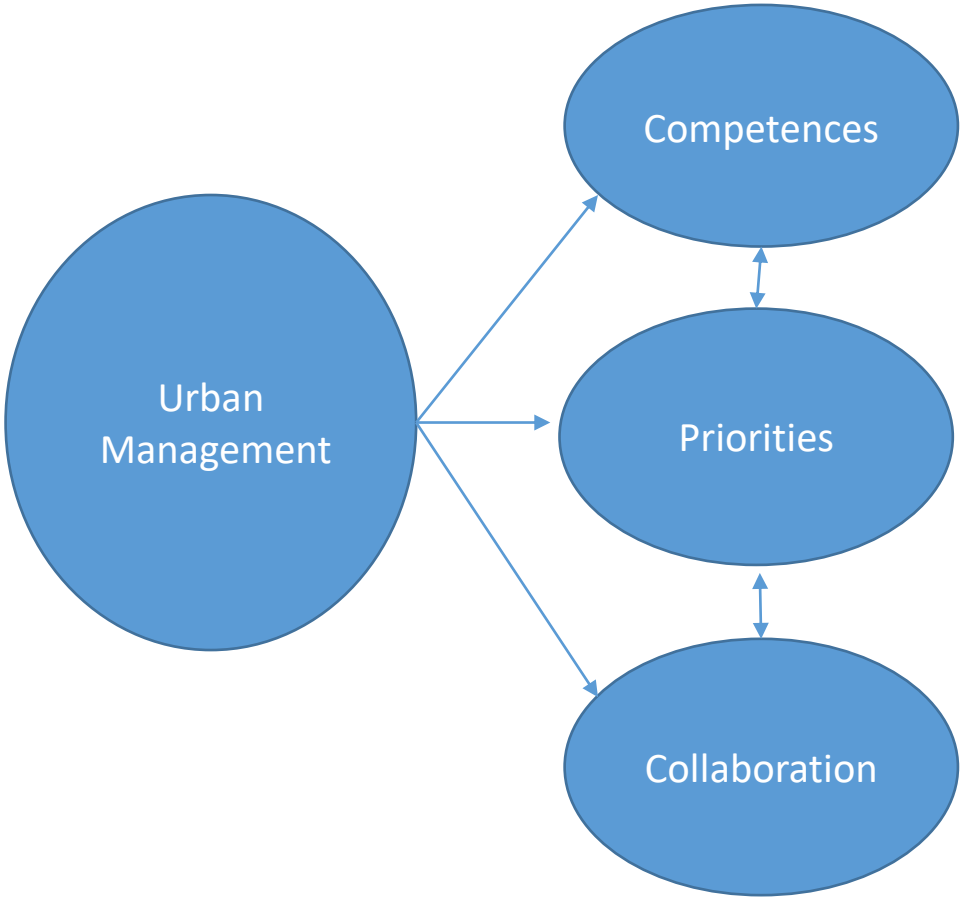
Fundament: Competences + Priorities+ Collaboration



