When the Community gets Smart. Looking at the IoT as value co-creation construct*

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Abstract

Purpose. The Internet of Things (IoT) is a dynamic network of smart interconnected objects that produces and consumes information bridging the gap between the real world and the digital realm (Miorandi et al., 2012; Lee et al., 2016; Rathore et al., 2016). Specifically, the interaction of both humans and objects in the Smart Community allows members to share thoughts, ideas, knowledge, and experiences and allows a faster access to resources (Ma et al., 2005; Anthopoulos and Fitsilis, 2010; Liang et al., 2012; Maury et al., 2015). According to the marketing perspective of Service-Dominant logic (SDL) (Vargo and Lusch, 2008) the resource integration (Kleinaltenkamp et al. 2012, Colurcio et al., 2014; Mele et al., 2014) is the main process for the value creation (Caridà et al., 2016). The aim of this study is to build a theoretical framework about the IoT as fundamental of resources integration process in the smart communities providing a novel marketing perspective of the phenomenon. Moreover, this work addresses relevant gaps in current knowledge on IoT and smart community as studies that investigate resource integration in such an environment are scant so far.

Methodology. We use a qualitative approach and deploy the case study methodology (Yin, 2013) to provide fresh interdisciplinary insights about value co-creation practices suitable for the building up and the development of smart communities. In this paper, we analyzed the SmartDataNet ecosystem and Yucca platform.

Findings. With the emerging popularity of smart personal devices, smart community and the Internet of Things (IoT), all information collected and redrafted in classes of interest may improve the quality of life in terms of stress-reduction, health, urban decorum, and consumption. The development of Smart Community that uses the IoT devices have great potential and facilitate to create a set of new services for daily life (Xia et al., 2011).

Practical implications. The added value of this work can be found in the effort to contribute to this field of study and to explore the challenges and the opportunities that IoT offers in Smart community to trigger resources integration process and, therefore, to co-create value.

Originality/value. The paper provides new knowledge on IoT as eco-system (Vargo, 2014) that allows and fosters the sharing of information and knowledge, and therefore the creation of new exchangeable resources (Vargo and Lusch, 2011; Chou et al., 2016). Furthermore, it enables and fosters value co-creation as it enhances the communication and the interaction. (Meola, 2016).

Keywords
Internet of Things, Smart Community, Value co-creation, Resource Integration

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1. Introduction

The Internet of Thing (IoT) is a novel paradigm focused on the concept of a complex ecosystem (Leminen et al., 2012) that link things and people (Colurcio et al., 2017). It enables a smart life of people that can manage different activities (Boulos et al., 2014) and provides advantages in terms of time and everyday life simplifying.

In Italy, the value of Internet of Things is around 2,8 billions of euro in 2016 (40% extra compared with the previous year) with 14,1 billions of smart objects connected through cellular network or other technologies and 36 billion of electricity meters linked to PLC (Power Line Communication)[1].

Furthermore, in the next few years is planned to increase further in Smart Metering, Smart Car, Smart Home, Smart City and Smart Community and Industrial IoT. The smart objects enable citizens to engage in participatory sensing through the collection and sharing of data of common interest (Ganti et al., 2011; Balestrini et al., 2015).

The development of Smart Community that uses the IoT devices have great potential and facilitate to create a set of new services for daily life (Xia et al., 2011). Specifically, the interaction of both humans and objects in the Smart Community allows members to share thoughts, ideas, knowledge, and experiences and allows a faster access to resources (Anthopoulos et al., 2010; Maury et al., 2015). All information collected and redrafted in classes of interest improve the quality of life in terms of stress, health, urban decorum, and consumption.

The IoT appears as a context that enables the process of resource integration. Specifically, Colurcio and Verre (2017) recognized that the IoT works as "service platform" (Lusch and Nambisan, 2015) that is "a modular structure that consists of tangible and intangible components (resources) and enabling the resource integration by leveraging resource liquefaction and enhancing resource density.

According to the marketing perspective of Service-Dominant logic (SDL) (Vargo et al., 2008) the resource integration (Kleinaltenkamp et al. 2012, Colurcio et al., 2014; Mele et al., 2014) is the main process to create value and all the actors are resource integrators (Vargo et al., 2008, 2009).

Given this, the IoT should enable and foster value co-creation as it enhances the communication and the interaction between things and people (Meola, 2016).

Nevertheless despite this intuitive link, to our best knowledge marketing research that treats the IoT and Smart Community according to a value co-creation perspective lack so far.

The aim of this study to build a theoretical framework about the IoT as fundamental of resources integration process in the smart communities providing a novel marketing perspective of the phenomenon.

