Defining Rural Smartness and Its Impact: A Systematic Literature Review

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Abstract

The utilisation of information technology to facilitate “smartness” is considered as a promising approach to improve the rural economy. However, the explanation of how the adoption of smartness in rural areas can lead to an improvement in the citizen’s economic welfare is still lacking in current studies. This paper aims to formulate a theoretical model that explains the causal mechanism of smartness adoption in rural areas to contribute to the improvement of rural citizen’s economic welfare. To achieve this, we conducted a systematic literature review based on three research questions resulting in 119 selected articles, which we used to formulate a theoretical model. The proposed model posits that rural smartness has a mediating effect on the citizen’s economic welfare through its positive impact on the competitiveness and innovativeness of rural business entities. Additionally, the proposed theoretical model highlights the necessity of adopting a smart service platform, representing the IT artefact for smartness. We argue that the adoption of such a platform would have a significant moderating effect on the competitiveness and innovativeness of rural business entities. We also contribute a comprehensive set of candidate measures we extracted from the selected literature as operationalisation of the proposed model. In terms of contribution to practice, the proposed theoretical model can be used as the starting point to guide the diffusion of smartness in rural areas.

Keywords Rural smartness · Economic welfare · Theoretical model · Service platform · Systematic literature review

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Introduction

According to the United Nations (2018), most of the world's population is living in urban areas. However, the projections for 2030 indicate that almost half of the population in developing countries is expected to live in rural areas (Roland Berger, 2017). Using data from the World Bank for 89 developing countries, Castañeda et al. (2018) found that around 75% of those living on less than \$3.1 per day are people who live in rural areas. To escape the poverty trap, and motivated by a higher potential income, people from rural areas are migrating to urban areas (Sicular et al., 2007; Østby, 2016; De Magalhães and Santaaulàlia-Llopis, 2018). Nevertheless, this is not a solution for the poverty problem, as shown in the study by Imai et al. (2017), which argue that rural–urban migration is not reducing, but increasing poverty. This phenomenon can be explained by the fact that a large proportion of people migrating from rural to urban areas end up working in low-skilled jobs for low wages (Zhang, 2016), while the living costs are significantly higher. Therefore, instead of encouraging urbanisation, efforts in developing the rural economy are more effective in reducing poverty (Imai et al., 2017).

In line with the advances of information technology (IT), one of the promising approaches to develop the rural economy is to make the rural areas smarter (Zavratnik et al., 2018). While the definition of smartness for rural areas is vague, and just starting to gain some attention in literature (Zavratnik et al., 2018; Mishbah et al., 2018), the concept of smartness for urban areas is already well established. Albino et al. (2015) provide a reference to the definition of smartness in urban areas that we summarised into the following: utilisation of information technology in hard domains (e.g. buildings, environment, mobility infrastructure, and logistics infrastructure) and soft domains (e.g. education, innovation, culture, and government) in an integrated manner that contributes to the improvement of citizen's living quality. Based on this reference, we define smartness as the utilisation of IT in an integrated manner to improve the living quality of the citizens. With this definition, our paper studies the adoption of smartness in rural areas, in particular with the aim to improve the citizen's economic welfare in an effort to reduce poverty.

There is a difference in focus between the adoption of smartness in urban and rural areas. In the urban context, the objective is generally to handle the typical problems of densely populated areas. For example, traffic and mobility, waste management, pollution, energy supply, or social issues (Angelidou, 2017; Neirotti et al., 2014). However, in the rural context, the objective is strongly centred around the empowerment of citizens and the development of the regional economic potential. The main assumption is that fostering IT innovation will lead to the emergence of a better local micro-economic climate (Zavratnik et al., 2018; Mishbah et al., 2018; Katara, 2016; Martinez-Gil et al., 2019).

Academics are showing their interest in the research related to the adoption of smartness to improve the economic situation for people living in rural areas. Previous studies have discussed the case of IT utilisation in rural

economy activities (Santhiyakumari et al., 2016; S. Yu, 2017; Gyeltshen and Osathanunkul, 2018), the formulation of a strategy to implement smartness in a rural context (Naldi et al., 2015; Zavrtnik et al., 2018), and the development of a framework for smartness adoption in rural areas (Mishbah et al., 2018; Katara, 2016; Talbot, 2016). However, the causal mechanism of how smartness adoption leads to economic welfare improvement is still missing in previous studies. Thus, to fill this gap, this paper has as a main objective the formulation of a theoretical model that explains the mechanisms through which the adoption of smartness is contributing to the achievement of economic welfare improvement for people living in rural areas.

To achieve this objective, this paper systematically identifies (1) the characteristics of smartness that have been mentioned in literature as having an economic impact, (2) the challenges that might constitute barriers for the adoption of smartness in the rural context, and (3) the functional characteristics of an IT artefact that facilitates the rural smartness implementation and acts as vehicle for the improvement of economic welfare for citizens in rural areas. We utilised systematic literature review (SLR) as the methodology guiding our research, which is further explained in the “[Research Method](#)” section. This methodology allows us to have a longitudinal analysis of the current academic literature, and to consolidate relevant information on this topic (Lagorio et al., 2016).

The contribution of this paper is twofold. First, this paper proposes a theoretical model that explains the causal mechanisms of smartness adoption in rural areas, which is hypothesised to have a positive impact on the improvement of citizen’s economic welfare. Next to the model itself, an important contribution of this work is the rigorous definition of the concept of rural smartness which is defined both semantically as the situation when the implementation of IT infrastructure and services can empower the citizens to improve their living quality and welfare through connectivity and participatory governance, and operationally through a comprehensive set of candidate measures extracted from the literature. Hence, the proposed model and its operationalisation can become the starting point for further empirical research on this topic.

Secondly, this paper provides practical guidance for the implementation of rural smartness. For example, the readiness factors presented in the theoretical model can help the local government to assess and take necessary measures to stimulate the adoption and development of smartness in rural areas, with the aim of reducing the poverty. Moreover, the main functional characteristics of smartness presented in the theoretical model can be translated into a preliminary set of functional requirements guiding the design of an IT smartness service platform tailored for the rural context.

The remainder of this paper is structured as follows: the “[Related Work](#)” section describes the related work in the area of rural smartness. The “[Research Method](#)” section explains our approach to the SLR based on the selected research methodology. The “[Results](#)” section presents the results from the SLR. The “[Discussion](#)” section discusses the development of the theoretical model based on the results presented in the “[Results](#)” section. Finally, the “[Conclusion](#)” section provides the conclusion of this study and gives pointers to future work.

Related Work

Research on the adoption of smartness technology in rural areas is recently gaining attention from academics. Several authors conducted case studies on the utilisation of IT to improve the economic situation for citizens in rural areas. For example, utilisation of IT equipment to increase the productivity of farmers (Santhiyakumari et al., 2016), development of a financing platform for rural SMEs (Yu, 2017), and the development of a platform to market agricultural products (Gyeltshen and Osathanunkul, 2018).

Other authors conducted studies that put more emphasis on the formulation of strategies to successfully implement smartness technology in the rural context. Naldi et al. (2015) examined strategies to achieve economic growth in the rural areas of Europe. In this regard, the authors suggest that the utilisation of IT in rural areas should support the development of local creative economies, optimise the potential of local amenities (e.g. natural amenities, recreational sites, and local culture), and strengthen the connectivity with related parties in the region for collaboration. Zavrtnik et al. (2018) examined several smart villages initiatives worldwide. Their analysis resulted in the following strategies to develop the rural economy through the adoption of smartness technology. First, finding local solutions according to the unique potentials in particular rural areas. Second, exploring linkages with small towns or cities. Third, directing economic activities into the low-carbon circular economy. Fourth, promoting digital transformation.

Other studies are aimed at developing a framework to classify essential elements of rural smartness. Katara (2016) studied the adoption of smart villages in India. The author proposed a framework consisting of necessary components for the realisation of rural smartness, namely, (1) an economic component (e.g. entrepreneurship and governance model), (2) an environmental component (e.g. environmental infrastructure and natural products), (3) a social component (e.g. citizens participatory and culture), and (4) capacity building (e.g. personality development and community development). Mishbah et al. (2018) investigated academic literature with regards to smart villages. Based on a systematic literature review, the authors proposed a framework consisting of four main components for rural smartness: objectives, strategies, dimensions, and foundations. Mishbah et al. (2018) suggest, to achieve the objective in developing rural economies, strategies that lead to innovation through the utilisation of ICT need to be defined in seven dimensions: economy, IT, people, governance, environment, living, and energy. Furthermore, to be able to execute the strategies, several foundational elements (e.g. amenities, IT infrastructure, and human resources) according to specific characteristics of a rural area need to be prepared.