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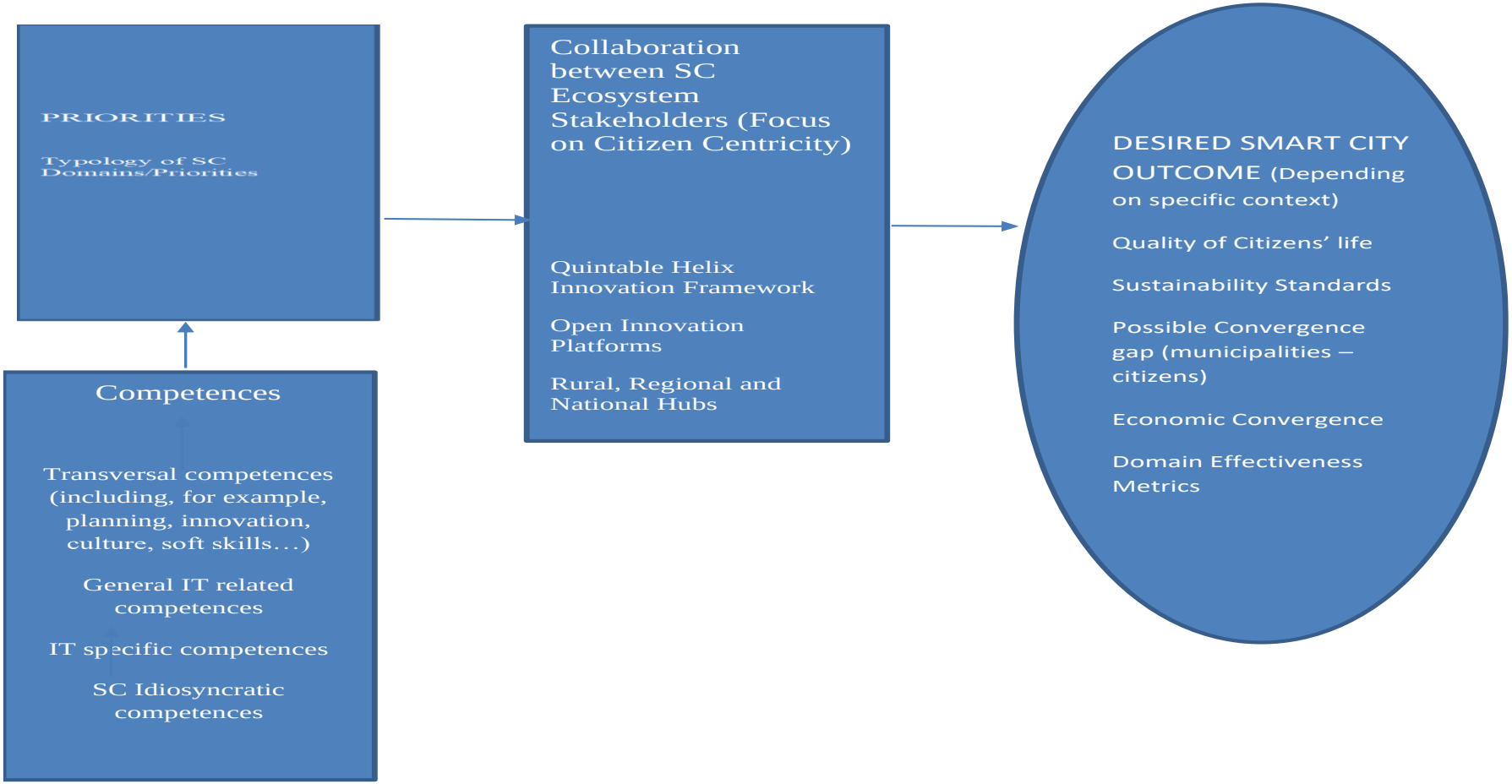
Literature Review for added analysis



Source: developed from the authors based on Agbali et al. (2017) Allam (2019), Appio et al. (2019), Charalabidis et al. (2020), Cukusic et al. (2019), Garg, Mittal and Sharma (2017), Kaufmann et al. (2020), Lytras and Serban (2020), Ojasalo and Kauppinen (2016), Umar (2018)

