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# CROWD-BASED OPEN INNOVATION IN TELCO OPERATORS: READINESS ASSESSMENT FOR SMART CITY SERVICE DEVELOPMENT

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**Abstract**

This paper studies the readiness of the Serbian telco operators and other stakeholders to implement a crowd-based open innovation business model. Telco companies are facing challenges in terms of market demands and with finding new opportunities to attract subscribers with innovative products and services. These innovations are frequently oriented towards smart city services based on emerging technologies such as Internet of things, cloud computing, software defined networks and blockchain. Due to complexity, pace and costs of research and development, telco operators have already recognized the need to shift from a traditional to an open innovation concept. The development of crowdsourcing models has further fueled the possibility to include customers in the open innovation process, in order to better design and develop services suited to their own needs. With this in mind, the goal of this paper is to propose a crowd-based open innovation business model for improvement of innovation capacities of Serbian telco operators. The proposed model is used as the basis of evaluating the readiness of internal and external stakeholders for participation in open innovation projects. The study is based on the adjusted value-based adoption model, while the analysis is performed using the PLS-SEM method. The results show that participants identify trust as the most influential factor for the perceived value of crowd-based open innovation, while the internal stakeholders of telco companies find expected income and reputation as the most relevant. Both groups have shown a high interest in innovations related to smart city services such as smart traffic and ecology-related services.

*Keywords*: telco industry, open innovation, crowd-based business models, smart cities

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## 1. INTRODUCTION

During the COVID-19 pandemic the telecommunications sector has been faced with number of challenges related to the increase in load on the networks, optimizations of the infrastructure, data and service security, efficient resolving of complaints. Furthermore, Telco companies face challenges in terms of market demands and the difficulty of finding new opportunities for attracting subscribers with new innovative products and services. These challenges also provide new opportunities to create new shared value through innovation. These opportunities should be seized, and used to improve the capacity to develop and attract subscribers by introducing external ideas into the company's business and offering new innovative products and services. One of the areas full of such opportunities where services are not yet fully defined and for which profiling approaches are still required are smart city services. These smart city services can be implemented through new communication models and technologies such as: Internet of Things (IoT), machine-to-machine (M2M), vehicle-to-everything (V2X), device-to-device (D2D), human-to-machine, software-defined network (SDN), Edge computing, device-to-cloud (D2C), Blockchain technologies.

This paper analyzes the readiness of telco companies in Serbia to apply the concept of open innovation in profiling of new smart city services. The analysis is focused on the possibility of applying the crowd-based open innovation business model in Serbian business environments. This business model was chosen because regular activities of telco companies already provide resources to Internet services, as well as possess sufficient human resources to organize and carry out complex business processes. Telecommunication companies within this business model can carry out the profiling of the innovation process in two ways: as providers of the platform for open innovation, and as users of the same platform for their own innovation processes.

The main hypothesis of the research, whose results are presented in this paper is: A crowd-based open innovation business model is suitable for application in telco companies operating in Serbia. The proposed business model relies on the utilization of Internet as the platform of choice and Serbian telco companies have sufficient technical and technological equipment and trained staff to implement the proposed model. In order to confirm this hypothesis, a readiness study of companies in Serbia for crowd-based open innovation business model was conducted. The research covers two aspects of the application of the model: one is related to potential providers of an open innovation platform specialized for telco companies. Some of the providers that meet the requirements are: Telekom Srbija, PTT Serbia, A1 and Yettel. The other aspect considered is other companies, public administration and educational institutions, as potential users of the platform for open innovation.

The impact of different perceived benefits was analyzed for crowd participants (satisfaction, improvement of their own knowledge and skills, independence in work, financial benefits, reputation, social responsibility) and for companies (improvement of innovation activity, value-added services, reputation, social responsibility, expected income). Furthermore, perceived sacrifices were analyzed for crowd participants (effort, time

spent, perceived personal loss of knowledge power) and for companies (effort, costs, risk, perceived loss of knowledge power in relation to perceived new value and willingness to participate).

The material presented in this paper is organized as follows: the second chapter provides an overview of the literature in the field of open innovation. Special attention in the analysis of the literature is paid to the European Union's initiative "Open Innovation 2.0", platforms for open innovation, as well as ecosystems and business models of open innovation. The third chapter provides the research methodology based on the value-based adoption model (VAM) used in the analysis. The results of the research and their analysis are given in the fourth chapter. The conclusion, directions of future research and used literature are given in the final part of the paper.

## 2. LITERATURE REVIEW

The term "open innovation" was first introduced by Chesbrough in "Open Innovation: The New Imperatives for Creating and Profiting from Technologies ". Chesbrough concept of open innovation is defined as: the use of knowledge from the company and its environment, in order to accelerate internal innovation processes with external knowledge, and increase the market for external placement of existing internal innovations (Chesbrough 2003, 2006; Chesbrough & Bogers, 2014) (Figure 1). Open innovation can also be defined as "a distributed innovation process based on management of knowledge flows outside the organization" (Chesbrough & Bogers, 2014; Bogers et al., 2018).

Models of open innovation can be roughly divided into: Outside-in model - whose aim is to take external knowledge and include it in the internal innovation processes, and