In terms of IT artefacts for rural smartness, Talbot (2016) developed a model that connects the policymakers and the entrepreneurs to boost innovation for economic growth in rural areas. The key feature in the model is the establishment of a network-based innovation brokerage (NBIB) as a service platform. This should facilitate collaboration between diverse business entities, independent of their geographical location, to optimise their existing potential and promote

innovation-based value creation. Talbot (2016) validated the model through a case study in the rural region of Scotland. The results of the case study confirmed that utilisation of the service platform can facilitate the innovation process which is the driver for economic development in rural areas.

Furthermore, Mukti (2019) proposed a framework to improve the economic welfare of rural citizens through the utilisation of a service platform as the IT artefact for rural smartness. The framework suggests that the introduction of a service platform relies on technological readiness (e.g. connectivity and availability of devices), organisational readiness (e.g. government support and sustainable funding) and environmental readiness (e.g. citizen's digital capability and supportive regulatory).

The aforementioned studies all suggest that the adoption of smartness in rural areas can have a positive contribution to the rural economy. However, the explanation of how smartness adoption in rural areas can lead to improved citizen's economic situation is still missing. Therefore, this paper formulates a theoretical model that explains the causal mechanisms of smartness adoption in rural areas as a means to improve citizens' economic welfare.

Research Method

For this study, we had to adopt a literature review methodology that can support us to comprehensively analyse the extant literature to the extent that the objectives mentioned in the “[Introduction](#)” section are achievable. According to our analysis on the topology of literature review methodologies identified by Hood and Wilson (2001), Grant and Booth (2009), Paré et al. (2015), and Samnani et al. (2017), the methodologies to review the extant literature can be divided into two categories:

- Content-based methodologies, in which the focus is on in-depth analysis of the literature content with the goal of advancing the knowledge of a particular topic of interest. Methodologies falling into this category are including narrative review, critical review, SLR, mapping review, and umbrella review.
- Metric-based methodologies, which focus on the statistical analysis of quantitative metrics of the literature (e.g. number of citations and number of keywords) to understand the dynamics of a particular research field. Methodologies falling into this category are including descriptive review, quantitative meta-analysis, bibliometrics, and scientometrics.

Among the methodologies mentioned in the two above categories, we argue that SLR is the most suitable methodology to achieve the objective of this paper. The reason is because SLR comes with a very clear standard scientific protocol to select and critically analyse the content of the extant literature to answer the proposed research questions that will further be described in the “[SLR Research Questions](#)” section (Kitchenham and Charters, 2007; Samnani et al., 2017; Linnenluecke et al., 2020). Furthermore, as justified by Shaffril et al. (2020), the SLR method

Fig. 1 SLR activities

provided us guidance to execute the literature study in an organised, transparent, and replicable manner.

This paper follows the SLR methodology proposed by Rouhani et al. (2015) and Kitchenham and Charters (2007). The argument for this SLR variant is that it has been specifically designed for literature research in the information system field, to which this work clearly belongs. Figure 1 presents all the SLR activities performed in this paper that are grouped into three phases. We describe these phases in more detail in the following sub-sections.

Research Design

This phase defines several requirements to ensure that the article selection process will meet the research objectives. These requirements include the definition of SLR research questions (RQ), scientific databases for article selection, search query for each RQ, and inclusion and exclusion criteria.

SLR Research Questions

Defining the RQs is an essential step in the SLR since it drives the entire review process (Kitchenham and Charters, 2007). In our research, we defined three RQs that contribute to the development of the theoretical model. Figure 2 presents a summary of the RQs and their contributions to the theoretical model.

RQ1: What are the contributions of smartness to the economic welfare of the citizens?

Our goal with this question is to identify the characteristics of smartness that have been mentioned in literature to have an economic impact, and the performance indicators used to measure that impact. Answering this question will contribute to

Fig. 2 Relationship between RQs and theoretical model

the theoretical model development, particularly in selecting those elements that can be seen as antecedents of citizens' economic welfare improvement.

RQ2: What are the challenges of implementing the concept of smartness in rural areas?

This question will require the identification of challenges that might raise barriers for the adoption of smartness in the rural context. Answering this question will help us identify those elements of the theoretical model that represent readiness factors, and need to be in place for the successful adoption of smartness in rural areas.

RQ3: What is the state-of-the-art on service platforms in the context of smartness?

There is a growing interest in implementing service platforms as the IT artefact that can help to improve the economic welfare of citizens in rural and urban areas. Talbot (2016) found that service platforms facilitate the collaboration between business entities in rural areas, and connect them to the larger networks. Thus, this medium enables entrepreneurs in rural areas to become aware of, and to exploit new economic opportunities. Furthermore, Lusch and Nambisan (2015) suggest that a service platform is a suitable IT artefact to exchange or share resources, and co-create value.

To answer this question, we explore the current developments concerning service platforms as the IT artefact of smartness. This will require the identification of the state-of-the-art functional characteristics, the technology used, and the stakeholders involved in such platforms. This helps us identify the functional characteristics of the service platform that have a significant moderating effect on the citizen's economic welfare. Furthermore, insights gained from answering this question will constitute the foundation for the architectural design process of the service platform tailored to improve the rural economy.

Scientific Databases

To obtain relevant academic publications for answering the research objectives, this SLR used scientific databases as the source to perform the article selection process. The main reason for this is that scientific databases aggregate articles from relevant academic sources such as journals, conference proceedings, and book series. The following are the scientific databases selected for our SLR:

- Scopus (<http://www.scopus.com/>)
- Web of Science (WoS) (<http://www.webofknowledge.com/>)
- IEEE Xplore (<http://ieeexplore.ieee.org/>)

We chose these databases since they provide a good coverage of the existing academic literature and they lead to the highest number of relevant results. For example, searches using keywords related to urban smartness (“urban smartness” OR “city smartness” OR “smart urban” OR “smart city” OR “smart cities” OR “digital city” OR “digital cities”) resulted in 20,612 results in Scopus, 10,413 results in WoS, and 11,596 results in IEEE Xplore. Moreover, these databases provide easy to use search engines that enable query-based searching with logical operators (e.g. AND and OR), facilitate filtering to limit the selection of the articles based on pre-defined criteria (e.g. year, topics, language, and type of publications), and allow to export the lists of results to reference management tools, such as EndNote.

Search Query Design

The search query is constructed based on a set of (synonymous) keywords related to a particular research question, which are combined with logical operators. The search query is applied to the article’s title, abstract, and keywords.

Search Query for RQ1 The objective of this search query is to retrieve articles that describe the characteristics of the smartness and their contributions to the citizen’s economic welfare. To achieve this objective, we used the sets of relevant synonymous keywords presented in Table 1. In the first and the second column, we used

Table 1 Synonymous keywords for RQ1

Urban smartness	Rural smartness	Characteristic	Economy	Contribution
Urban smartness	Rural smartness	Characteristic	Economy	Effect
City smartness	Smart rural	Component	Economic	Impact
Smart urban	Smart village	Factor	Welfare	Benefit
Smart city	Village smartness	Element	Business	Influence
Smart cities	Digital rural	Predictor	Entrepreneurship	Opportunit*
Digital city	Digital village			Indicator
Digital cities	Digital inclusion			Performance
				Measurement

synonymous keywords related to the adoption of smartness in urban and rural areas. In the third to the fifth column, we used the synonymous keywords that can help us identify those characteristics of smartness that have been mentioned in the literature as having an economic contribution, including the relevant performance indicators.

To construct the search query, the keywords within each column are combined using the “OR” operator, while between columns we use the “AND” operator. This approach resulted in the following search query:

(“urban smartness” OR “city smartness” OR “smart urban” OR “smart city” OR “smart cities” OR “digital city” OR “digital cities” OR “smart rural” OR “rural smartness” OR “smart village” OR “village smartness” OR “digital rural” OR “digital village” OR “digital inclusion”).

AND (*factor* OR *component* OR *element* OR *predictor* OR *characteristic*)

AND (*economy* OR *economic* OR *welfare* OR *business* OR *entrepreneurship*)

AND (*impact* OR *effect* OR *influence* OR *benefit* OR *opportunit** OR *indicator* OR *performance* OR *measurement*).

Search Query for RQ2 The objective of this search query is to retrieve articles that describe the challenges during the adoption and diffusion of smartness technology in rural areas. The sets of relevant synonymous keywords used to construct this search query are presented in Table 2. Since the concept of smartness for urban areas is already well established, we used synonymous keywords related to urban smartness (column 1) merged with synonymous keywords that represent the rural area (column 2) to direct the results into the adoption of urban smartness within the rural context. In column 3, we used synonymous keywords related to rural smartness to focus on the adoption of smartness in rural areas. In the last column, we used synonymous keywords that will help us identify the challenges of smartness adoption in the rural context.