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Descriptive Findings

Dimension	Competence	Smart City Planner	Chief Digital Officer/IT Officer	Required from External IT experts, Consulting service provider, University
General technical competences	Technical skills to switch from operational to strategic tasks	34	23	22
	Broad and deep process understanding due to higher process complexity	31	26	19
	Creativity	28	16	21
	Technical skills to evaluate and apply the integration between geospatial tech and traditional IC tech & engineering processes	24	34	19
	Media skills (i.e. smart media, i.e. smart glasses)	21	25	19
	Rudimentary understanding of technology (data analytics, the ability to leverage and communicate that know-how)	20	22	22
	IT, Media or IoT-specific skill	17	27	20
	Familiarity with ICT hybrid media literacy	17	22	26
	IoT architect or an IoT security specialist	17	27	24
	IoT supportive skill	15	27	26
	Understanding IT security	14	31	23
	Combination of existing skills that are augmented to some degree with IoT expertise	13	27	25
Methodological competences	Design thinking	28	20	17
	Efficiency orientation	26	26	18
	Conflict solving	25	21	19
	Research skills and continuous learning	25	20	26
	Entrepreneurial thinking (corporate entrepreneurship; social entrepreneurship)	24	19	22
	Problem solving	24	22	16
	Decision making	24	21	16
	Analytical skills	24	22	17
	To be able to co-operate in ad-hoc fashion (to take individual or socially constructed ideas into action)	22	19	19
Social competences	Create relationships	30	28	15
	Ability to merge different skills	30	22	14
	Being co-operative	29	22	14
	Resilience	29	24	19
	Ability to work in a team	28	28	17
	Social skill	28	21	12
	Intercultural skills	27	17	20
	Diversity Management	27	13	14
	Ability to transfer knowledge (explicit and tacit)	26	20	17
	Language skills	25	24	27
	Networking skills	25	28	17
	Ability to be compromising	25	22	16
	Action-related competencies	24	16	12
	Communication skills (including virtual communication skills)	24	23	16
	Past professional experiences	23	22	17
Personal competences	Sustainable mindset	30	17	18
	Strategic vision	28	21	15
	Open-mind behaviours	27	24	13
	Project and process management	27	19	12
	Compliance	26	25	16
	Leadership skills (every employee becoming a leader)	25	24	15
	Flexibility	25	25	14
	Ambiguity tolerance	25	12	16
	Spatial thinking	25	17	16
	Emotional intelligence	25	23	12
	Ability to work under pressure	24	24	15
	The ability to mediate conflicts	24	21	15
	Motivation to learn	23	24	20
	Attitudes, communication	23	21	12
	Reflective	22	18	14
	Leadership capacity	22	21	10
	Empathy	21	20	11
	Output oriented	21	18	15
	Autonomous	19	24	11
Legal competences	Legal aspects of public procurement	23	20	17
	Contractual issues involved in public-private partnerships	21	18	20
	Legal notions regarding big data/open data management	20	22	15
	Data security	19	23	21
City Planning capabilities	Territorial planning	31	18	18
	Management of urban facilities	27	20	17
	Urban innovation	26	16	21
Civil-national competences	Engaging citizens	24	17	17
Average		*24.2*	*21.9*	*17.4*
Mean		*25.0*	*22.0*	*17.0*
Standard deviation		*4.2*	*4.1*	*4.0*

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Descriptive Finding

The top three IT/IoT competences needed for SC planners:

-Teamwork (36 participants mentioned this aspect)

-urban innovation (32)

-user experience (28)

The top three competences needed for chief digital officers/internal IT officers

-Big data management (36)

-System operation skills (such as database and network administration, coding)

-Software architecture (32).

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Descriptive Findings

The highest perceived training demands:

- IoT specific knowledge (31)
- DevOps (integrating software development and operations, 28)
- Machine learning as well as deep learning (27).

Will to co-operate with external partners for the acquisition of the following top three competences:

- Mobile development (35)
- IT/cyber security as well as artificial intelligence (32 for both competences).

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The average of 20.4 participants perceive a training demand (M = 21.0, SD = 5.0) for a specific competence while co-operation with external partners is preferred from 25.8 participants on average (M = 25.0, SD = 4.2).

Interestingly, the competences in which training is mostly needed, do not overlap with those competences which are chosen for co-operation. Therefore, we conclude that these competences are rated as **very important**, so that these should be trained and be existent **in-house** instead of relying on external competences.