We have been used a qualitative approach and the case study methodology (Yin, 2013) to provide fresh interdisciplinary insights for developing value co-creation practices suitable for the building up and the development of smart communities.

The analysis is focused on *SmartDataNet* and the Yucca platform that is the engine to elaboration and representation the data.

The paper provides a new knowledge on IoT that allows and fosters, the sharing of information and knowledge, and therefore the creation of new exchangeable resources (Vargo et al., 2011; Chou et al., 2016). Furthermore, it enables and fosters value co-creation as it enhances the communication and the interaction (Meola, 2016).

[1] Retrieved June 6, 2017, from "http://www.osservatori.net/it_it/osservatori/executive-briefing/boom-del-mercato-iot-in-italia-2-8-miliardi-di-euro-40.

2. Conceptual background

2.1 Internet of Things and Smart Community

The advancements in information technology have made growing evidence the presence of Internet of things that offers new opportunities to improve the quality of life (Xia et al., 2012; Balaji et al., 2017).

Initially, Internet was born as a network of services, instead, today Internet is a network of things and people (Coetzee et al., 2011).

Things are network connected to provide data, influence the environment and to create the opportunity for society. (Haller et al., 2008; Coetzee et al. 2011).

Despite the popularity of Internet of Things, there is no universal definition. IoT is composed of two words: i) "internet" that representing a dynamic global network infrastructure based on standard protocols; ii) "things" that are network connected (Whitmore et al., 2015; Mulani et al., 2016).

The IoT is based on three pillars that are identification, communication and interaction of smart objects – interconnected with other devices, services and people to accomplish objectives common (Elmenreich et al., 2009; Miorandi et al., 2012; Dohr et al., 2010; Whitmore et al., 2015; Balaji et al., 2017).

According to Dohr et al. (2010), the Internet of Things (IoT) is the logical further development of Internet and technological advancements lead to smart objects being capable of identifying, locating, sensing and connecting and thus leading to new forms of communication between people and things and things themselves (Dohr, et al., 2010). It is not a single novel technology, but rather a set of several complementary technologies and smart objects (Gubbi et al., 2013). The basic idea of this concept is the pervasive presence of a variety of things that generate the integration of the physical world with the virtual world of the Internet and that sharing information across platforms on large scale (Atzori et al., 2010; Haller, 2010; Gubbi et al., 2013).

Generally, the technologies used are the Radio Frequency Identification (RFID), Global Positioning system (GPS), developments in sensor networks, Micro Electro-mechanical Systems (MEMS) (Dohr et al., 2010; Miorandi et al., 2012; Lee et al., 2016; Rathore et al., 2016). These technologies allow the application in various sectors such as transportation and logistics domain (Atzori et al., 2010; Gubbi et al., 2013), healthcare sector to enhance service quality and reduce costs (Li et al., 2015; Mulani et al., 2016), in the infrastructure to improve smart cities, environmental monitoring, and smart homes and building (Whitmore et al., 2015; Li et al., 2015), personal and social application (Atzori et al., 2010; Gubbi et al., 2013; Whitmore et al., 2015). Furthermore, a number of leading global companies have begun the journey towards adopting the IoT. In business sectors, Internet of things allows to identify the hidden patterns, predict future trends and enable to access increasingly massive amounts of data and equip them with more powerful analytical tools to support their strategic and tactical decisions (Li et al., 2017).

The term Smart Community refers to a new generation of technologies integrated into the real word and community (Nam et al., 2011; Mital et al., 2015) whose members share a common interest or geographical area (Xia et al., 2013; Maury et al., 2015).

The interaction of Things in the Smart Community allows to members to share their thoughts, ideas, knowledge, and experiences with the virtual community. In addition, members with high levels of sense of community are more willing to exert extra effort and to help others to achieve certain objectives (Tonteri et al., 2011), to improve livability, preservation, revitalization, and sustainability, of community (Bagozzi et al., 2002; Sun et al., 2016; Chou et al., 2016).

The information shared can be personals, social and public, which focuses on sharing data with everyone for the greater public good and thanks to IoT there are tremendous opportunities to improve and impact the quality of life of urban communities (Nahrstedt et al., 2016).

The Internet has had a significant and progressive impact on people. Today, the electronic communication is a primary form of interaction, of sharing of common interests and goals and the members have become active co-creators of knowledge and experiences (Ridings et al., 2004; Sawhney et al., 2005; Casaló et al., 2007; De Valck et al., 2009; Tonteri et al., 2011; Chou et al., 2016).

The sharing information understood as resources of singular actors allows to access to additional resources, and thus to create new exchangeable resources (Vargo et al., 2011).