Similarly to the previous research question we used logical operators to construct the following search query:

((“urban smartness” OR “city smartness” OR “smart urban” OR “smart city” OR “smart cities” OR “digital city” OR “digital cities”) AND (*rural* OR *village* OR *region*))

OR (“smart rural” OR “rural smartness” OR “smart village” OR “village smartness” OR “digital rural” OR “digital village” OR “digital inclusion”))

AND (*challenge* OR *difficulty* OR *difficulties* OR *impediment* OR *barrier*).

Table 2 Synonymous keywords for RQ2

Urban smartness	Rural context	Rural smartness	Challenges
Urban smartness	Rural	Smart rural	Challenge
City smartness	Village	Rural smartness	Difficulty
Smart urban	Region	Smart village	Difficulties
Smart city		Village smartness	Impediment
Smart cities		Digital rural	Barrier
Digital city		Digital village	
Digital cities		Digital inclusion	

Table 3 Synonymous keywords for RQ3

Urban smartness	Rural smartness	Platform	Government
Urban smartness	Smart rural	Platform	Government
City smartness	Rural smartness	Service platform	Local government
Smart urban	Smart village	e-government	Municipality
Smart city	Village smartness	Open data	Municipalities
Smart cities	Digital rural	Government as a platform	
Digital city	Digital village		
Digital cities	Digital inclusion		

Search Query for RQ3 The objective of this search query is to retrieve articles that describe the current developments and trends on service platforms in the context of urban and rural smartness. For this purpose, we used the sets of relevant synonymous keywords presented in Table 3. In the first and the second column, we used synonymous keywords related to urban and rural smartness, since the service platform should be applicable in the context of smartness. In the third and fourth column, we used synonymous keywords to extract search results that focus on service platforms initiated by the government. We emphasise the role of government in the provision of the service platform since the investment in smartness for rural areas is not economically attractive for private companies (Philip and Williams, 2019; Roberts et al., 2017; Correa and Pavez, 2016).

The search query we used for the last research question is shown below:

(“urban smartness” OR “city smartness” OR “smart urban” OR “smart city” OR “smart cities” OR “digital city” OR “digital cities” OR “smart rural” OR “rural smartness” OR “smart village” OR “village smartness” OR “digital rural” OR “digital village” OR “digital inclusion”).

AND (platform OR “service platform” OR “e-government” OR “open data” OR “government as a platform”)

AND (government OR “local government” OR municipality OR municipalities).

Inclusion and Exclusion Criteria

Inclusion and exclusion criteria are defined to identify primary articles that provide direct evidence for the research question (Kitchenham and Charters, 2007). In this phase, we selected articles that meet the inclusion criteria. Then we removed articles according to the exclusion criteria by evaluating their title, abstract, and full text. Table 4 shows the inclusion and exclusion criteria used in this study.

Concerning the inclusion criteria, we only include the articles that are written in English. This is because most of the search results related to the RQs are written in English (more than 98% in Scopus and WoS). Second, we only considered articles published in journals and conference proceedings. The reason for this is that journals and conference proceedings usually go through a thorough peer-review process to ensure the quality of published articles. Third, to help retrieve relevant articles, we only included those in the subject areas related to the RQs: engineering, computer science, social sciences, decision

Table 4 Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
Articles written in English	Duplicate articles (by title or content)
Articles published in Journals or Conference Proceedings	Articles not related to the RQ (by title, abstract, and full text)
Subject areas of the articles are in the field of engineering, computer science, social sciences, decision science, business management, and economics.	
Articles published from 2011	

science, business management, and economics. Fourth, regarding the publishing period, we only selected articles published from 2011. The reason for this decision is based on a study conducted by Cocchia (2014), in which it is mentioned that research related to urban smartness shows significant growth from 2011 on. Scopus search results also justified this trend. As shown in Fig. 3, there is a significant growth in publications on the topic of urban smartness from 2011 on.

On the other hand, as result of applying the exclusion criteria, we remove duplicate articles and the articles that have no relation with each RQ. For RQ1, these articles do not describe any characteristics of smartness and its contribution to economic welfare improvement. For RQ2, these articles do not explain any challenges in implementing smartness in rural areas. Lastly, for RQ3, these articles have no relation with service platforms in the context of smartness.

Fig. 3 Scopus search result on query related to urban smartness: *TITLE-ABS-KEY* (“urban smartness” OR “city smartness” OR “smart urban” OR “smart city” OR “smart cities” OR “digital city” OR “digital cities”)

Fig. 4 Article selection process

Selection Process

There are six steps taken in the selection process phase to obtain the primary articles for this study. Figure 4 shows a diagram of these steps, along with the number of selected articles in each step. First, we executed the search query for each RQ in the selected academic databases (Scopus, Web of Sciences, and IEEE Xplore) in July 2019. Second, we refined the search results by applying the inclusion criteria using the filters provided in the academic databases. We exported the search results to EndNote since it is easier to categories the references, to find and delete duplicate references, to assess the reference information (e.g. title, abstract, keywords, year of publication, type of publication, and name of publication), and it has a built-in tool to download the full text of the reference. Furthermore, using EndNote, for each RQ, we consolidated the references retrieved from the three databases by removing the duplicate references and retaining the unique references.

In the third step, we removed irrelevant articles in each RQ by reviewing the title and abstract and based on further analysis according to the exclusion criteria. Fourth, we deleted the articles for which we could not download the full text. Fifth, we removed irrelevant articles through the assessment of the full text according to the exclusion criteria. At this point, we collected 120 articles for all RQs. However, in the last step, we found an article that is relevant for both

RQ1 and RQ3. Considering this duplication, the number of selected articles is 119 (see [Appendix](#)). Please note that we use the unique article ID included in the [Appendix](#) when we refer to a specific article in a table to present the literature analysis results in a more compact manner. Nevertheless, when we discuss an article in the text we refer to it using a usual citation.

Synthesis

To properly synthesise the primary articles, we collected relevant information based on the data extraction form shown in Table 5. We used the extracted information to carry out both a quantitative and qualitative synthesis. We performed the quantitative synthesis based on bibliographic reference and the qualitative synthesis based on the thematic analysis according to the data items relevant to the RQs, as is presented in the “[Results](#)” section. Furthermore, based on the results of our synthesis, we formulate the theoretical model that will be discussed in the “[Discussion](#)” section.

Results

In this section, we present the results of the SLR based on the information we collected and synthesised using the data extraction form. The bar chart in Fig. 5 illustrates the number of articles based on publication type, grouped by RQ. As shown in the chart, the number of selected articles for RQ1 and RQ3 are published almost equally in journals and conference proceedings. This result indicates that the topic covered in RQ1 (contributions of smartness to the economic welfare) and RQ3 (state-of-the-art on service platforms) has a higher level of maturity since articles published in a journal, in most cases, go through a more rigorous peer-review process and contain more elaborate research. In the case of RQ2, the majority of articles are published in conference proceedings and has the highest number of conference proceedings articles among other RQs. This result indicates that the topic covered in RQ2 (adoption of smartness in rural areas) is still in the early stage of development.

When it comes to the source of the selected articles, in Fig. 6, we can see that all the scientific databases contributed as sources of the selected articles. Scopus dominated as the main source of literature in all RQs, IEEE results give a significant contribution to the selected articles in RQ2, and WoS contributed to the majority of articles in RQ3.

Figure 7 shows the histogram of publications between 2011 and (July) 2019. Note that the majority of the selected articles are published in the last four years (73%). This suggests that there is a growing interest among researchers for the topics covered by all RQs, with a sudden surge in 2018 of research on topics related to the adoption of smartness in rural areas (RQ2) and the utilisation of service platforms as the IT artefact of smartness (RQ3).

To gain insight in the relationship between the authors of the selected articles, in Fig. 8, we plot countries of the first authors’ affiliation against the selected

Table 5 Data extraction form

No.	Extracted data	Data item	Relevance
1	Bibliographic reference	Authors, year of publication, title, source of publication, source of database, and type of publication	General
2	Contributions of smartness to the economic welfare	Smartness characteristics contributed to the improvement of economic welfare, economic impacts of smartness, and performance indicators that measured economic welfare improvement caused by smartness	RQ1
3	Challenges in implementing the smartness concept in rural areas	Challenges in three categories (technological, organisational, and environmental)	RQ2
4	State of the art of service platform	Functional characteristics, technology used, and involved stakeholders service platforms	RQ3

articles for each RQs. According to the United Nations (2020), countries in the bracket are developing countries, while the rest are developed countries. As it can be seen from the histogram, selected articles on the topic of RQ1 were written by authors from developed and developing countries with 15 and 19 articles, respectively. This finding suggests that research on the topic of the contributions of smartness to the economic welfare is commonly addressed by researchers, regardless of the country of origin classification. With regard to

Fig. 5 Number of selected articles based on publication type

Fig. 6 Number of selected articles across scientific databases

the topic of RQ2, whilst there is no much difference between the total number of articles written by authors from developed and developing countries (18 and 19 articles, respectively), authors from India were dominating our selection with 11 articles. This finding indicates that the topic concerning the adoption of smartness into rural areas is gaining momentum in countries where the majority of the population is living in rural areas. On the other hand, most of the selected articles on the topic of RQ3 were written by authors from developed countries with 37 articles, which is significantly more than the number of contributions from developing countries with 12 articles. This result indicates that the research addressing state-of-the-art service platforms were mostly gaining attentions from the authors located the countries with a well-established IT infrastructures.