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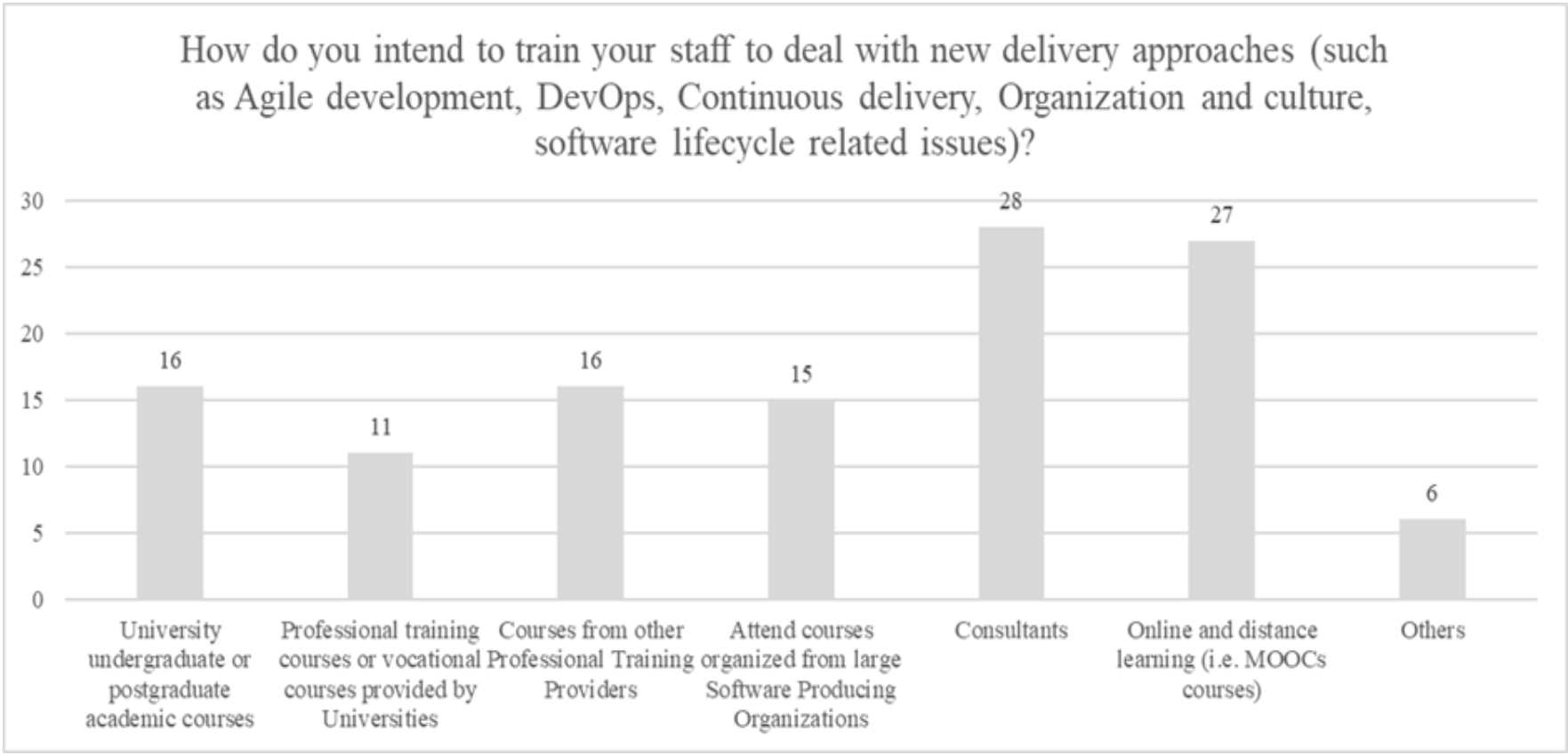
Descriptive Findings

Intentions to train staff



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Transversal/generic competences: **highest need for training of competences, e.g. technical skills to switch from operational to strategic tasks, 34) is covered inhouse.**

However, external knowledge is also required, especially in those competences in which **fewer demands for training** have been identified. On average 24.2 participants (M = 25.0, SD = 4.2) perceive a need for training for smart city planners, and on average 21.9 participants (M = 22.0, SD = 4.1) perceive a need for training for chief digital officers/IT officers, while on average 17.4 participants (M = 17.0, SD = 4.0) perceive a need for external knowledge.