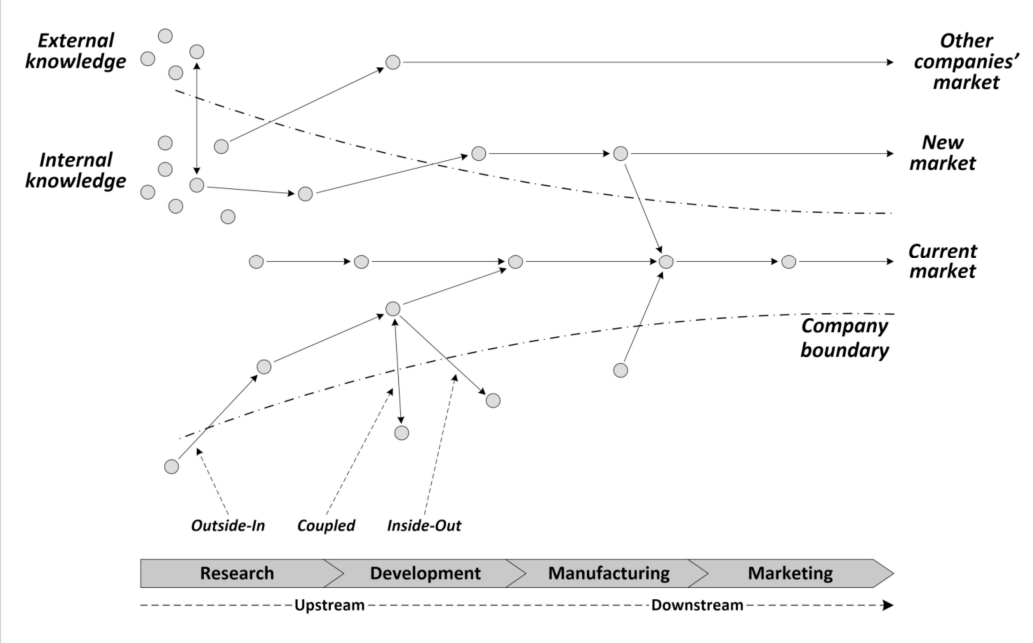


*Figure 1. Open innovation model (adapted from Chesbrough & Bogers, 2014)*

Inside-out model in which internally generated knowledge is presented to other companies (Inauen et al., 2012). With the rapid development of information technologies and the emergence of the Industry 4.0 paradigm, the conditions have been created for the innovation process to make a shift towards the integration of innovative activities in order to open new markets and offer new and innovative services (Curley & Salmelin, 2013). To foster synergies and integrative processes in innovation, the European Commission presented the Open Innovation 2.0 (OI2) approach based on the principles of integrated cooperation, joint value creation and the creation of innovation ecosystems (Nepelski, 2019). A summary of the development of open innovation, an overview of the current situation and a set of open problems to be addressed in the future are given in detail in the papers (Bigliardi et al., 2021; Grimaldi et al., 2021; Payán-Sánchez et al., 2021).

Adoption of OI2 approach integrates 6U adoption patterns (European Commission, 2018):

•utility - explores what values or usefulness the innovation provides.

• uniqueness - is the chief factor in adoption of innovations and provides the means of meeting the needs of people in real-time.

• usability - examines how usable the new innovation or service is.

• user experience - products and services that provide better user experience are being adopted more quickly.

• ubiquity – innovation take advatage of network, software, information and economics.

• user-driven innovations – users share their innovation with others, create new intellectual commons, and associated user-driven innovation communities.

To support integrative innovation processes, digital platforms for open innovation have been developed, most commonly in the form of a virtual environment providing digital services to support the creation of innovations, and encourage innovators to overcome temporal and spatial distance in collaboration. According to their functionality, platforms for open innovations can be divided into: Innovation Contest; Innovation Communities; Innovation Marketplaces; Innovation Toolkits and Innovation Technologies (Hallerstede, 2013). Given the integrative nature of open innovation, there is a wide range of stakeholders involved in the operation of open innovation platforms. The companies that implement and maintain the platform are the platform providers. They provide technical support, innovative services and legal security for participants in the innovation process by monetizing the provided services. The users of the platform can be businesses, entrepreneurs, freelancers, citizens, public administration, civil society, and academia. Platform users can be further divided into two groups: seekers and solvers. Platform providers face challenges: how to motivate someone to participate and how to inspire participants to generate creative ideas (Witt, 2017; Singh et al., 2021). These problems can be solved by choosing an adequate open innovation business model. Business models of open innovation platforms are domain-specific, in the sense that formation of a business model should begin with clear answers to the questions: What should be done? Who works? Why is this being done? (Malone et al., 2010; Mubarak & Petraite, 2021). One way to define a business model that can be

applied to open innovation platforms is given in (Osterwalder & Pigneur, 2010) where the business model is described as the way a company creates, delivers and monetizes newly created value. To better conceptualize the business model a Business Model Canvas (BMC) is presented.

## 3. METHODOLOGY

### 3.1. Research context

The core of the business model proposed in this paper is based on the recommendations of the European Commission for Open Innovation 2.0 (Nepelski, 2019). In defining the business model, experiences from the analysis of public administration support for the development of open innovation in Vojvodina (Anisic et al., 2013) were used, as well as the analysis of barriers to open innovation in the Republic of Macedonia (Janevski et al., 2015) and the Republic of Serbia (Sarić et al., 2019).The model's domain of application are smart city services, functionalities specialized for this domain are provided by the Open Innovation Platform, an approach based on best practice in Crowdsourcing platforms, which includes crowdsourcing, crowdfunding, microwork, social product development (SPD) and the sharing economy (Abhari et al., 2022). Crowd based open innovation business models enables companies to find sources of innovation and actors in the innovation process in the business environment and among citizens. The Internet platform enables the actors of the innovation process to perform technical, marketing, legal and financial tasks related to the innovation process, efficiently and remotely (Tremblay & Yagoubi, 2017). By adopting open innovation models, companies can easily and efficiently expand their capacity to innovate, generate new ideas, improve research performance, develop businesses and grow revenue. Citizens can get involved in this process in order to realize some financial or otherwise expressed interest (Saebi & Foss, 2015). The results from (Rosienkiewicz et al., 2022) were used when considering the involvement of the academic community. The role of managers in this model is profiled according to the recommendations from (Shaikh & Randhawa, 2022).

The business model canvas of the proposed model can be seen in Table 1.

The provider of the open innovation platform provides technical infrastructure, internet services for the operation of the platform, marketing of the platform, business processes, customer support, service billing, and protection of copyright and other rights. Users of the open innovation platform are divided into two groups, those who seek partners with ideas and knowledge for specific innovations through the platform, and another group of stakeholders who want their innovative ideas and knowledge for money or other expressed interest to give to those in need. The platform enables them to connect with each other, legally formulate mutual relations and obligations, and provides them with internet services to support the realization of contracted work. This is a complex set of tasks. One part of the research is dedicated to the analysis of the readiness of large telecommunications companies in Serbia to include an internet platform for open innovations in the portfolio of their services.