Findings on RQ1

The objective of RQ1 is to identify contributions of the smartness adoption to the improvement of citizen's economic welfare. To achieve the objective, based on the assessment of the selected articles, we identified several characteristics of smartness that contribute to the economic welfare improvement (Table 6), the economic impacts of smartness (Table 7), and the performance indicators to measure these impacts (Table 8).

In Table 6, we present four characteristics of smartness that contribute to the improvement of citizen's economic welfare. What is interesting in the results is that although the most cited characteristic is closely related with IT, the second and the third most cited characteristics are related to cooperation between

Fig. 7 Number of selected articles per year and RQ

involved stakeholders and the capabilities of the citizens. This finding shows that the concern relating to the smartness adoption is not merely about the use of IT, but also the orchestration of multiple stakeholders.

In Table 7, we present seven main economic impacts of smartness adoption identified from the selected literature. The economic impacts mentioned in the table are relatively equally distributed over the selected articles which indicates that they are acknowledged by most authors as main consequences of smartness adoption. However, the facilitation of business collaboration has the highest number of supporting articles, which suggests that it is an essential factor.

In Table 8, we categorised relevant performance indicators to measure the economic impact of smartness adoption in four categories: productivity, welfare, innovation, and new business creation. The results indicate that the utilisation of smartness discussed in the selected articles is mainly aiming at improving the productivity of business activities. The utilisation of smartness as the enabler for innovation, especially to create new business, seems understudied.

Fig. 8 Number of selected articles per country of the first author's affiliation location and RQ

Table 6 Characteristics of smartness contribute to economic welfare improvement

Aspects	Definition	Number of articles	Article identifiers
Connectedness	Connectedness between stakeholders (e.g. citizens, government, private sector, and knowledge institution) enabled by IT and infrastructure	21	P01, P02, P03, P04, P07, P08, P09, P14, P16, P17, P19, P20, P23, P24, P25, P29, P30, P31, P32, P33, P34
Participatory governance	Participation from all stakeholders (e.g. citizens, government, private sector, and knowledge institution) in improving living qualities and creating welfare through IT services provision	18	P03, P05, P07, P12, P13, P16, P19, P20, P21, P23, P24, P25, P27, P29, P30, P31, P32, P34
Digitally empowered citizens	Citizen's creativity and innovation empowered by the usage of IT services	17	P02, P04, B07, P16, P19, P20, P21, P23, P24, P27, P28, P29, P30, P31, P32, P33, P34
Coherence in technology services provision	Coordinated IT services that provide coherence in the service provision	9	P04, P06, P14, P22, P23, P24, P30, P32, P33

Table 7 Economic impact of the smartness adoption

Economic impact	Description	Number of articles	Article identifiers
Facilitates business collaboration	Facilitates business entities to collaborate for the creation of economic value	15	P07, P09, P14, P16, P19, P20, P21, P23, P24, P29, P30, P31, P32, P33, P34
Improves business productivity	Enables business entities to have a productivity growth in their business	14	P04, P06, P07, P08, P09, P12, P17, P15, P20, P21, P23, P24, P30, P34
Improves business efficiency	Enables business entities to have a more productive use of their available resources	14	P03, P04, P06, P07, P09, P12, P14, P17, P20, P21, P23, P24, P30, P33
Fosters entrepreneurship	Empowers citizens to be innovative that lead to the creation of the new business entity	13	P02, P06, P09, P14, P21, P22, P23, P28, P29, P30, P31, P33, P34
Facilitates product or service creation	Facilitates business entities to develop new products or services	12	P06, P09, P14, P21, P22, P24, P28, P29, P30, P31, P32, P34
Increases market access	Facilitates business entities to access broader market, both national and global	12	P05, P07, P09, P10, P17, P21, P23, P24, P27, P29, P30, P32
Improve citizen's welfare	Triggers improvement of citizen's welfare through the increment of employment opportunities and the economic growth	12	P01, P02, P04, P05, P06, P08, P19, P20, P21, P25, P33, P34

Table 8 Performance indicators to measure economic welfare improvement

Performance indicator category	Description	Number of articles	Article identifiers
Productivity	Indicators to measure the productivity outcome triggered by the adoption of smartness concept. For example, the investment rate in digital-related business, value of goods/services sold through e-commerce, and the expansion rate to national/global market	10	P02, P07, P09, P10, P11, P15, P23, P26, P27, P30
Welfare	Indicators to measure the welfare level of citizens. For example, the citizen's average wage, employment/ unemployment rate, Gini ratio, consumption rate, and GDP per capita	9	P02, P09, P11, P13, P15, P17, P18, P19, P30
Innovation	Indicators to measure the innovation triggered by the adoption of smartness concept. For example, employment rate in the knowledge-intensive sector, R&D expenditure, and the number of patents	7	P02, P07, P09, P10, P17, P23, P27
New business creation	Indicators to measure the creation of new businesses empowered by IT. For example, the self-employment rate and new business registered per year	5	P07, P09, P23, P27, P30

Findings on RQ2

The objective of RQ2 is to identify challenges that might raise barriers for the adoption of smartness in the rural context. To achieve the objective, we structured the challenges based on the technology-organisation-environment (TOE) framework by Tornatzky, Tornatzky and Fleischer (1990). According to this framework, three aspects influence the adoption of technological innovation, namely technological, organisational, and environmental. We consider the adoption of smartness in rural areas as a form of technological innovation adoption. Therefore, according to the TOE framework, we use the following three categories to group the challenges:

- Technological challenges are related to the quality and characteristics of technology that influence the adoption of smartness in rural areas.
- Organisational challenges are related to the characteristics and capability of the organisation responsible for managing the smartness initiatives in rural areas.
- Environmental challenges are related to the characteristics of involved stakeholders and regulatory environment that influence the adoption of smartness in rural areas.

Table 9 shows five technological challenges for the adoption of smartness in rural areas found in the selected articles. We found a significant gap between the frequency of the most mentioned technological challenge, i.e. broadband access implementation, and that of all other challenges. Also notable is the finding that only very few of the authors mention challenges related to strategic guidelines. This suggests that the main barrier for adopting smartness in rural areas is the lack of sufficient connectivity infrastructure as prerequisite of rural smartness.

Table 10 shows organisational challenges identified from the selected articles. Our assessment indicates that the main organisational bottlenecks for smartness adoption are related to the availability of sustainable funding, and organisational capabilities. This result suggests that the assurance of funding, and the capabilities of the organisation responsible for managing the smartness initiatives which are perceived as the two most important organisational aspects for the successful adoption of smartness in rural areas.

Table 11 presents the environmental challenges addressed by the selected articles. What stands out from the results is that most of the challenges are related to the citizen's capabilities, including, low level of digital knowledge, low purchasing power for digital infrastructure and services, resistance to change, and lack of entrepreneurial capabilities. These results suggest that the development of rural citizen's capabilities is a crucial aspect for the successful adoption of smartness in rural areas.

In order to make explicit the relation between a regional characteristics and specific types of challenges in adopting smartness in rural areas, in Fig. 9, we map them against the location of the study (horizontal axis). The number in the grid represents the number of articles that cite a specific challenge carried out in a particular location. We used the term “generic” for studies where the authors did not mention any specific location. As it can be seen in Fig. 9, the studies from

Table 9 Technological challenges

Challenges	Description	Number of articles	Article identifiers
Broadband access implementation	Challenges related to the availability, quality, and reliability of broadband access in rural areas due to the difficulties of geographical location and unsupported technology infrastructure, as well as, the cost associated to implement and operate the broadband access	22	P35, P37, P40, P43, P45, P46, P47, P48, P49, P51, P55, P56, P57, P58, P59, P60, P63, P65, P67, P68, P69, P71
Technology services suitability	Challenges related to the suitability of technology and digital services to the situation and people's needs in rural areas. These include vendor/technology push instead of demand-pull, unsupported ICT infrastructure for digital services, non-user-friendly services, language gap, and outdated technology	7	P37, P39, P46, P60, P61, P62, P69
End-user digital devices ownership	Challenges related to the difficulties for rural people to own the digital device(s) due to the lack of availability and high cost of ownership	5	P37, P40, P45, P46, P69
Reliable electricity	Challenges related to the availability of reliable electricity access	4	P43, P45, P46, P69
Strategic guidelines	Challenges related to the lack of guidelines in the provision of digital services. These include the lack of ecosystem approach in developing the digital solution and lack of reference architecture for rural settings	2	P39, P62