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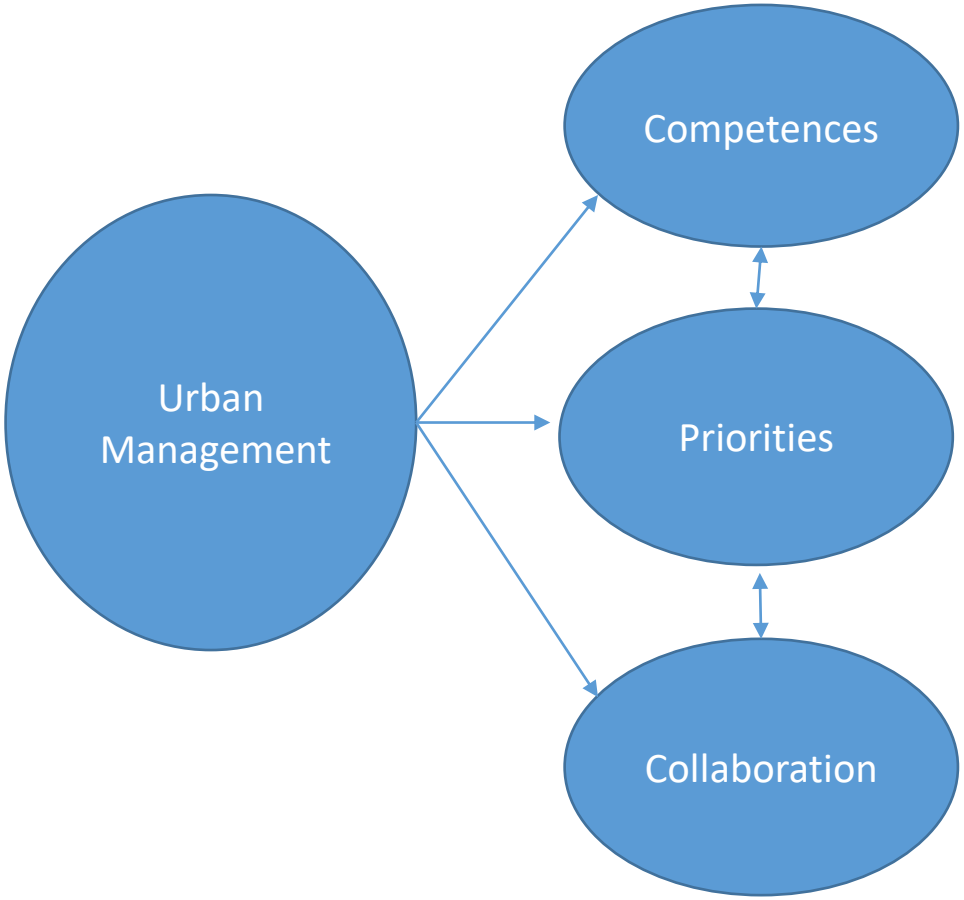
Fundament: Competences + Priorities+ Collaboration



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Explanatory findings

Figure 2: Relationships between level of competence and current and future importance of domain priorities

Note: * < .05, ** < .01, *** < .001

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Key findings

- SC service of Natural Resources & Energy: strong relation between level of competence and current importance (as well as Smart Building/Smart Home); currently and in future highly important, but currently negatively adding value (insignificant, but indication: highest need for development as well as transportation and mobility)
- All SC services are currently and in future of importance pointing to a long-term commitment to all of the services
- Smart living has the highest future importance followed by Natural Resources & Energy and Smart Government.
- The topics add in future even higher value to SC (relation between adding currently value and adding future value).