Users of the open innovation platform are divided into two groups:

- users who search through the

*Table 1. Business model canvas for proposed model*

<table>
<tr><td colspan="5">Products and services: An open innovation platform for smart city service development</td></tr>
<tr><td rowspan="2">Key partners.<br>City government.<br>Citizens.<br>Freelancers.<br>Entrepreneurs.<br>Companies.<br>Utility companies.<br>Scientific research institutions.<br>Educational institutions.<br>Telecommunication operators.<br>Manufacturers of telecommunications equipment.</td><td>Key activities.<br>Development of an open innovation platform.<br>Infrastructure development for smart city services.<br>Development of smart city services.<br>Marketing.<br>Public Relations.<br>Intellectual property management.</td><td rowspan="2">Proposed value.<br>For crowd participants:<br>- pleasure,<br>- improvement of own knowledge and skills,<br>- independence in work,<br>- financial incentive,<br>- reputation<br>For companies:<br>- improvement of innovation activities<br>- services with added values.<br>- reputation.<br>Social responsibility in the form of environmental protection and improvement of quality of life.</td><td>Customer relationship.<br>Self-service platform for open innovations.<br>Existing user base and communication channels.</td><td rowspan="2">Market segments.<br>Citizens and other users of smart city services.</td></tr>
<tr><td>Key resources.<br>New business models and technologies of smart cities.<br>Safety systems.<br>Human Resources.</td><td>Channels.<br>Platform for open innovations.<br>Mobile communications (SMS, messaging applications).<br>Social media.</td></tr>
<tr><td colspan="3">Cost structure.<br>Costs of developing and maintaining an open innovation platform.<br>Financial incentives for participants.<br>Marketing costs.</td><td colspan="2">Sources of income.<br>Subscription for developed smart city services.<br>Grants for innovation projects.</td></tr>
</table>

platform for partners with ideas and knowledge for concrete innovations, and

• interested users who want to monetize their innovative ideas and knowledge or otherwise donate to those who need it.

The platform enables users to connect with each other, legally formulate mutual relations and obligations and Internet services for the support in implementation of contracted work. Users of the platform can be companies that are platform providers, companies, public administration, academic institutions, entrepreneurs, freelancers and citizens. The second part of the research is dedicated to their readiness to participate in crowdsourcing projects on the open innovation platform.

One of the areas where increased needs for innovation are expected in the future are Smart cities. For this reason, readiness of telco providers' users and internal stakeholders was examined in the context of smart city service development.

### 3.2. Research questions

The main research questions in this research are:

1. What factors (benefits and sacrifices) influence the perceived value and behavioral intention of participants in the open innovation crowdsourcing platform?
2. What factors (benefits and sacrifices) influence the perceived value and behavioral intention of internal stakeholders in the Telco open innovation crowdsourcing platform?
3. What smart city services are expected to attract the interest of contributors?

In order to answer the research questions, the research is based on the VAM-based research model, which has already been in use for the adoption of telco services (Kim et al., 2007), but is extended with concepts related to the adoption of crowdsourcing (Wang at al., 2021). Two research models were developed, one for studying the attitudes of participants (Figure 2) and the other for studying attitudes of internal stakeholders (Figure 3).

The following hypotheses are set:

Research model – participants:

**H1 – H5**: perceived benefits listed in Figure 2 are correlated with the participants'

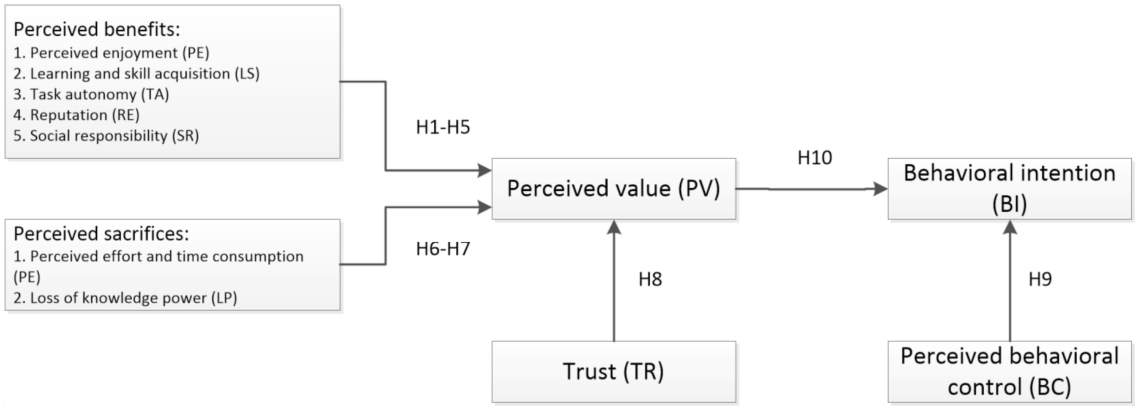


*Figure 2. Research model - participants*

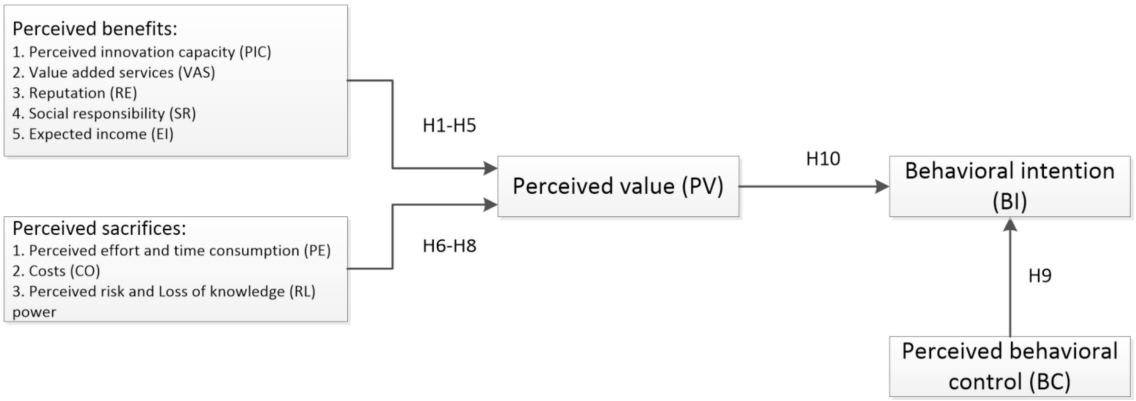


*Figure 3. Research model – internal stakeholders*

perceived value of crowdsourcing-based open innovation platform.