Table 10 Organisational challenges

Challenges	Description	Number of articles	Article identifiers
Funding	Challenges related to the funding of technology services provision in rural areas. These include difficulties to define the business model and pricing strategy, unattractiveness for investment, unsustainable operational funding	10	P35, P40, P51, P54, P57, P58, P63, P64, P65, P71
Organisational capabilities	Challenges related to the capabilities of the responsible organisation in managing technology services provision in the rural area. These include lack of technical capabilities, lack of manpower, poor management, overlapping roles and responsibilities, low integrity and responsibility, inefficient bureaucracy, lack of innovation, lack of understanding of local needs, lack of flexibility and adaptability in the agile environment, and lack of leadership capabilities to orchestrate the initiatives	10	P37, P39, P45, P47, P49, P59, P60, P64, P65, P71
Commitment from the government	Challenges related to the commitment from the government supporting the utilisation of IT services in rural areas and the lack of political commitment to support the continuity of the initiatives	5	P36, P40, P44, P51, P63
Collaboration	Challenges related to the communication and cooperation aspect of the responsible organisation in the provision of IT in rural areas. These include lack of alignment between government and the local communities, delay in information sharing from government to relevant stakeholders, lack of public–private partnership establishment, and difficulties in the coordination between involved stakeholders	5	P36, P40, P43, P47, P51

Table 11 Environmental challenges

Challenges	Description	Number of articles	Article identifiers
Digital knowledge	Challenges related to the digital knowledge of citizens in rural areas. These include low digital literacy, lack of awareness of the digital potential, and resource limitation for digital education	23	P35, P36, P37, P39, P40, P41, P43, P45, P46, P47, P49, P51, P52, P53, P57, P58, P59, P64, P65, P68, P69, P70, P71
Third-party involvement	Challenges related to the difficulties in engaging the third parties (e.g. companies, organisations, and educational institution) in the rural smartness initiatives. These include difficulties to integrate knowledge and resources among stakeholders, difficulties in building mutual trust, difficulties to fulfil the stakeholders' needs, and unattractiveness of ICT investment for vendors	9	P36, P38, P39, P47, P51, P60, P63, P69, P70
Resistance to change	Challenges related to the resistance of local citizens to change the current situation. These include the reluctance to grow existing businesses, lack of motivation to change, and rejection caused by cultural reasons	7	P35, P36, P40, P47, P57, P62, P63
Purchasing power	Challenges related to the affordability of digital infrastructure and services for rural citizens	8	P37, P43, P46, P63, P67, P68, P69, P71
Regulations and policies	Challenges related to the supportive regulations and policies related to the utilisation of IT in rural economic activities. These include lack of supportive legal framework, inaccuracy of the policies to the actual needs, delay in implementation of the policies, and instability of the policies due to political dependencies	6	P36, P40, P43, P47, P63, P71
Entrepreneurial capabilities	Challenges related to the entrepreneurial capabilities of rural citizens. These include the lack of innovation capability, lack of business capability, and lack of ability to scale their business	5	P39, P41, P47, P60, P71
Citizens involvement	Challenges related to the difficulties in engaging the citizens in the provision of IT services and related policy. These include communication difficulties between government and citizens, and reluctant from the citizens to get involved	4	P47, P50, P51, P63

Fig. 9 Challenges mapping based on the location of study

the selected articles are carried out both in developing, and developed countries. However, the studies located in developed countries are more dispersed compared to those in developing countries. In developing countries, most of the studies concern African countries and India, where the citizens in rural areas represent a majority of the country’s population (World Bank, 2018). Furthermore, the most cited challenges (the lack of broadband access, lack of organisational capability, and limited digital knowledge) are also identified by studies that carried out in India. Thus, these results suggest that the challenges identified in this section are most relevant for the developing countries (see Fig. 10).

Fig. 10 Proposed theoretical model

Findings on RQ3

The objective of RQ3 is to identify the state-of-the-art on service platforms, which represents the IT artefact of smartness. To achieve this objective, based on the results of the SLR, we identified several main functional characteristics, main types of technology used, and main categories of stakeholders involved in the service platforms.

Table 12 presents the main features of service platforms discussed in the selected literature. From the table, we can see that the most important features of service platforms are related to the ability to connect the stakeholders within the ecosystem. These features include the ability to integrate various services in a unified platform, accessibility of data by external parties, facilitation of services co-creation, facilitation of data management processes, of stakeholders' coordination, and of citizen's participation. However, other important features of service platforms remain underrepresented in the extant research, namely security and privacy, easiness to deploy, and easiness for end-users to use the platform.

Table 13 presents four categories of stakeholders mentioned in the literature. As it can be seen in the table, each of the stakeholder types appears in a significant number of articles (at least 20 articles). These results indicate that the design of service platforms should accommodate the collaboration between all these stakeholders' categories.

Table 14 presents six main technologies used by the service platforms. As it can be seen, two types of technologies that are most prevalent: (mobile) Internet access and data exchange infrastructure. Some authors also emphasize the importance of using open-source software components that enable service platforms to become vendor-independent.

Discussion

In this section, we discuss the formulation of the theoretical model that explains the causal mechanisms underlying the relationship between the adoption of rural smartness and improvement of the economic welfare of citizens in rural areas. The theoretical model has been derived from the articles we selected during the SLR. The articles on RQ1 are used to elaborate on the smartness characteristics that can contribute to the improvement of citizen's economic welfare, and to identify the specific economic impacts of smartness adoption. The articles on RQ2 are used to identify the readiness factors that need to be in place for the successful adoption of smartness in rural areas. Finally, the articles on RQ3 are used to define the characteristics of IT artefacts of smartness that can accelerate the positive economic impacts of smartness adoption in rural areas.

However, because our SLR is actually divided between three independent research domains/questions (determined by the three separate queries), the resulting literature sample is very much confined to these three domains and therefore not covering the links between them. Therefore, in order to link the three domains, and to be able rely on a sound theoretical foundation when

Table 12 Main functional characteristics of service platforms

Features	Description	Number of articles	Article identifiers
Integrated services	Integrates various necessary services (functionality, payment, authentication) and its resources (data, infrastructures) into a unified platform	36	P72, P73, P74, P06, P75, P76, P78, P79, P80, P81, P82, P85, P88, P89, P91, P92, P93, P95, P96, P97, P98, P101, P102, P103, P104, P105, P107, P108, P109, P110, P111, P112, P113, P117, P118, P119
Open data access	Data provided by the platform accessible by the external parties (e.g. citizens, developers, companies, and other private entities)	36	P73, P74, P06, P75, P76, P77, P78, P79, P80, P81, P83, P85, P86, P87, P88, P89, P90, P91, P92, P93, P95, P96, P97, P98, P99, P102, P103, P104, P105, P106, P107, P110, P111, P113, P115, P116
Data management	Facilitates data management processes (including data collection, data storage, data processing, and data presentation) and data exchange mechanism with the existing systems and external parties through the establishment of APIs	38	P73, P06, P75, P76, P78, P79, P80, P81, P86, P89, P91, P92, P95, P96, P97, P98, P102, P103, P105, P107, P111, P113, P116, P115, P118, P119, P103, P104, P105, P106, P107, P110, P111, P113, P115, P116, P118, P119
Stakeholders coordination	Governs the interconnectedness between involved stakeholders for cohesive collaboration, concerning their needs, role, and business model	25	P06, P75, P76, P78, P79, P83, P85, P88, P90, P92, P93, P94, P96, P98, P101, P102, P104, P107, P108, P111, P112, P115, P116, P117, P119
Services co-creation	Facilitates innovation process for involved stakeholders to collaborate in co-creating new services for better economic opportunities	30	P73, P74, P06, P75, P76, P78, P79, P83, P85, P89, P90, P91, P92, P93, P94, P96, P98, P100, P101, P102, P104, P107, P108, P109, P110, P111, P113, P116, P118, P119
Citizen's participation facilitation	Facilitates citizens to give feedback on the existing public services and infrastructures, and contribute to the decision-making process of public policies	26	P73, P74, P76, P77, P78, P84, P89, P90, P91, P93, P94, P98, P101, P105, P106, P107, P108, P109, P110, P111, P113, P114, P115, P116, P117, P119
Security and privacy	Prevents threats from cyber-attacks to the applications, data, or infrastructures (e.g. viruses, hack, and network attack), and protect users' privacy and personal data	18	P73, P06, P74, P75, P78, P80, P81, P85, P86, P88, P89, P93, P96, P102, P105, P107, P111, P119
Ease of deployment	Design of the platforms provide aspects that support ease of implementation and scaling. These aspects include modularity, pluggability, configurability, and easiness to deploy in multiple technology environments	13	P88, P89, P92, P95, P102, P105, P107, P110, P111, P112, P116, P117, P118

