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## The importance of selected factors in smart city development: the student's perspective

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### Abstract

Smart city means creativity and intelligence. In this paper we focus on the 'smart city' concept, and understanding its selected features by students of the Faculty of Law, Administration and Management at the Jan Kochanowski University in Kielce. The data was collected in April 2016.

The paper is structured into four parts. In the first section we concentrate on 'smart city' definitions. In the second section, we concentrate on 'smart city' indicators and factors presented in literature. Section three concerns the 'smart city' phases of development. In section four we focus on our own research with our hypothesis presentation and validation.

**Keywords:** smart city, development, factors

### 1. Introduction

All over the world, cities are being reborn. By one estimate, about 80% of global GDP is generated in cities – driven by a mixture of urbanisation, geographic sprawl and concentrated zones of innovation. As a result, a whole new market has opened up for 'smart cities' [1].

The concept of the 'smart city' itself can be fuzzy and inconsistent. In general, 'smart city' means "creativity and intelligence". In detail, 'smart city' means different things. For some, it may be finding ways to relieve pollution or congestion - using sensors and data analysis. For others, it is more about finding ways to make cities greener - with more parks.

In this paper, we focus on the 'smart city' concept, and understanding its selected features by students of the Faculty of Law, Administration and Management at the Jan Kochanowski University in Kielce.

The paper is structured into four parts. In the first section we concentrate on 'smart city' definitions. In the second section, we concentrate on 'smart city' indicators and factors presented in literature. Section three concerns the 'smart city' phases of development. In section four we focus on our own research with our hypothesis presentation and validation.

### Smart city definition

A city can be defined as 'smart' when investment in social and human capital, combined with investment in traditional (transport) and modern information and telecommunication infrastructure, generates sustainable economic development and a high quality of life, while promoting prudent management of natural resources, through participatory governance [2]. Another perspective which indicates that a city is 'smart' is when that city can integrate and synchronize formal leadership and endogenous democratic participation in the IT-based urban ecosystem. This means that a 'smart city' is a hybrid model combining democratized open innovation with central city support, coordination, and monitoring [3].

In a narrow perspective, 'smart city' might be understood as a city that uses information and communication technologies to deliver services to citizens. In a broader aspect, 'smart cities' use information and communication technologies (ICT) to be more intelligent and efficient in the use of resources, resulting in cost and energy savings, improved service delivery and

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quality of life, and a reduced environmental footprint - all supporting innovation and the low-carbon economy [4].

Gartner defines a 'smart city' as an urbanized area where multiple sectors cooperate to achieve sustainable outcomes through the analysis of contextual, real-time information shared among sector-specific information and operational technology systems [5].

The document 'Smart Cities & Communities' issued by the European Commission in 2011 states that: "A smart city...uses digital technologies to enhance performance and well-being, to reduce costs and resource consumption and to engage more effectively and actively with the citizens. Key smart sectors include transport, energy, health care, water and waste. A smart city should be able to respond faster to urban and global challenges than one with a simple 'transactional' relationship with its citizens" [6].

**Smart city indicators and factors**

The six most-common indicators of 'smart cities' are, smart economy, smart people, smart governance, smart mobility, smart environment, and smart living.

'Smart economy'- means competitiveness, and consequently entrepreneurial skills, economic image and trademarks, productivity, flexibility of labour market, ability to innovate, etc. [7].

'Smart people' - social capital drives this dimension. 'Smart people' are the result of ethnic and social diversity, tolerance, creativity, and engagement. Cities may offer

online courses and workshops, online assistance with education, and programs and services designed to raise social capital and qualifications [8].