**H6 – H7**: The perceived sacrifices listed in Figure 2 are correlated with the participants' perceived value of crowdsourcing-based open innovation platform.

**H8**: The effect of Trust in operator is correlated with the perceived value of crowdsourcing-based open innovation platform.

**H9**: The effect of Perceived behavioral control is correlated with the Behavioral intention of participants.

**H10**: The effect of Perceived value is correlated with the Behavioral intention of participants.

Research model – internal stakeholders:

**H1 – H5**: perceived benefits listed in Figure 3 are correlated with the participants' Perceived value of crowdsourcing-based open innovation platform.

**H6 – H8**: The perceived sacrifices listed in Figure 3 are correlated with the participants' Perceived value of crowdsourcing-based open innovation platform.

**H9**: The effect of Perceived behavioral control is correlated with the Behavioral intention of internal stakeholders.

**H10**: The effect of Perceived value is correlated with the Behavioral intention of internal stakeholders.

### 3.3. Participants

This survey was performed during the February 2022 among the potential participants in the crowd-based open innovation (175 participants), as well as with internal stakeholders (employees and managers) of 3 telco operators in Serbia (149 participants). Main demographic data about the each group of participants are shown in tables 2 and 3.

### 3.4. Instruments

The questionnaire used in the research was anonymous and consisted of three parts: the first part was related to demographic information, the second part included questions related to attitudes and expected behaviors in the context of open innovation platform, while the third part included proposed smart city services. The questionnaire for participants included 43 questions in the second part, and 8 questions in the third, while the questionnaire for internal stakeholders included 26 questions in the second part, and 8 questions in the third. All the questions in the second and the third parts of the questionnaires were based on the five-point Likert-type scale. To minimize biases, most of the questions were formulated neutrally, and there are both positive and negative statements. Aim of these questionnaires was to determine the degree of readiness of these actors to express interest and contribute to innovation in this area.

## 4. ANALYSIS OF THE RESULTS

### 4.1. Factors influencing the perceived value and behavioral intention of participants in the open innovation crowdsourcing platform

The causal relations assumed the structural model shown in Figure 1 were analyzed using the PLS-SEM method and SmartPLS 3.0 software (Ringle et al., 2015). Using this method, we can explain the

*Table 2. Main demographic data - participants.*

| Variable | Values | Frequency | Percentage |
|---|---|---|---|
| Age group | <25 | 8 | 5% |
| | 25-40 | 41 | 23% |
| | 40-55 | 88 | 50% |
| | 55> | 38 | 22% |
| Education Level | Primary | 3 | 2% |
| | Secondary | 36 | 21% |
| | Bachelor's or equivalent | 53 | 30% |
| | Masters or specialist | 67 | 38% |
| | PhD | 16 | 9% |
| Occupation | Student | 6 | 3% |
| | Employed | 151 | 86% |
| | Unemployed | 15 | 9% |
| | Retired | 3 | 2% |
| Gender | Female | 90 | 51% |
| | Male | 85 | 49% |
| Income | Less than 50000RSD | 20 | 11% |
| | 50000RSD-70000RSD | 43 | 25% |
| | 70000RSD-100000RSD | 29 | 17% |
| | More than 100000RSD | 30 | 17% |
| | Don't want to say | 53 | 30% |
| Desired role in the project | Participant - proposing ideas and solutions | 84 | 48% |
| | Participant - solving tasks and developing prototypes | 35 | 20% |
| | Organization and management of open innovation projects | 31 | 18% |
| | Manager – strategy and business model development | 25 | 14% |

*Table 3. Main demographic data – internal stakeholders*

| Variable | Values | Frequency | Percentage |
|---|---|---|---|
| Age group | <25 | 10 | 7% |
| | 25-40 | 39 | 26% |
| | 40-55 | 69 | 46% |
| | 55> | 31 | 21% |
| Education Level | Primary | 0 | 0% |
| | Secondary | 21 | 14% |
| | Bachelor's or equivalent | 43 | 29% |
| | Masters or specialist | 72 | 48% |
| | PhD | 13 | 9% |
| Gender | Female | 74 | 50% |
| | Male | 75 | 50% |
| Income | Less than 50000RSD | 13 | 9% |
| | 50000RSD-70000RSD | 17 | 11% |
| | 70000RSD-100000RSD | 28 | 19% |
| | More than 100000RSD | 34 | 23% |
| | Don't want to say | 57 | 38% |
| Desired role in the project | Participant - proposing ideas and solutions | 41 | 28% |
| | Participant - solving tasks and developing prototypes | 36 | 23% |
| | Organization and management of open innovation projects | 44 | 30% |
| | Manager – strategy and business model development | 28 | 19% |

variances of the variables, without specific data distributions being required. Through the analysis, we have evaluated the connections between data collected through the survey and variables in the model. Also, we have evaluated the connections within in the model. The results are presented in Figure 4.

Due to colinearity issues, four indicators have been removed from the original model. The relationships between the considered variables were analyzed using path coefficients of the structural model. The results reveal that variable Trust has the strongest positive impact on the Perceived value. In addition, variables Social responsibility, Task autonomy and Reputation have a positive impact on the Perceived value, while all other variables have path coefficients near zero, indicating very low impact.

Table 4 presents assessment of reliability and validity of the measurement model. All the presented values indicate a high reliability of the measurement model. In addition, we used the Fornell-Larcker validity criterion to check discriminant validity (Fornell & Larcker, 1981).