Table 12 (continued)

Features	Description	Number of articles	Article identifiers
Ease of use	Users can easily access the platform through multiple channels (e.g. web portal, mobile web, mobile apps) and multiple devices (e.g. personal computer, tablet, smartphone) in a friendly manner	6	P89, P92, P95, P98, P107, P108

Table 13 Involved stakeholders in a service platform

Stakeholders	Description	Number of articles	Article identifiers
Government	Government entities, including central government, municipality, and government agencies	35	P73, P06, P75, P76, P79, P80, P81, P82, P83, P88, P89, P90, P91, P92, P93, P96, P97, P98, P101, P102, P103, P104, P105, P106, P107, P108, P109, P110, P111, P112, P113, P115, P116, P117, P119
End users	Entities using the services provided by the platform, including citizens, communities, and business entities (SMEs).	35	P73, P06, P75, P76, P79, P80, P81, P82, P83, P88, P89, P90, P91, P92, P93, P96, P97, P98, P101, P102, P103, P104, P105, P106, P107, P108, P109, P111, P112, P113, P115, P116, P117, P118, P119
Business service providers	Business entities providing goods or services through the platform	22	P73, P81, P83, P89, P90, P91, P93, P96, P97, P98, P101, P102, P103, P104, P108, P109, P110, P111, P113, P115, P118, P119
Technology providers	Entities that support the provision of digital services provided by the platforms, including software developers, IT infrastructure providers, and digital services providers	20	P06, P75, P76, P79, P88, P89, P90, P91, P92, P93, P97, P98, P102, P107, P108, P108, P111, P116, P117, P119

structuring the theoretical model, we also use several other studies going beyond the SLR, namely, the TOE framework by Tornatzky and Fleischer (1990), the process-oriented model of IT business value by Mooney et al. (1996), the service innovation concept by Lusch and Nambisan (2015), and the service platform case study by Talbot (2016).

Figure 10 shows the proposed theoretical model. This model includes three independent variables (technological readiness, organizational readiness, and environmental readiness), three mediating variables (rural smartness, innovation improvement, and competitiveness improvement), one moderating variable (rural smart service platform adoption), and one dependent variable (perceived welfare benefits). In the remainder of this section, we will explain the rationale behind the proposed theoretical model.

To identify the variables that can predict the likelihood of the successful adoption of smartness in rural areas (rural smartness), we incorporate the TOE framework by Tornatzky and Fleischer (1990) into the theoretical model. The TOE framework has been widely used as the basis to study the adoption of various technology innovations. For example, electronic data interchange (Iacovou et al., 1995), e-business (Zhu et al., 2006), and enterprise resource planning (Awa et al., 2016). Although the TOE framework was initially developed in the context of organisations, as a general theory of technology innovation, this framework has been used to study technological innovation in urban areas as well, such as smart cities (Dewi et al., 2018; Bremser et al., 2019).

Table 14 Technology used in service platforms

Technology	Description	Number of articles	Article identifiers
Cloud platform	Technology that enables access to the provided services over the internet	25	P06, P75, P78, P79, P81, P82, P89, P91, P95, P96, P98, P99, P102, P104, P105, P106, P107, P108, P109, P110, P111, P112, P113, P117, P118
Data exchange	Technology that enables data exchange with the existing systems and external parties, including web services, APIs, SDKs, Enterprise Service Bus, and open standardise file format (e.g. xml, json)	17	P06, P78, P79, P80, P86, P91, P92, P95, P96, P97, P98, P102, P105, P107, P111, P115, P119
Mobile platform	Technology that facilitates access to the provided services through mobile devices, including native mobile application and mobile web	12	P06, P75, P89, P91, P102, P105, P111, P112, P113, P115, P116, P119
Data management	Technology that covers activities in data collection, data storage, data processing, and data presentation	11	P78, P88, P95, P99, P101, P102, P103, P106, P107, P110, P118
Open-source	Utilisation of open source software components that enable the service platform to be vendor-independent	5	P88, P102, P104, P108, P110

Given this wide applicability and relevance, we incorporate the TOE framework in the theoretical model to represent the independent variables that can influence the successful smartness adoption in rural areas: technological readiness, organisational readiness, and environmental readiness. Technological readiness covers the technology characteristics required as infrastructure for rural smartness. Organisational readiness covers the required characteristics and capabilities of the organisation responsible for the rural smartness initiatives. The environmental readiness covers the required characteristics of the involved stakeholders and of the regulatory environment that surrounds the initiatives for rural smartness.

To operationalise the readiness variables explained above, we refer to the challenges of rural smartness adoption that we identified in response to RQ2. We argue that by being ready to overcome these challenges, we can increase the likelihood to realise rural smartness. Indicators for technological readiness, organisational readiness, and environmental readiness are presented in Table 15, Table 16, and Table 17, respectively.

We used the term rural smartness to represent the successful adoption of smartness in rural areas. To further define the indicators of rural smartness, we refer to the smartness characteristics resulted from the SLR on RQ1. Based on these characteristics, we proposed four indicators of rural smartness in Table 18. According to these indicators, we can define rural smartness as *the situation when the implementation of IT infrastructure and services can empower the citizens to improve their living quality and welfare through connectivity and participatory governance*. This definition is aligned with the most widely cited definition of urban smartness by Andrea Caragliu et al. (2011). In the proposed theoretical model, we argue that rural smartness has a positive mediating effect on the economic welfare improvement for rural citizens.

To explain the positive impacts of rural smartness on the citizen's economic welfare, we refer to the process-oriented model of IT business value by Mooney et al. (1996). According to this model, benefits from IT adoption (smartness) are obtained through the impact that the smartness adoption has on the intermediate processes. Now, the question arising is what are the intermediate processes that can lead to the improvement of rural citizen's economic welfare. To answer this question, we use the service innovation concept by Lusch and Nambisan (2015).

They defined service innovation as the re-bundling of diverse resources that create novel resources (values) that are beneficial for entities in a given context. Such a conceptualisation leads to the understanding of the critical role IT has as a means to facilitate the exchange of resources between diverse stakeholders, and thus to accelerate the value creation process. We found that this concept is relevant for our model formulation since it helps us emphasize the role of IT in creating economic value. According to this concept, the use of IT that can support collaboration between diverse stakeholders within an ecosystem enables resource liquefaction and resource density.

Resource liquefaction refers to the digitisation process that decouples the information from its source. This digitisation leads to faster information processing and sharing and enables business entities in an ecosystem to have broader market access, more accurate business decision, and more productive use of available resources. Therefore, it enables the business entities to improve their competitiveness

Table 15 Technological readiness indicators

Indicators	Description	Number of articles	Article identifiers
Broadband access penetration	Level of broadband access penetration in rural areas	22	P35, P37, P40, P43, P45, P46, P47, P48, P49, P51, P55, P56, P57, P58, P59, P60, P63, P65, P67, P68, P69, P71
Information technology services suitability	Level of IT service suitability with the situation and needs in rural area	7	P37, P39, P46, P60, P61, P62, P69
Digital device ownership penetration	Penetration level of devices owned by rural citizens to access the IT service	5	P37, P40, P45, P46, P69
Electric reliability	Level of electric reliability in rural areas	4	P43, P45, P46, P69
Adequacy of strategic guidelines	The level of adequacy of strategic guidelines for the provision of IT services in rural areas	2	P39, P62

Table 16 Organisational readiness indicators

Indicators	Description	Number of articles	Article identifiers
Certainty of sustainable funding	Level of certainty of sustainable funding for IT infrastructure and services provision in rural areas	10	P35, P40, P51, P54, P57, P58, P63, P64, P65, P71
Organisation capability	Capability level of the organisation responsible in managing IT services provision in rural areas	10	P37, P39, P45, P47, P49, P59, P60, P64, P65, P71
Commitment from the government	Level of government's commitment to supporting the utilisation of IT services in rural areas	5	P36, P40, P44, P51, P63
Collaboration	Collaboration level of the organisation responsible for managing the rural smartness	5	P36, P40, P43, P47, P51