2.2 Value co-creation and Resource Integration

The remarkable development of network environment and communication technologies allow numerous devices to be connected to the Internet anytime, and to improve the quality life by helping to build an intelligent society (Ahmad et al., 2016). Furthermore, the innovation represents the collaborative recombination or combinatorial evolution (Arthur, 2009) of practices that provide novel solutions for new or existing problems (Vargo et al., 2015).

The Web 2.0 had changed the interaction between the people that now are able to interact, collaborate and share the information, resources and ideas (Pitta et al., 2005; Kozinets et al., 2008; Boudreau et al., 2013; Neuhofer, 2016).

The actors are connected through reciprocal promises of value (Ballantyne et al., 2006; Jaakkola et al., 2014; Reypens et al., 2016) and resources can be integrated with a larger set of resources available through a web of actors (Snehota et al., 1995; Lusch et al., 2010; Jaakkola et al. 2014).

According to Vargo and Lusch (2004), the value is always co-created and is characterized by the activity carried out of actors to contribute and receive resources. The value is co-created when the actors integrate the resources (Gummesson et al., 2010; Lusch, et al., 2010; Vargo et al., 2011; Jaakkola et al., 2014) and resources are integrated at level of network (Håkansson et al., 2009; Gummesson et al., 2010; Jaakkola et al, 2014).

According to Jaakkola et al. (2014), in the value co-creation process, the individual actors execute activities to contribute and receive resources, value is co-created when the actors integrate the resources and resources are integrated at level of network (Vargo et al., 2008; Gummesson et al., 2010; Lusch et al., 2011; Vargo et al., 2011; Jaakkola et al., 2014).

Value creation is always an interactive process that takes place in the context of a unique set of multiple, all actors possess the resources and these do not have value per se but merely the potential value. Therefore, the integration of resources and the use by actors, in a specific context and a common purpose are able to co-create value (Vargo et al., 2008). The interaction through actors and resources generate new resources (Edvardsson et al., 2014). Hence, at the network level, resources can be integrated with a larger set of resources available (Snehota et al., 1995; Lusch et al., 2010; Jaakkola et al. 2014).

3. Methodology

In this work has been used an exploratory and qualitative approach as it aims to build a theoretical framework about the IoT as fundamental of resources integration process in the smart communities providing a novel marketing perspective of the phenomenon. Specifically, a qualitative approach and the case study methodology (Yin, 2013) has been used to provide

fresh interdisciplinary insights to develop value co-creation practices suitable for the building up and the development of smart communities.

An exploratory case study can help to explore contextual phenomena (Yin, 2013) and it is consistent with the objective of the analysis that is exploratory and descriptive, and with the complex nature of the phenomenon under investigation. In addition, a case study approach better fits the dynamic interactive processes of resources integration.

The research process has been developed in two phases. The first phase related to the research planning and the literature review, whereas, the second phase related to the selection and the analysis of the empirical contextualization to better illustrate the IoT in Smart Communities in a vision of resources integration and value co-creation. We limited our analysis to SmartDataNet and the Yucca platform that is the engine to elaboration and representation the data.

The case has been selected according to the scientific interest, the possibility to reduce the risk of the examples redundancy and the availability of information.

Data collection and analysis

Data collection occurred mainly through non participant observation during the period from January to May. The interaction with the platform actors allowed to obtain information and frame the relationship among actors and objects.

The information collected has been analyzed consistently with the theoretical construct of the study focusing the key elements of Internet of Things, Smart Community and resource integration in the value co-creation process.

SmartDataNet is the cloud platform available for publics or privates, managed within a view of PAAS (Platform As A Service). It connects IoT and smart community thanks to Yucca and has been launched by Piedmont Region in collaboration with CSI Piedmont.

SmartDataNet and Yucca are unique in Italy because of match the data by Internet of Things, Internet of People and open data, giving tools, standard and framework for all user and allow tho share data in the open source.

4. The Case

SmartDataNet is the private-public ecosystem and is the evolution of "*Dati Piemonte*" portal that was born in 2010. It is the portal to use the public data collect to "*Dati Piemonte*" and other public application of the Piedmont region.

SmartDataNet allows to create new services and to take more efficient decisions, for example, to control the air quality thanks to the low-cost device that collecting the real-time data. The data may be aggregated and transformed in useful applications, for example, the apps for cyclist or drivers in particular and problem areas.

The aim to *SmartDataNet* is to promote data sharing to improve the growth of digital economic.

SmartDataNet links IoT, Open Data and Smart Community and is the only international experience offered from Public Administration that connects the data of Internet of Things and Open data in the big data world and offers the service in a view of platform-as-a-service and open source. The data are originated to Internet of Things (webcam, traffic sensor or weather stations) and Internet of People (smartphone, personal devices, tweet, post). The big data shared concern mainly the environment, healthcare and energy sectors and the central element of this ecosystem is Yucca.