Collinearity was checked as a part of assessment of the structural model. Values of Variance inflation factor (VIF) are below 5, indicating that there is no collinearity of the

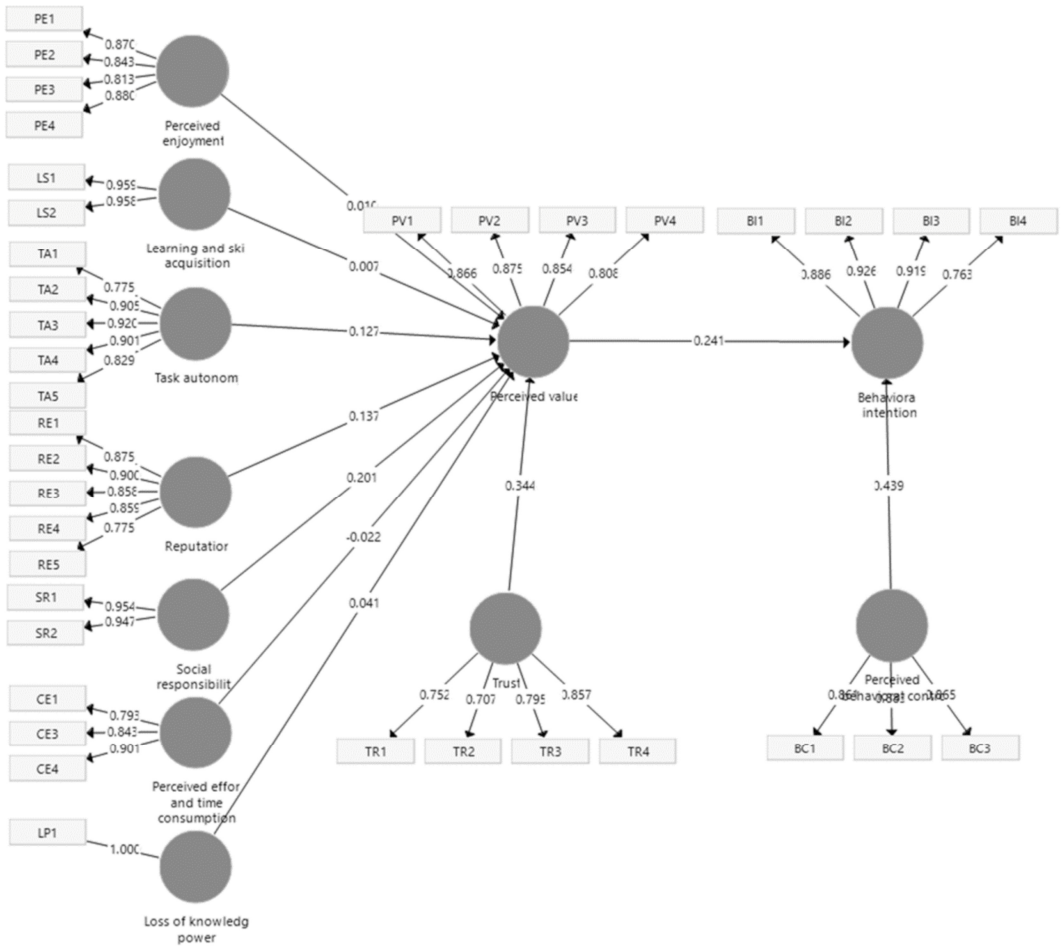


*Figure 4. Results of application of PLS algorithm – participants*

variables (Table 5) (Hair et al., 2014).

In order to evaluate the predictive accuracy of the proposed model, we have used the coefficient of determination ($R^2$). The obtained values of $R^2$ coefficients of determination are moderate, 0.428 and 0.368, for Perceived value and Behavioral intention, respectively.

The results of hypotheses testing done using the bootstrapping method are presented in Table 6. The results show that the statistically significant impact on the Perceived value has Trust ($t$=3.536, $p$< .005), while both Perceived value ($t$=2.419, $p$<.005) and Perceived behavioral control (t =4,891, $p$<.005) have a statistically significant impact of Behavior intention. Social responsibility has a statistically significant impact on Perceived value with $p$<0.1 ($t$=1.829, $p$<.005). Having in mind that the significance of Reputation on Perceived value is slightly above 0.1, further investigations could be needed to assess this relationship more accurately.

### 4.2. Factors influencing the perceived value and behavioral intention of internal stakeholders in the Telco open innovation crowdsourcing platform

Figure 5 presents the results obtained using the PLS algorithm. Due to colinearity issues, three indicators have been removed from the original model. The values of path coefficients indicate the strength of relationships between the variables. The

*Table 4. Validity assessment of the measurement model – participants*

| | Cronbach's Alpha | rho_A | Composite Reliability | Average Variance Extracted (AVE) |
|---|---|---|---|---|
| Behavioral intention | 0.897 | 0.904 | 0.929 | 0.767 |
| Learning and skill acquisition | 0.912 | 0.912 | 0.958 | 0.919 |
| Loss of knowledge power | 1 | 1 | 1 | 1 |
| Perceived behavioral control | 0.839 | 0.843 | 0.903 | 0.756 |
| Perceived effort and time consumption | 0.814 | 0.86 | 0.884 | 0.718 |
| Perceived enjoyment | 0.876 | 0.905 | 0.914 | 0.726 |
| Perceived value | 0.873 | 0.873 | 0.913 | 0.724 |
| Reputation | 0.907 | 0.914 | 0.931 | 0.73 |
| Social responsibility | 0.894 | 0.897 | 0.949 | 0.904 |
| Task autonomy | 0.917 | 0.928 | 0.938 | 0.753 |
| Trust | 0.784 | 0.796 | 0.861 | 0.608 |