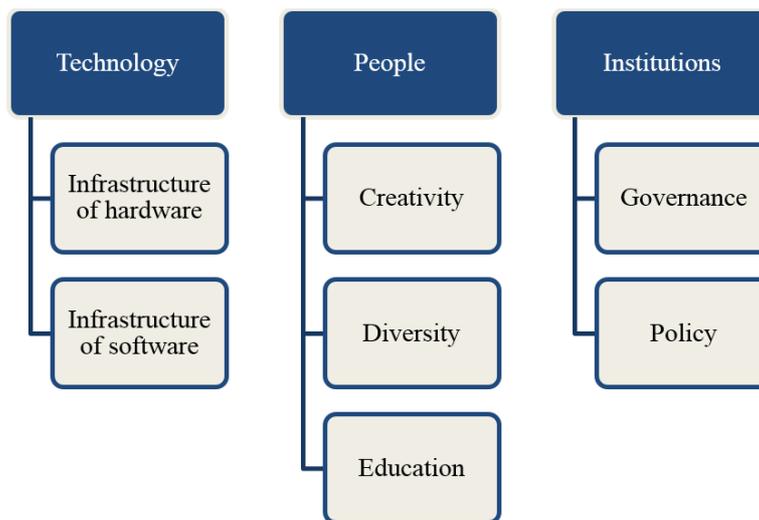
'Smart governance' - implies participation in the decision-making process, availability of public and social services, transparent governance, good political strategies, and perspectives [9].

'Smart mobility'- with local, national and international accessibility, for the promotion of sustainable, innovative and safe transport systems [10].

'Smart environment' - the use of innovative technologies, such as solar energy and other renewable sources of electricity, can enhance the natural environment [11].

'Smart living' - concerns improving quality of life in terms of services, enhancing attractiveness for tourists, and promoting social cohesion and safety. 'Smart living' includes cultural facilities, e-health, social services, and public safety tools, such as surveillance systems and inter-emergency service networks. Other tools such as smart sensors and wireless platforms exist. Projects such as 'Smart Cities IBM', 'Smarter Neighborhoods', and 'Box Projects Alcatel', aim to develop a 'smart city'. Scholars show an increasing interest in living labs and Free Art and Technology Lab as incubators for innovation and knowledge [12].

Mentioned indicators lead to the factors of the 'smart city' concept. This factors are: technology, people and institutions (see Figure).



**Fig 1:** Factors of smart city concept.

**Source:** Based on: J. H. Lee, M. G. Hancock, M-Ch. Hu, *Towards an effective framework for building smart cities: Lessons from Seoul and San Francisco*, "Technological Forecasting & Social Change" 2014, Vol. 89, s. 81-82.

First of all, the concept of a 'smart city' must contain software and hardware infrastructure. Secondly, people must be creative and willing to use that infrastructure (the infrastructure must be common and easy to use by users). And finally, there must be policy supporting this concept.

As a supplement, it is worth indicating the six characteristic features defining a 'smart city':

1. Improving economic and administrative efficiency and enabling the development of culture and society by utilizing networked infrastructures;
2. An underlying emphasis on business-oriented urban development;

3. A strong focus on the goal of realizing the social inclusion of different kinds of urban residents in public services;
4. Emphasizing the significant role of high-tech and creative industries in long-term growth;
5. Paying close attention to the function of social and relational capital in city development;
6. Taking social and environmental sustainability as an important aspect of 'smart city' development [13].

**3. Smart City phases**

Three distinct phases of how cities have embraced technology and development may be distinguished, moving

tech-company driven, to city government driven, to, citizen driven.

First phase – Smart Cities 1.0: technology driven. This technology-centric vision of ‘smart cities’ creates an environment that is attractive to urban technology innovators, who in turn have the potential to grow the economy. Smart Cities 1.0 is characterized by technology

providers encouraging the adoption of their solutions to cities that were really not equipped to properly understand the implications of the technology solutions, or how they may impact the citizen’s quality of life. Smart Cities 1.0 is also the underlying philosophy behind most of the bespoke ‘smart cities’ projects proposed around the globe from PlanIT in Portugal, to Songdo in South Korea <sup>[14]</sup>.