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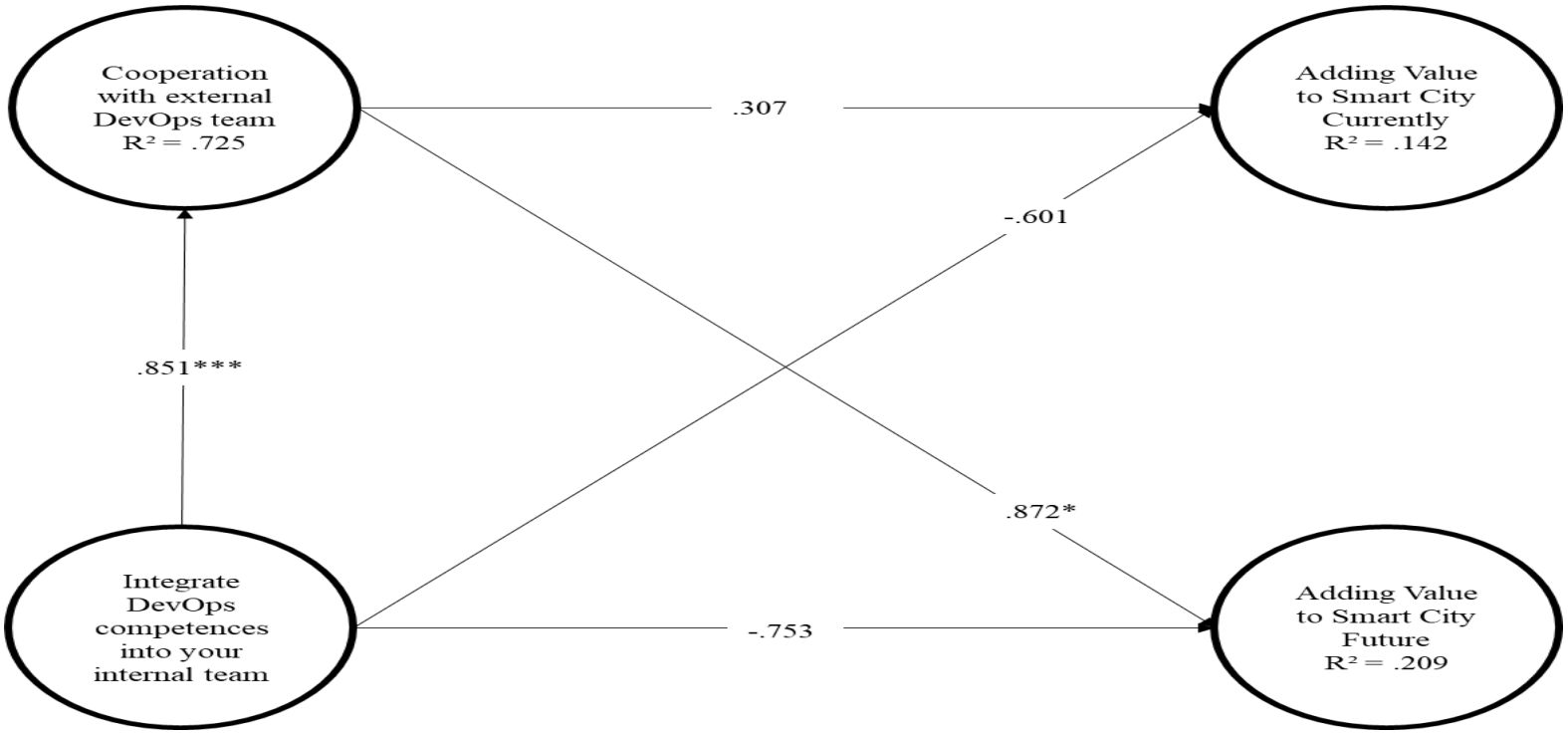
Key Findings

Figure 3: Results of structural equation modelling, own depiction.