*Table 5. VIF values – participants*

| | Behavioral intention | Perceived value |
|---|---|---|
| Learning and skill acquisition | | 2.99 |
| Loss of knowledge power | | 1.276 |
| Perceived behavioral control | 1.442 | |
| Perceived effort and time consumption | | 1.237 |
| Perceived enjoyment | | 3.148 |
| Perceived value | 1.442 | |
| Reputation | | 1.685 |
| Social responsibility | | 1.884 |
| Task autonomy | | 2.268 |
| Trust | | 1.521 |

*Table 6. Testing the hypotheses – participants*

| | Original Sample (O) | Sample Mean (M) | Standard Deviation (STDEV) | T Statistics (\|O/STDEV\|) | P Values |
|---|---|---|---|---|---|
| Learning and skill acquisition -> Perceived value | 0.007 | 0.002 | 0.134 | 0.052 | 0.958 |
| Loss of knowledge power -> Perceived value | 0.041 | 0.04 | 0.073 | 0.559 | 0.577 |
| Perceived behavioral control -> Behavioral intention | 0.439 | 0.438 | 0.09 | 4.891 | 0.000 |
| Perceived effort and time consumption -> Perceived value | -0.022 | -0.032 | 0.075 | 0.292 | 0.77 |
| Perceived enjoyment -> Perceived value | 0.01 | 0.019 | 0.1 | 0.101 | 0.92 |
| Perceived value -> Behavioral intention | 0.241 | 0.244 | 0.097 | 2.491 | 0.013 |
| Reputation -> Perceived value | 0.137 | 0.136 | 0.088 | 1.567 | 0.118 |
| Social responsibility -> Perceived value | 0.201 | 0.203 | 0.11 | 1.829 | 0.068 |
| Task autonomy -> Perceived value | 0.127 | 0.126 | 0.104 | 1.227 | 0.221 |
| Trust -> Perceived value | 0.344 | 0.345 | 0.097 | 3.536 | 0.000 |

results indicate that most of the variables, both regarding perceived benefits and perceived sacrifices, do not influence the perceived value (values close to zero). However, higher strength can be observed regarding the influence of Reputation, Expected income, and Social responsibility. This indicates that the representatives of providers mainly focus on these three elements when considering the value of open innovation in their company. The strength of Perceived value and Behavioral intention variables is relatively strong, leading to conclusion that the understanding the value of open innovation concept plays a significant role in participation in open innovation projects.

Table 7 presents assessment of reliability and validity of the measurement model.

Except relatively low Cronbach alpha scores for Costs variable, all other values indicate high reliability. Having in mind the high composite reliability for Costs variable, the items were kept in further analysis. Still, in future work, the formulation of items used to measure Costs variable will be reconsidered. The values of Average Variance Extracted (AVE) parameters are all above the recommended value of 0.5 (Hair et al., 2014). The discriminant validity was checked using Fornell-Larcker criterion (Fornell & Larcker, 1981) and achieved for all variables.

Table 8 shows that the variance inflation factor (VIF) values are all bellow the recommended value of 5, indicating that there is no collinearity of the variables (Hair et al., 2014).

The obtained values of $R^2$ coefficients of determination were 0.393 and 0.626, for Perceived value and Behavioral intention, respectively. The first value indicates moderate, while the second indicates high predictive accuracy of the model. The values of $Q^2$ obtained using the blindfolding technique confirms these conclusions, with 0.278 and 0.535, respectively.

The results of hypotheses testing done using the bootstrapping method are presented in Table 9. The results show that the statistically significant impact on the Perceived value have Expected income ($t$=3.199, $p$<.005) and Reputation ($t$ = 3.572, $p$<.001), while both Perceived value ($t$=14.365, $p$<.005) and Perceived behavioral control ($t$=2.938, $p$<.005) have a statistically significant impact of Behavior intention.