Table 17 Environmental readiness indicators

Indicators	Description	Number of articles	Article identifiers
Digital knowledge	Level of digital knowledge of rural citizens	23	P35, P36, P37, P39, P40, P41, P43, P45, P46, P47, P49, P51, P52, P53, P57, P58, P59, P64, P65, P68, P69, P70, P71
Third-party involvement	Level of third-party involvement for the IT services provision in rural areas	9	P36, P38, P39, P47, P51, P60, P63, P69, P70
Willingness of rural citizens to utilise technology in their economic activities	Willingness level of rural citizens to utilise IT services in their economic activities	7	P35, P36, P40, P47, P57, P62, P63
Purchasing power of rural citizens for technology services	Level of purchasing power of rural citizens for IT services	8	P37, P43, P46, P63, P67, P68, P69, P71
Supportive regulation and policies	Level of supported regulation and policy for the utilisation of IT services in the rural economic activities	6	P36, P40, P43, P47, P63, P71
Entrepreneurial capability of rural citizens	Level of the entrepreneurial capability of rural citizens	5	P39, P41, P47, P60, P71
Citizens involvement	Level of involvement of rural citizens in the provision of IT services and related policy	4	P47, P50, P51, P63

Table 18 Rural smartness indicators

Indicators	Description	Number of articles	Article identifiers
Connectedness	Level of connectedness between stakeholders in rural areas (e.g. citizens, government, businesses, financial institution) enabled by IT and infrastructure	21	P01, P02, P03, P04, P07, P08, P09, P14, P16, P17, P19, P20, P23, P24, P25, P29, P30, P31, P32, P33, P34
Participatory governance	Level of participation of stakeholders in rural areas (e.g. citizens, government, businesses, financial institution) in improving living quality and welfare creation through technology services provision	18	P03, P05, P07, P12, P13, P16, P19, P20, P21, P23, P24, P25, P27, P29, P30, P31, P32, P34
Digitally empowered citizens	Level of citizen's creative and innovation ability empowered by technology services	17	P02, P04, B07, P16, P19, P20, P21, P23, P24, P27, P28, P29, P30, P31, P32, P33, P34
Coherence of technology services provision	Level of coherence in the technology services provision	9	P04, P06, P14, P22, P23, P24, P30, P32, P33

(Du Plessis and Marnewick, 2017; Borsekova et al., 2018; Okrepilov et al., 2019; Neirotti et al., 2014; Lusch and Nambisan, 2015). On the other hand, resource density refers to the ability of stakeholders in an ecosystem to exchange appropriate resources in the value creation process (Lusch and Nambisan, 2015). High resource density enables stakeholders to easily integrate various accessible resources that lead to a collaborative process resulting in the creation of new economic value, such as new products/services or new business entities (Lusch and Nambisan, 2015; Borsekova et al., 2018; F. Li et al., 2016; J. Yu et al., 2019).

Based on our understanding of the impact of smartness on resource liquefaction and resource density (explained above), we argue that the intermediate processes of smartness that lead to the improvement of rural citizen's economic welfare are competitiveness, and innovativeness improvement. Therefore, in the proposed theoretical model, we define competitiveness improvement and innovativeness improvement as the variables that mediate the impact of rural smartness on citizen's economic welfare. To operationalise these variables, based on the articles we selected for RQ1, indicators for competitiveness improvement and innovativeness improvement are presented in Table 19 and Table 20, respectively.

In terms of the IT artefact, our SLR results show that there is a growing interest concerning the utilisation of service platforms (see Fig. 7) as implementation and diffusion vehicle for smartness. According to the SLR results on RQ3, the main characteristics of a service platform can be summarised as follows: integrates various services in a unified platform, facilitates cohesive collaboration between stakeholders, facilitates the third parties to co-create services, and facilitates citizen's participation. These service platform characteristics are in line with the definition by Lusch and Nambisan (2015), in which a service platform is defined as a modular structure that consists of tangible and intangible components which facilitate the interaction between stakeholders and resources.

As mentioned earlier, according to Lusch and Nambisan (2015), the main benefits of service platforms is that they can leverage resource liquefaction and enhance resource density, which in turn can intensify competitiveness and innovativeness, respectively. To further understand the role of the service platform in the rural context, we refer to the study by Talbot (2016). The author conducted a case study on the utilisation of a service platform as a means to improve the economic situation in a rural area of Scotland. This study confirmed that the utilisation of service platforms enables entrepreneurs in rural areas to (1) recombine their existing productive assets and improve their competitiveness, and (2) collaborate with relevant stakeholders which leads to the innovative process for creating new economic values.

The aforementioned explanations motivate us to posit that the adoption of a service platform in rural areas can accelerate the impact rural smartness has on improving competitiveness and innovativeness. In our research, we named the service platform as the rural smart service platform. Therefore, in the proposed theoretical model, we define the adoption of a rural smart service platform as a variable that positively moderates the influence of rural smartness on business competitiveness and business innovation. To operationalise this variable, Table 21 proposes the indicators we identified during the SLR on RQ3.

Table 19 Indicators for competitiveness improvement

Indicators	Description	Number of articles	Article identifiers
Market access improvement	Level of increase in access by business entities in rural areas to a broader market through the utilisation of IT services	12	P05, P07, P09, P10, P17, P21, P23, P24, P27, P29, P30, P32
Business productivity improvement	Level of increase in products/services that are produced/ delivered by business entities in rural areas through the utilisation of IT services	14	P04, P06, P07, P08, P09, P12, P17, P15, P20, P21, P23, P24, P30, P34
Business efficiency improvement	Level of improvement in the efficiency of resources utilised by business entities in rural areas in providing their products/services	14	P03, P04, P06, P07, P09, P12, P14, P17, P20, P21, P23, P24, P30, P33

Table 20 Indicators for innovativeness improvement

Indicators	Description	Number of articles	Article identifiers
Business collaboration improvement	Level of increase in innovation through collaboration between stakeholders in the rural business ecosystem that is empowered by IT services	15	P07, P09, P14, P16, P19, P20, P21, P23, P24, P29, P30, P31, P32, P33, P34
Value creation improvement	Level of increase in the creation of new products or services empowered by IT services	12	P06, P09, P14, P21, P22, P24, P28, P29, P30, P31, P32, P34
Increase in entrepreneurship	Level of increase in the creation of the new business entity empowered by IT services	13	P02, P06, P09, P14, P21, P22, P23, P28, P29, P30, P31, P33, P34

Table 21 Indicators for rural smart service platform adoption

Indicators	Description	Number of articles	Article identifiers
Provision of integrated services	Level of integration of the IT services (services supporting economic growth, payment, authentication) and its resources (data, infrastructures) into a unified platform	36	P72, P73, P74, P06, P75, P76, P78, P79, P80, P81, P82, P85, P88, P89, P91, P92, P93, P95, P96, P97, P98, P101, P102, P103, P104, P105, P107, P108, P109, P110, P111, P112, P113, P117, P118, P119
Facilitation of business collaboration	Level of facilitation for cohesive collaboration between involved stakeholders in the rural business ecosystem	25	P06, P75, P76, P78, P79, P83, P85, P88, P90, P92, P93, P94, P96, P98, P101, P102, P104, P107, P108, P111, P112, P115, P116, P117, P119
Facilitation of services co-creation	Level of facilitation for 3rd party developers to get involved in co-creating new IT services supporting rural business ecosystem	30	P73, P74, P06, P75, P76, P78, P79, P83, P85, P89, P90, P91, P92, P93, P94, P96, P98, P100, P101, P102, P104, P107, P108, P109, P110, P111, P113, P116, P118, P119
Facilitation of citizens participation	Level of facilitation for citizens to give feedback and suggestions in the provision of IT services supporting their economic activities	26	P73, P74, P76, P77, P78, P84, P89, P90, P91, P93, P94, P98, P101, P105, P106, P107, P108, P109, P110, P111, P113, P114, P115, P116, P117, P119

Table 22 Indicators for perceived welfare benefits

Indicators	Description	Number of articles	Article identifiers
Perceived income increase	Level of increase in the income of citizens in rural areas	14	P01, P04, P06, P08, P09, P11, P13, P15, P17, P19, P20, P21, P30, P34
Perceived increase in the employment rate	Level of increase in the number of people being employed by business entities	13	P02, P04, P08, P09, P14, P18, P21, P23, P25, P27, P30, P33, P34

The improvement in competitiveness and innovativeness triggered by rural smartness and the rural smart service platform is stimulating economic growth that leads to the improvement of citizen's economic welfare (Zavratnik et al., 2018; Naldi et al., 2015; Talbot, 2016). However, it is not often possible to measure the benefits of IT innovation, such as smartness, in terms of a numerical value, since other intervening environmental variables may influence the value (Wu and Wang, 2006). Therefore, several studies on IT adoption measured these benefits in terms of users' perceptions, e.g. perceived usefulness, perceived net benefits, and perceived individual impact (Wixom and Watson, 2001; Davis, 1989; McGill et al., 2003). Similarly, in the theoretical model, we use "perceived welfare benefits" as the dependent variable that represents the improvement of citizen's economic welfare. To operationalise this variable, in Table 22, we show the set of indicators resulting from analysis of the SLR on RQ1 (see Table 23).