**Table 1:** Information marketplace in smart city

Real-time data inputs	Raw data	Information component	Information products
Citizen, mobile device	-Date/time -Location -Communication Pattern -Services Accessed		
Public transport	-Location and time of use -Number of passengers -Journey time -Potential delays	-Number of mobile subscribers on bus in neighborhoods -Usage patterns of public transport in different neighborhoods	Improved decision making -Feedback to improve public transport services -Reducing cost of delivery of government services
Mobile network	-Location -Cell Tower Information -Services Accessed -Length of time and extent of use -Usage patterns of subscribers	-Load on mobile network in certain neighborhoods during different events e.g. concerts	Product for sale -Feedback to improve public transport services -Reducing cost of delivery of government services -Improving crime response rate
City areas	-Temperature -Environmental data -Usage patterns -Demographics	-Demographics of Mobile Internet Usage -Mapping of cities digital divide	
City maps	-Routes -Geospatial information		

**Source:** E. Cosgrave, K. Arbuthnot, T. Tryfonas, *Living Labs, Innovation Districts and Information Marketplaces: A Systems Approach for Smart Cities*, “Procedia Computer Science” 2013, Vol.16, p. 760.

Second phase - Smart cities 2.0: technology enabled, city-led. In this generation, the municipality - led by forward-thinking mayors and city administrators - takes the lead in helping to determine what the future of their city is and what the role is for the deployment of smart technologies and other innovations. In this phase, city administrators increasingly focus on technological solutions as enablers to improve quality of life. Most leading “smart cities” are probably Smart Cities 2.0. Barcelona, for example, has more than 20 ‘smart city’ program areas and more than 100 active ‘smart city’ projects, from Wi-Fi in public spaces and public transit to intelligent lighting and the promotion of an electric-vehicle charging infrastructure.

Third phase - Smart Cities 3.0: citizen co-creation. In the past year, a new model has started to appear. Leading “smart cities” are beginning to embrace citizen co-creation models for helping to drive the next generation of “smarter cities”. Vienna, for example, is a leading city regularly at the top of the ‘smart city’ rankings. It continues to be quite active in the 2.0 model and, like Barcelona, also has more than 100 active ‘smart city’ projects. But some of those projects have a different feel. For example, in a partnership with the local energy company, Wien Energy, Vienna included its citizens as investors in local solar plants as a contribution to the city’s 2050 renewable energy objectives. It has also had a strong focus on citizen engagement in addressing affordable housing and gender equality. Smart Cities 3.0 appears to be grounded more in the issues of equity and social inclusion as well. The emergence of ‘sharing cities’ is one example where cities are providing the enabling conditions to allow

local sharing activities to emerge. While massive, venture capital backed platform companies like Airbnb and Uber are not necessarily consistent with Smart Cities 3.0 visions, many other projects such as Repair Cafes, tool-lending libraries for performing repairs to your home, and bike-sharing services have the potential to not only optimize under-utilized resources but also raise the quality of life for all residents <sup>[15]</sup>.

**4. Conceptual framework and hypothesis development**

The study included 64 students at the Faculty of Law, Administration and Management at the Jan Kochanowski University in Kielce. The data was collected in April 2016. Participants were first asked to give their self-assessment by answering questions on their opinion about ‘smart city’ aspects. The response format was a seven-point scale with: 1 – the less important;...; 7 – the most important. Subsequently, the questionnaire contains questions concerning socio-demographic variables such as gender, job situation or place of residence.

Therefore, the following hypotheses are presented:

- H1: Men, compared with women, will be more oriented about the knowledge of the ‘intelligent city’ notion.
- H2: City dwellers, compared with village inhabitants, will be more oriented about the knowledge of the ‘intelligent city’ notion.
- H3: Men, more than women, perceive human capital improvement as important indicator of ‘smart city’ development.

- H4: City dwellers, more than village inhabitants, perceive human capital improvement as important indicator of ‘smart city’ development.
- H5: Men, more than women, perceive quality of live improvement as important indicator of ‘smart city’ development.
- H6: City dwellers, more than village inhabitants” perceive quality of live improvement as important indicator of ‘smart city’ development.
- H7: Men, more than women, perceive increase of the city inhabitants’ participation as important indicator of ‘smart city’ development.
- H8: City dwellers, more than village inhabitants, perceive increase of the city inhabitants’ participation as important indicator of ‘smart city’ development.

The methodological tool used to examine the above relationships was a non-parametric significance test chi-

square and parametric significance test t-student. The null hypothesis was rejected at the significance level  $p = 0.05$ .