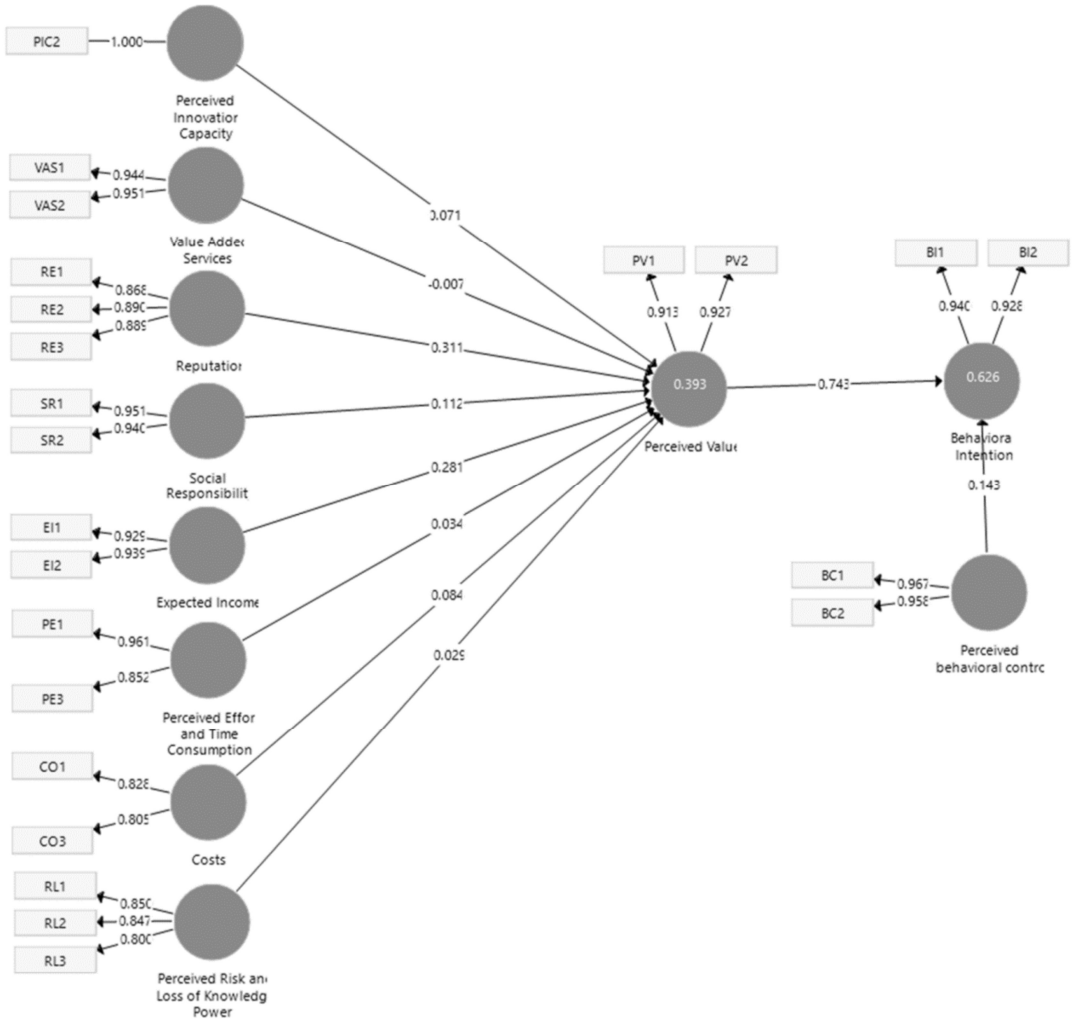


*Figure 5. Results of application of PLS algorithm – internal stakeholders*

*Table 7. Validity assessment of the measurement model – internal stakeholders*

| | Cronbach's Alpha | rho_A | Composite Reliability | Average Variance Extracted (AVE) |
|---|---|---|---|---|
| Behavioral Intention | 0.854 | 0.859 | 0.932 | 0.873 |
| Costs | 0.501 | 0.502 | 0.8 | 0.667 |
| Expected Income | 0.854 | 0.857 | 0.932 | 0.872 |
| Perceived Effort and Time Consumption | 0.805 | 1.042 | 0.904 | 0.825 |
| Perceived Innovation Capacity | 1 | 1 | 1 | 1 |
| Perceived Risk and Loss of Knowledge Power | 0.784 | 0.805 | 0.871 | 0.693 |
| Perceived Value | 0.82 | 0.824 | 0.917 | 0.847 |
| Perceived behavioral control | 0.921 | 0.93 | 0.962 | 0.926 |
| Reputation | 0.859 | 0.87 | 0.913 | 0.779 |
| Social Responsibility | 0.882 | 0.888 | 0.944 | 0.894 |
| Value Added Services | 0.886 | 0.889 | 0.946 | 0.898 |

*Table 8. VIF values – internal stakeholders*

| | Behavioral intention | Perceived behavioral control |
|---|---|---|
| Costs | | 1.478 |
| Expected Income | | 1.728 |
| Perceived Effort and Time Consumption | | 1.497 |
| Perceived Innovation Capacity | | 1.829 |
| Perceived Risk and Loss of Knowledge Power | | 1.182 |
| Perceived Value | 1.066 | |
| Perceived behavioral control | 1.066 | |
| Reputation | | 1.629 |
| Social Responsibility | | 1.62 |
| Value Added Services | | 1.53 |

*Table 9. Testing the hypotheses – internal stakeholders*

| | Original Sample (O) | Sample Mean (M) | Standard Deviation (STDEV) | T Statistics (\|O/STDEV\|) | P Values |
|---|---|---|---|---|---|
| Costs -> Perceived Value | 0.084 | 0.085 | 0.102 | 0.824 | 0.41 |
| Expected Income -> Perceived Value | 0.281 | 0.262 | 0.088 | 3.199 | **0.001** |
| Perceived Effort and Time Consumption -> Perceived Value | 0.034 | 0.004 | 0.093 | 0.364 | 0.716 |
| Perceived Innovation Capacity -> Perceived Value | 0.071 | 0.067 | 0.092 | 0.771 | 0.441 |
| Perceived Risk and Loss of Knowledge Power -> Perceived Value | 0.029 | 0.05 | 0.08 | 0.357 | 0.721 |
| Perceived Value -> Behavioral Intention | 0.743 | 0.742 | 0.052 | 14.365 | **0.000** |
| Perceived behavioral control -> Behavioral Intention | 0.143 | 0.148 | 0.049 | 2.938 | **0.003** |
| Reputation -> Perceived Value | 0.311 | 0.301 | 0.087 | 3.572 | **0.000** |
| Social Responsibility -> Perceived Value | 0.112 | 0.12 | 0.086 | 1.303 | 0.193 |
| Value Added Services -> Perceived Value | -0.007 | -0.006 | 0.085 | 0.082 | 0.935 |

### 4.3. Smart city services expected to attract the interest of contributors

Table 10 shows the mean values, standard deviations and confidence intervals of scores for interest of participants and internal stakeholders for groups of smart city services. Both the participants and the internal stakeholders show high interest in developing services for mapping ecological and traffic problems (ID 6 and 8 in the Table 9). However, regarding smart home services, providers show a higher interest.

Figure 6 shows the comparison of interest for specific services of participants and internal stakeholders. The histogram shows that internal stakeholders show much higher interest for smart home services and the service for mapping traffic problems. On the other hand, participants are more interested in mapping pollution service.

## 5. DISCUSION AND CONCLUSION

The papar proposes a crowd-based open innovation business model for possible application by telco companies operating in Serbia. A readiness study of companies in Serbia for crowd based open innovation business model was conducted. Two aspects of the model application were examined.