Note: * < .05, ** < .01, *** < .001



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Key Findings

- A strong positive and significant relationship between Integrating DevOps competences into the own team and Co-operation with External DevOps teams; this co-operation with have a strong adding value to Cities in the Future (indicating high perceived importance of DevOps); DevOps competences in the own team (at least partially) is a precondition for collaborating with external partners.
- Indicative as not significant findings: co-operation currently adding less value (and low level of explanation of current value addition);
- Indicative as not significant: integrating DevOps Competences into the own team has a negative relationship to currently adding value and adding value in the future; reflecting current low level of competences in DevOps competences

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Key take aways of the added analysis

- The research confirms the existence and training of competences to be conditional for priority setting of services and requested collaboration with external partners.
- With emphasizing competences and its relationship to priorities and collaboration, the DevOps project put a good foundation for more detailed conceptual work.
- If companies are integrating more DevOps competences into their internal team, the co-operation with external DevOps teams is more likely, however, a certain degree of DevOps competences is necessary
- The adding value to the SC increases, in times companies co-operate with external DevOps teams.

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Key Takeaways

- Smart city planners perceive and do need trainings in certain competences in order to generate own additional and sustainable human capital.
- Competences regarded as most important should be trained and existing in-house instead of outsourcing these competences externally.
- An increase of competences lead to a higher current and future importance of every priority subdomain.

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Further Research

- Considerably increase the sample size and replicate the quantitative research by detailed operationalization and investigating possibly existing moderating or mediating effects
- Digital Sovereignty
- Specific focus on Marginalized Groups
- Societal implications: i.e. Brain Drain from Regions; Identity
- Differentiation of a Smart City strategy as to capitals, small cities and, especially, regions and relate this differentiation to the DevOps technology
- A differentiation of Smart City strategies as to northern European (low context) and Mediterranean European countries (high context)

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Further Research

- Covid19: Health Services and AI; Data for Good

- More explicitly relate DevOps to concrete benefits for the smart cities: i.e. individualized City identity, increased competitive advantage of the SC, tailormade and quicker problem solutions, entrepreneurial opportunities due to higher level of innovation

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Final Call

Proposal: Smart City Multi-Disciplinary and Creative Research Labs and Idea Tanks for Smart City Improvements.

You are cordially invited to project events!