The demographic balance of men and women is reflected in a sample with 71.9 per cent women ( $n=46$ ) and 28.1 per cent men ( $n=18$ ). The proportion of people living in a village is 57.8 per cent ( $n=37$ ) whereas 42.2 per cent ( $n=27$ ) live in a city. There are 11 per cent ( $n=7$ ) people that only study, whereas 28 per cent ( $n=18$ ) study and work in the public sector, and 61 per cent ( $n=39$ ) study and work in the private sector.

In order to test Hypotheses 1 and 2, we first tested differences in knowledge of the ‘intelligent city’ notion. The difference in knowledge of the ‘intelligent city’ notion between two groups (men vs. women) was not statistically significant (chi-square = 0.724,  $p = 0.389$ ). H1 was rejected. The difference in knowledge of the ‘intelligent city’ notion between two groups (village vs. city) was not statistically significant (chi-square = 0.300,  $p = 0.584$ ). H2 was rejected.

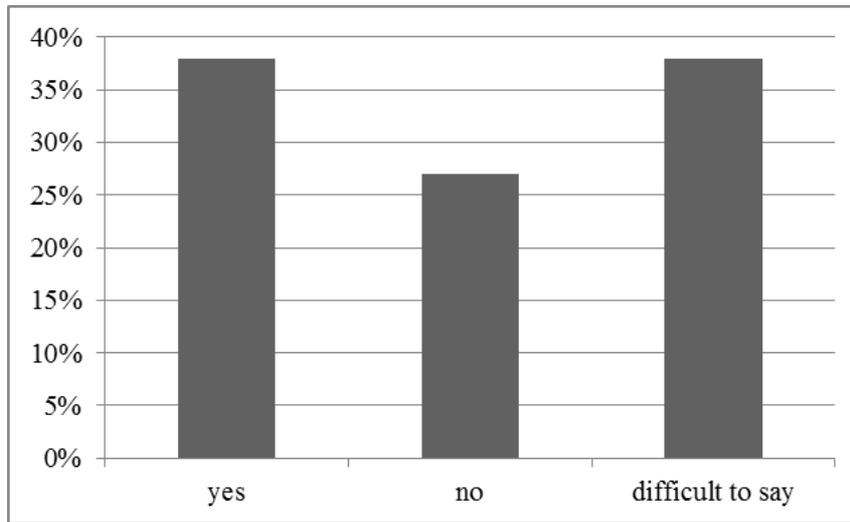
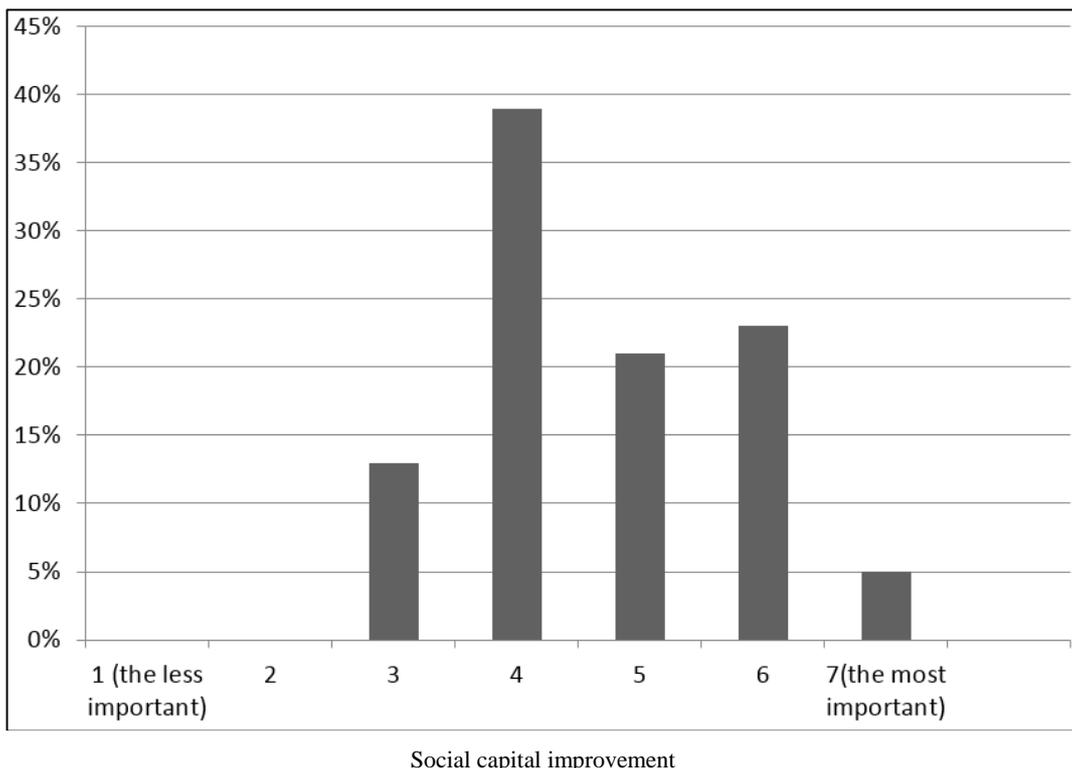
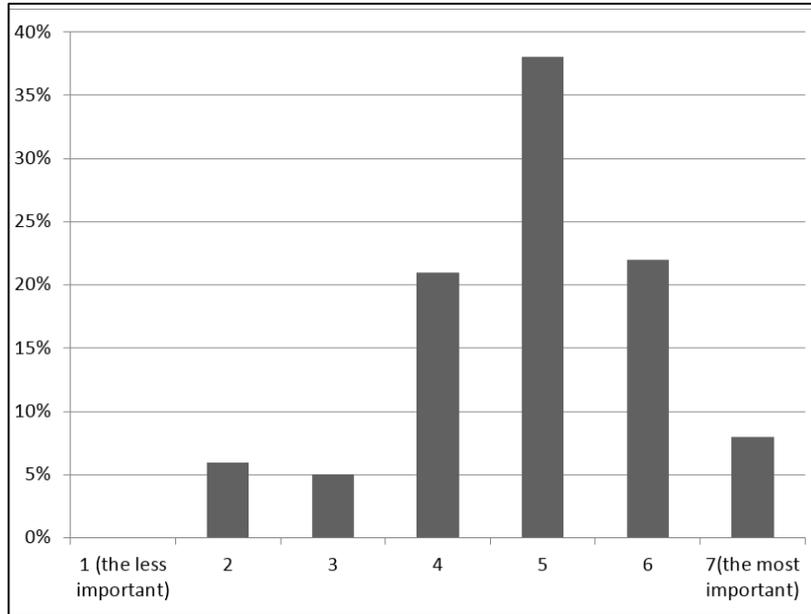