*Table 10. Interest in specific smart city services*

| | | Participants | | | Internal stakeholders | | |
|---|---|---|---|---|---|---|---|
| *ID* | *Smart city service* | Mean | SD | 95%CI | Mean | SD | 95%CI |
| **1** | **Smart house:** Sensors in your household monitor food stocks, your consumption habits, to optimize purchases (delivery time and quantity). | 3.87 | 0.93 | 0.14 | 4.15 | 0.88 | 0.14 |
| **2** | **Security:** Improved monitoring of your apartment, building, living space and more effective protection against burglary, fire, flood, etc. | 4.24 | 0.80 | 0.12 | 4.29 | 0.63 | 0.10 |
| **3** | **Healthcare:** Real-time monitoring of health parameters of your family members (eg elderly people, patients recovering from surgery or those with chronic illness) and the possibility to get medical advice or contact a doctor. | 4.21 | 0.83 | 0.12 | 4.21 | 0.74 | 0.12 |
| **4** | **Ecology:** Waste sensors to optimize waste collection. | 4.23 | 0.75 | 0.11 | 4.29 | 0.65 | 0.10 |
| **5** | **Smart house:** A digital handyman (with the help of smart glasses and gloves) and the help of a real or virtual expert, you can repair the devices yourself. | 4.06 | 0.95 | 0.14 | 4.16 | 0.75 | 0.12 |
| **6** | **Ecology:** Pollution mapping and proposing solutions to reduce pollution (air, water, environment). | 4.36 | 0.73 | 0.11 | 4.30 | 0.70 | 0.11 |
| **7** | **Traffic:** Sharing transportation to work (carsharing). | 4.15 | 0.85 | 0.13 | 4.23 | 0.63 | 0.10 |
| **8** | **Traffic:** Mapping traffic problems (traffic jams, road damage, signs, traffic lights, etc.) and proposing solutions. | 4.43 | 0.63 | 0.09 | 4.51 | 0.60 | 0.10 |

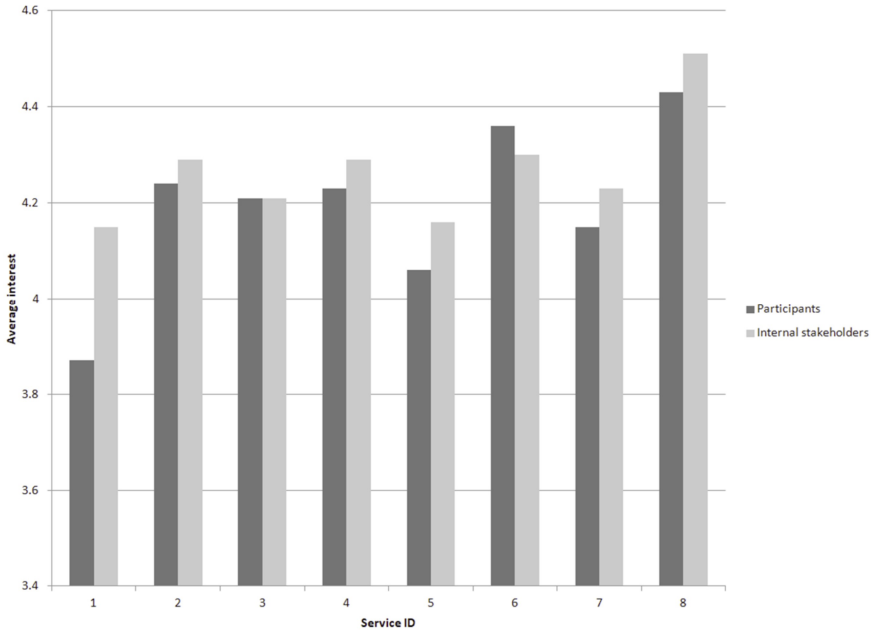


*Figure 6. Interest in specific smart city services*

One aspect was related to potential role of telco companies as providers of an open innovation platform in Serbia. The other aspect was related to participants in the crowd-based open innovation. The results of the research showed that there is a high interest in Serbian telco companies for the application of the proposed model in the role of a provider of a platform. The results of the research also confirm the assumption that a wider set of stakeholders is ready to participate as users of the platform. In addition, the results indicate smart traffic and ecology-based smart city services as suitable for both participants and providers.

The main limitation of this research is related to a relatively small number of participants in the survey. A larger sample would enable a more granular study of specific motives for participation, and could provide any future open innovation platform providers with more data needed for further calibration of the proposed business model.

Having in mind that many participants identified trust as an important factor influencing perceived value of open innovation platform, future work will be directed towards a more granular investigation of the trust construct. This study could include specific issues such as financial rewards for participants, intellectual property issues, transparency of the open innovation process, etc.

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# АНАЛИЗА СПРЕМНОСТИ ТЕЛЕКОМУНИКАЦИОНИХ ОПЕРАТЕРА ЗА "CROWD"-ЗАСНОВАНЕ ОТВОРЕНЕ ИНОВАЦИЈЕ У РАЗВОЈУ СЕРВИСА ПАМЕТНИХ ГРАДОВА

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**Извод**

Овај рад проучава спремност српских телеком оператера и других заинтересованих страна за имплементацију "crowd"-заснованог пословног модела отворених иновација. Телко компаније се суочавају са изазовима у погледу захтева тржишта и проналажења нових могућности да привуку претплатнике иновативним производима и услугама. Ове иновације су често оријентисане на услуге паметних градова засноване на новим технологијама као што су Интернет ствари, рачунарство у облаку, софтверски дефинисане мреже и "blockchain". Због сложености, темпа и трошкова истраживања и развоја, телеком оператери су већ препознали потребу да пређу са традиционалног на концепт отворене иновације. Развој "crowdsourcing" модела додатно је подстакао могућност укључивања купаца у отворени процес иновације, како би боље дизајнирали и развили услуге прилагођене њиховим сопственим потребама. Имајући то у виду, циљ овог рада је да предложи пословни модел отворених иновација који је "crowd"-заснован за унапређење иновационих капацитета српских телеко оператера. Предложени модел се користи као основа за процену спремности интерних и екстерних стејкхолдера за учешће у пројектима отворених иновација. Студија је заснована на прилагођеном моделу усвајања заснованом на вредности, док се анализа врши методом ПЛС-СЕМ. Резултати показују да учесници идентификују поверење као најутицајнији фактор за перципирану вредност "crowd"-засноване отворене иновације, док интерни стејкхолдери телеком компанија сматрају очекивани приход и репутацију као најрелевантније. Обе групе су показале велико интересовање за иновације у вези са услугама паметних градова као што су паметни саобраћај и услуге везане за екологију.

*Кључне речи*: телекомуникацијска индустрија, отворене иновације, "crowd"-засновани пословни модели, паметни градови

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