The proposed theoretical model shown in Fig. 9 is an attempt to explain how rural smartness leads to the improvement of economic welfare for citizens in rural areas. However, an empirical test of this model, and a validity & reliability check of the proposed candidate measures is beyond the scope of this paper, but is currently part of ongoing research in the West Java province of Indonesia. In its current form, the proposed theoretical model (and its operationalisation) led to the following recommendations:

1. To assure the realisation of rural smartness, attention should be given to preparing the technology, organisation, and environmental readiness as described in Table 15, Table 16, and Table 17.
2. There is a necessity to adopt a rural smart service platform as a means to improve the economic welfare of citizens in rural areas. We argue this adoption should have a significant moderating effect on the competitiveness and innovativeness of rural business entities.
3. To realise the moderating effect of the rural smart service platform adoption, design of such a platform should accommodate the necessary functional specifications represented by the indicators in Table 21.

Conclusion

In this paper, we have conducted a systematic literature review resulting in a theoretical model that explains the causal mechanisms of how smartness adoption leads to the economic welfare improvement for citizens in rural areas. The main premise of the proposed theoretical model is that rural smartness has a mediating effect on the economic welfare of rural citizens through its positive influence on the competitiveness and innovativeness of rural business entities. Meanwhile, to realise smartness in rural areas, attention should be given to prepare the technology, organisation, and environmental readiness. Furthermore, we posit that there is a necessity to adopt a rural smart service platform. We argue that the adoption of such a platform should have a significant moderating effect on the competitiveness and innovativeness of rural business entities.

This paper has limitations that generate directions of future research. First, the search process for the SLR was manually conducted in three academic databases in July 2019. This implies that we may have missed some relevant articles that were published after the period of search. Therefore, it is recommended for future research to include backward and forward snowballing search to have the maximum coverage of relevant articles.

Second, to achieve the objective, this paper mainly focused on analysing the content of the selected articles and only included a few descriptive statistical analysis based on bibliographic data. Therefore, to gain richer statistical insights, future research can complement the results of this paper by performing metric-based methodology, such as, bibliometrics or scientometrics, to the selected articles.

Third, relevant theories that we used as argument for the formulation of the theoretical model were not falling within the scope of the SLR. In future work a fine-tuning of this model can be achieved by identifying other possible alternative relevant theories which could result in a further consolidation of the structure of the model.

Fourth, this paper does not cover neither the empirical validation of the proposed theoretical model, nor the validity and reliability check of the proposed measurement instrument. Thus, our next step is to achieve this in an ongoing project in the West Java province.

Appendix

Table 23 Reference ID

ID	Reference	Relevance
P01	Giridhar Kamath et al. (2019)	RQ1
P02	Firmansyah et al. (2019)	RQ1
P03	Javidroozi et al. (2019)	RQ1
P04	Okrepilov et al. (2019)	RQ1
P05	Ramachandran et al. (2019)	RQ1
P06	J. Yu et al. (2019)	RQ1, RQ3
P07	Borsekova et al. (2018)	RQ1
P08	Cohen et al. (2018),	RQ1
P09	Indrawati et al. (2018)	RQ1
P10	Komarevtseva (2018)	RQ1
P11	Qu (2018)	RQ1
P12	Rothe et al. (2018),	RQ1
P13	Cowan et al. (2017)	RQ1
P14	Du Plessis and Marnewick (2017)	RQ1
P15	Han (2017)	RQ1
P16	Serrano-Santoyo and Rojas-Mendizabal (2017)	RQ1
P17	Shi et al. (2017)	RQ1
P18	Stankovic et al. (2017)	RQ1
P19	Tanda et al. (2017),	RQ1
P20	Yeh (2017)	RQ1
P21	Arroub et al. (2016)	RQ1

Table 23 (continued)

ID	Reference	Relevance
P22	Ianuale et al. (2016)	RQ1
P23	Joshi et al. (2016)	RQ1
P24	F. Li et al. (2016)	RQ1
P25	Makushkin et al. (2016)	RQ1
P26	Rui (2016)	RQ1
P27	Tahir and Malek (2016)	RQ1
P28	Lavcak and Hudec (2015),	RQ1
P29	Richter et al. (2015),	RQ1
P30	Neirotti et al. (2014),	RQ1
P31	Albino et al. (2013),	RQ1
P32	Bakici et al. (2013)	RQ1
P33	Mulligan and Olsson (2013),	RQ1
P34	A. Caragliu and Del Bo (2012)	RQ1
P35	Philip and Williams (2019)	RQ2
P36	Soulard and Lardon (2019)	RQ2
P37	Willis (2019)	RQ2
P38	Doerr et al. (2018)	RQ2
P39	Hosseini et al. (2018)	RQ2
P40	Mtingwi et al. (2018)	RQ2
P41	Jange and Chittaranjan (2018)	RQ2
P42	Kaposzta et al. (2018)	RQ2
P43	Manda and Backhouse (2018)	RQ2
P44	Matern et al. (2018)	RQ2
P45	Nedungadi et al. (2018)	RQ2
P46	Gyeltshen and Osathanunkul (2018)	RQ2
P47	Ray (2018)	RQ2
P48	Aldoiu and Tapus (2018)	RQ2
P49	Singh and Rahman (2018)	RQ2
P50	Das and Misra (2017)	RQ2
P51	Roberts et al. (2017)	RQ2
P52	Wongkhamdi et al. (2017)	RQ2
P53	Wihlborg and Engstrom (2017)	RQ2
P54	S. Yu (2017)S. Yu (2017)	RQ2
P55	Bertot (2016),	RQ2
P56	Pham et al. (2016)	RQ2
P57	Correa and Pavez (2016)	RQ2
P58	Freeman et al. (2016)	RQ2
P59	Katara (2016)	RQ2
P60	Limaye et al. (2016)	RQ2
P61	Nojozi et al. (2016)	RQ2
P62	Jara et al. (2015)	RQ2
P63	Freeman and Park (2015)	RQ2
P64	Chatterjee and Kar (2015)	RQ2

Table 23 (continued)

ID	Reference	Relevance
P65	Real et al. (2014)	RQ2
P66	Das et al. (2013)	RQ2
P67	Devkar et al. (2013)	RQ2
P68	Figueiredo et al. (2012)	RQ2
P69	Gore et al. (2012)	RQ2
P70	Henriques and Kock (2012)	RQ2
P71	Sumbwanyambe et al. (2011)	RQ2
P72	Drozhzhin et al. (2019)	RQ3
P73	Gil et al. (2019)	RQ3
P74	Sanchez-Corcuera et al. (2019)	RQ3
P75	Anindra et al. (2018)	RQ3
P76	Barns (2018)	RQ3
P77	Bolivar (2018)	RQ3
P78	Chamoso et al. (2018)	RQ3
P79	Gutierrez et al. (2018)	RQ3
P80	Ishii and Yamanaka (2018)	RQ3
P81	Koshizuka et al. (2018)	RQ3
P82	Lv et al. (2018)	RQ3
P83	Mahesa (2018)	RQ3
P84	Muñoz and Rodríguez Bolívar (2018)	RQ3
P85	Stone et al. (2018)	RQ3
P86	Vieira and Alvaro (2018)	RQ3
P87	Wang et al. (2018)	RQ3
P88	Schieferdecker et al. (2017)	RQ3
P89	Khan et al. (2017)	RQ3
P90	Leminen et al. (2017)	RQ3
P91	F. P. Li and Li (2017)	RQ3
P92	Abu-Matar and Davies (2017)	RQ3
P93	Pereira et al. (2017)	RQ3
P94	Soomro et al. (2017)	RQ3
P95	Usurelu and Pop (2017)	RQ3
P96	Yamakami (2017)	RQ3
P97	Abu-Matar (2016)	RQ3
P98	Anttiroiko (2016)	RQ3
P99	Bakerally et al. (2016)	RQ3
P100	Coelho and Lopes (2016)	RQ3
P101	Ojasalo and Kauppinen (2016)	RQ3
P102	Recupero et al. (2016)	RQ3
P103	Liu et al. (2016)	RQ3
P104	Soto et al. (2016)	RQ3
P105	Sakamura et al. (2015)	RQ3
P106	Lopez et al. (2015)	RQ3
P107	Yonezawa et al. (2015)	RQ3

Table 23 (continued)

ID	Reference	Relevance
P108	Anttiroiko et al. (2014)	RQ3
P109	Clohessy et al. (2014)	RQ3
P110	Delaney and Pettit (2014)	RQ3
P111	F. Li and Wang (2014)	RQ3
P112	Piro et al. (2014)	RQ3
P113	Balena et al. (2013)	RQ3
P114	Benouaret et al. (2013)	RQ3
P115	Walravens (2013)	RQ3
P116	Walravens and Ballon (2013)	RQ3
P117	Kuk and Janssen (2011)	RQ3
P118	Maheshwari et al. (2011)	RQ3
P119	Walravens (2011)	RQ3

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