Fig 2: Do you know of the ‘intelligent city’ notion?

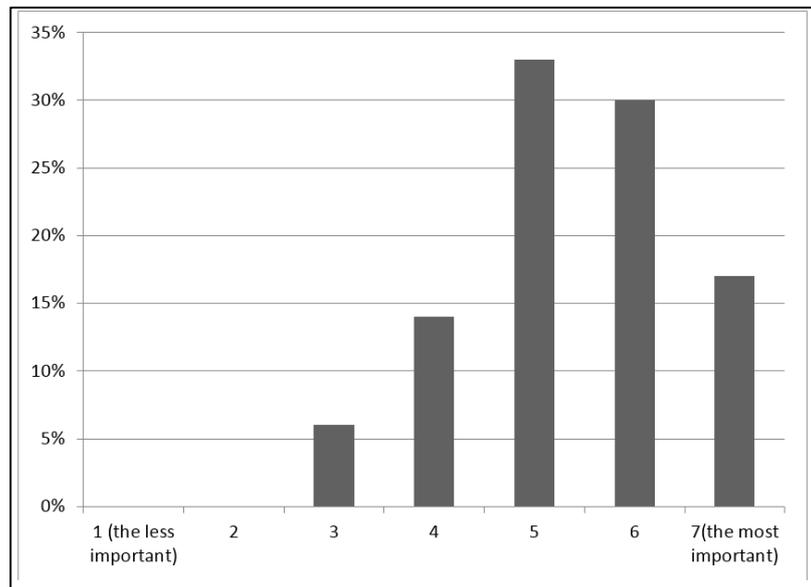
Source: Own analysis.