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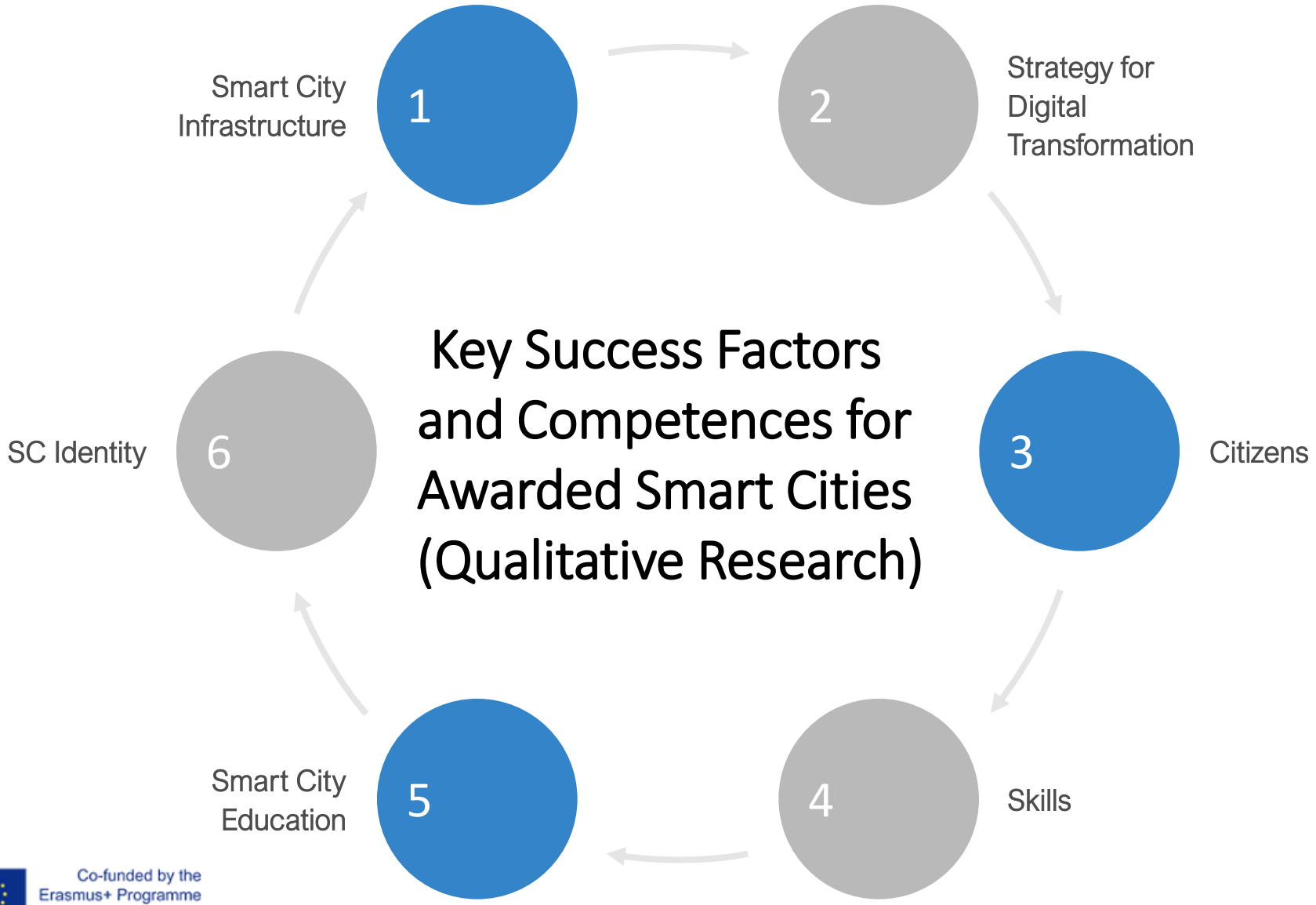

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DEVOPS COMPETENCES FOR SMART CITIES

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

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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

- 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 CDOs
- 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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Conclusions

- A standardized block of general IT competences to all three profiles
- Compared to European VET providers, DevOps imparts competences on ‘Agile methods’, ‘IT Quality Assurance’ and ’Introduction to Artificial Intelligence’.
- Central general IT competences: ‚technical skills to switch from operational to strategic tasks’ and the ‘broad and deep process understanding due to higher process complexity’
- Most required general IT competences for IT managers: ‘Evaluate and apply the integration between Geospatial Technologies and traditional IC Tech & Engineering Processes’

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Conclusions

- As to DevOps specific skills: Smart City Planners should be trained only on Introduction to DevOps and on Monitoring Tools (other competences optional)

- All DevOps specific skills are mandatory for CDOs and IT officers (common training packages)

- European VET training offers clearly lack of DevOps training (niche character of DevOps project)

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Conclusions

- Associate DevOps with the benefits for diverse stakeholders rather than merely associating DevOps with technical connotations

- DevOps skills are the most requested, among the technological ones: after IoT specific Knowledge and before Machine Learning and Deep Learning.

- ITIL Services: undecided if mandatory or optional or relevant

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Conclusions

- All Smart City related competences are judged mandatory for both, Smart City Planners and CDOs implying a unified training package
- High degree of commonality with European Training providers on Smart City related competences.
- As to Smart City related competences: Identity to be included (differentiating factor as to European VET offers)

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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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