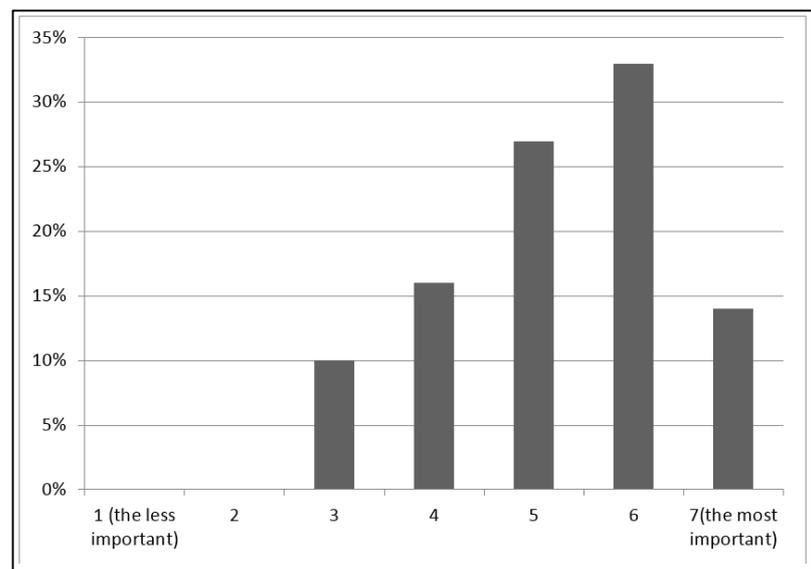
Social capital improvement



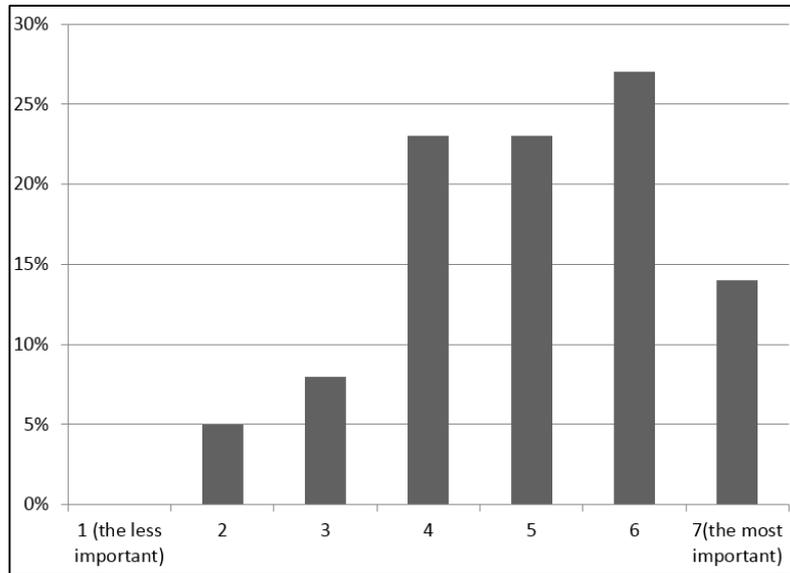
Human capital improvement



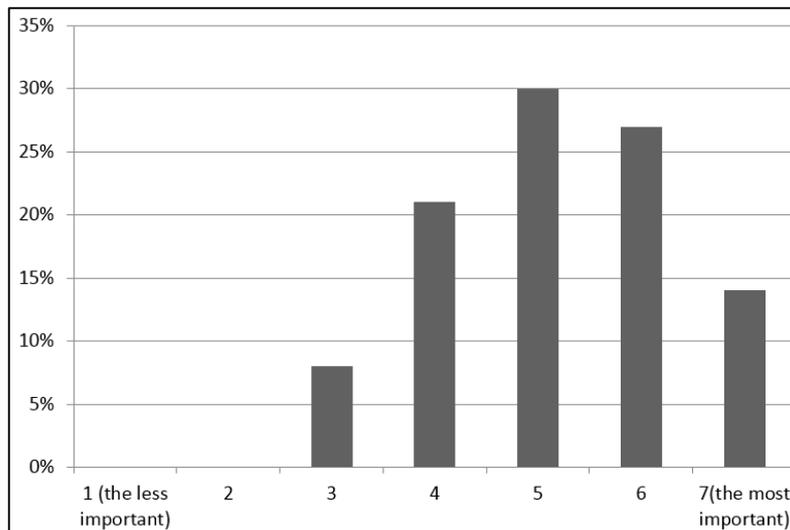
Quality of live improvement



Obtaining financial benefits for the city

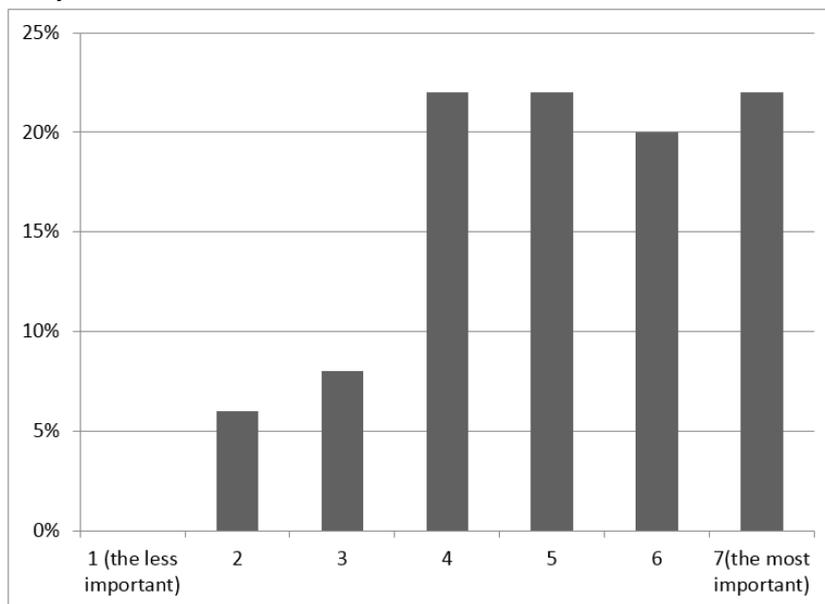


Obtaining financial benefits for companies functioning in the city

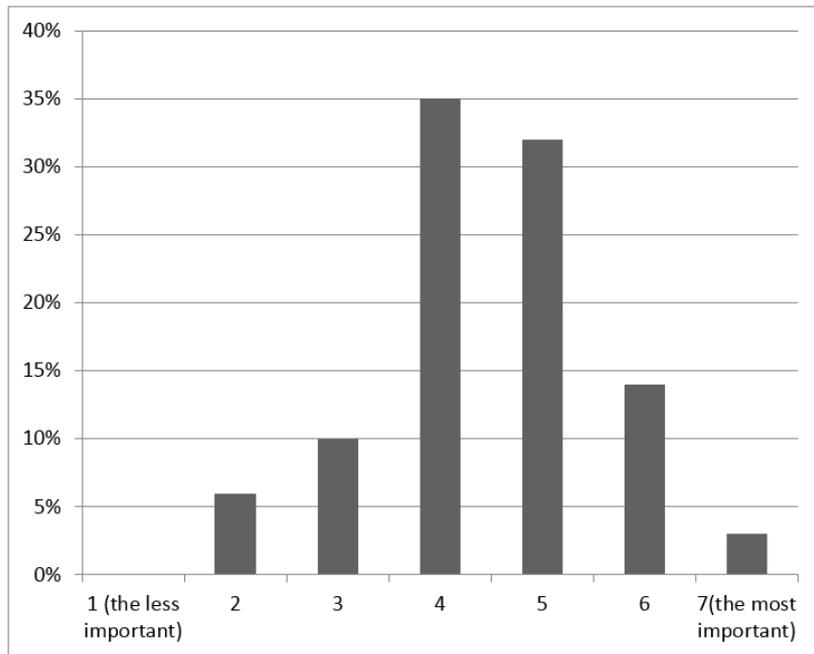


Improvement of the infrastructure of public and private communication

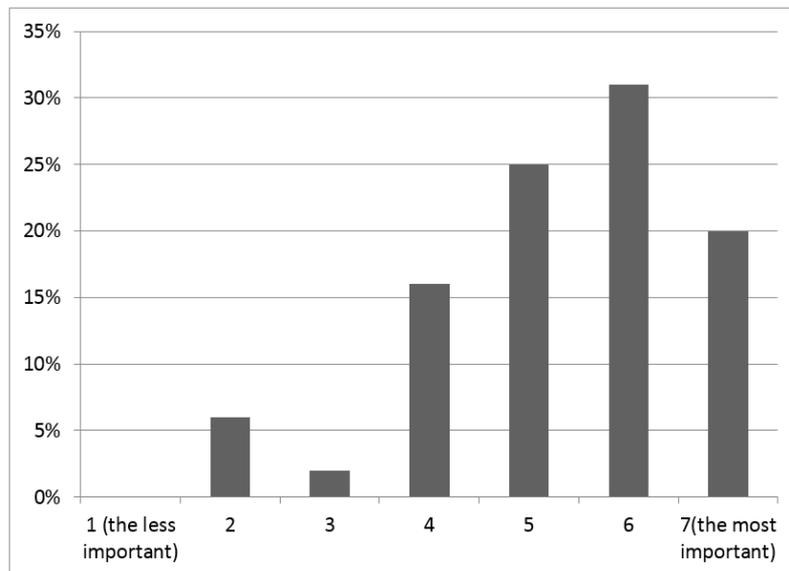
**Fig 3:** Please indicate meaning of the following factors in the smart city development – all respondents (Part 1)  
**Source:** Own analysis.



Efforts to clean the city



Increase of the city inhabitants participation



City image improvement

**Fig 4:** Please indicate the meaning of the following factors in the smart city development – all respondents (Part 2)

In order to test Hypotheses 3, 4, 5, 6, 7 and 8, we tested differences in meaning of chosen characteristics in ‘smart city’ development.

A *t*-test found the deviation between the means of human capital improvement for the two groups (gender) to be statistically significant at a  $p < .05$  level ( $t = -2.091, p = 0.041$ ). Men more than women perceive human capital improvement as important indicator of ‘smart city’ development ( $M = 5.39, SD = 0.916$ ) vs. ( $M = 4.69, SD = 1.294$ ). H3 was supported. Other variables were not statistically significant. H5 and H7 were rejected.

A *t*-test found the deviation between the means of human capital improvement for the two groups (place of living) to be statistically significant at a  $p < .05$  level ( $t = -2.341, p = 0.023$ ). City dwellers more than village inhabitants perceive

human capital improvement as an important indicator of ‘smart city’ development ( $M = 5.31, SD = 1.011$ ) vs. ( $M = 4.59, SD = 1.301$ ). H4 was supported. Other variables were not statistically significant. H6 and H8 were rejected.

From the perspective of all respondents the most important factors of ‘smart city’ development are: improved quality of life, city image improvement and obtaining financial benefits for the city. On the other hand, the least important are: increase of the city inhabitants’ participation, social capital improvement and human capital improvement.

At the end of this article it is worthwhile to indicate several limitations. First, the sample only consisted of students from The Jan Kochanowski University in Kielce. Second, the small sample size raises the issue of generalizability.

**Table 2:** Factors of smart city development

Factor	M	SD
Social capital improvement	4.68	1.113
Human capital improvement	4.89	1.233
Quality of live improvement	5.38	1.120
Obtaining financial benefits for the city	5.27	1.181
Obtaining financial benefits for companies functioning in the city	5.02	1.315
Improvement of the infrastructure of public and private communication	5.19	1.162
Efforts to clean the city	5.08	1.483
Increase of the city inhabitants participation	4.48	1.148
City image improvement	5.34	1.348

**Source:** Own analysis.

### Conclusion

This study examines the factors indicating 'smart city' development from the perspective of students of the Faculty of Law, Administration and Management at the Jan Kochanowski University in Kielce. The results show that students analyze factors of the 'smart city' concept very similarly. Differences in perceiving of factors of the 'smart city' concept contained only 'human capital improvement'. The results also show that respondents perceive the 'smart city' concept mostly from the perspective of the first phase. It is important to underline co-creation in city dwellers' consciousness to make the step into the third phase of the 'smart city' concept.

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