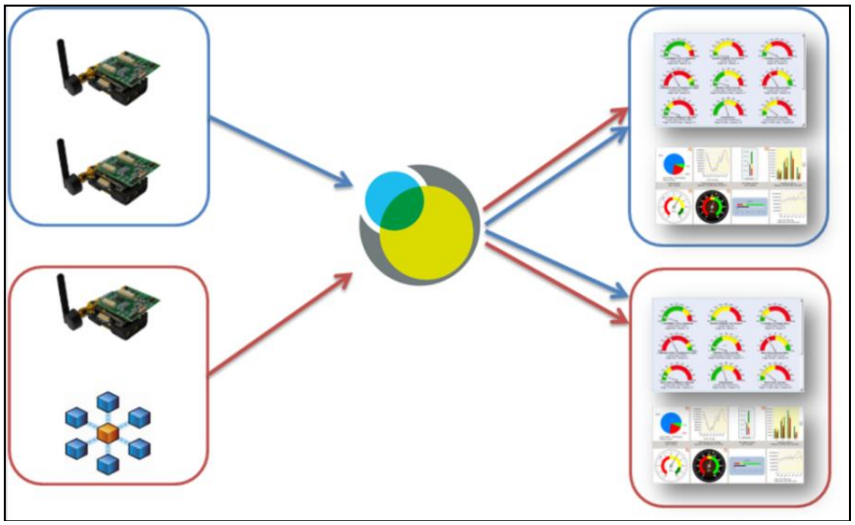
4.1 Yucca

Yucca is the platform of elaboration data by *SmartDataNet*. It is a digital ecosystem that allows to elaboration the information produce of different devices and to create the new digital application and real solutions.

Yucca is a cloud platform available for private and public operated as PAAS (Platform As A Service) and software open source on GitHub to web services of hosting to the development of open projects (Fig. 1).

On platform are collected the data of around 15.000 vehicles in real-time, around 250 sensors to control the environment, 200 building to manage the energy consume and around 80 patient to control the health.

Figure 1: Yucca platform



Source. http://developer.smartdatanet.it/platform/

The platform allows to improve the assets of data to encourage the development of the innovative ideas and thanks to ecosystem is possible to know the territory by promoting new services to better quality of life.

The community is composed of Public Administration, Private, Firms and Research Center with a sharing of Internet of Everythings. In Smart Community, the public and private sharing applications, devices, experiences and technologies and the sensor networks send this information for ecosystem.

The data are generated by Internet of Things and the Internet of People and of the assets of data by Public Administration and the data offers on platform are in self-service mode to management devices and sensors according to standard protocols. It is available a private datastorage to elaborate and manage events and measures in real-time with the open data offers to PA.

The applications use the platform to data processing but the data are generated in the independent environment. Furthermore, Yucca offers different actions to link tools and things, people and systems.

The user that sharing the information and data can choose the policy of security. Furthermore, the data can be user to investigate and manage in "near-real-time" physical and social phenomenon and to create statistical maps.

The platform allows to realize the solution based on Internet of things, Open Data, Internet of People and allows (i) to register and manage the sensors, smartobjects or gateway that sharing the data in real-time; (ii) to elaborate the data in new stream of data; (iii) user the data

in on-demand mode; (iv) to share the data in private or public form; (v) to make monitoring activity; (vi) to manage of smartobjects, Stream and Dataset; (vii) to research the dataset or stream (with WebSocket or MQTT protocol) through a store; (viii) to make subscriptions to manage the application with oAuth2 paradigm; (ix) to create end-to-end solutions.

In this moment there are 4 types of data:

(i) measures derived from sensors in real-time stream;

(ii) dataset that is the data already available on the platform;

(iii) media that are multimedia data;

(iv) social that are data derived to web and social forum.

These data are collected in 18 classes as agriculture, energy, school, environment, health, public administration, culture, work and training (Table 1).

Table 1. Data on the platform

What can you find in the platform	
Available measures	552,86 mln
Measures in May	729,93
Organizations	105 (both public and private)
Active Smart Objects	405
Online streams	1647

Source. https://userportal.smartdatanet.it/userportal/#/home at 02/06/2017

Furthermore, it makes available a Developer Center in which there are tools, applications, information, reference implementation and cases to use the platform also for firms.

It offers different actions to link tools and things, people and systems and the user that sharing the information and data can choose the policy of security. The data can be user to investigate and manage in "near-real-time" physical and social phenomenon, to create statistical maps, technical prospects and information set.

The access in Yucca can be anonymous or public with the authentication.

The authentication can be carried out Facebook, Google, Yahoo and Piedmont systems authentication.

With the anonymous authentication is possible to use the dataset, public streaming or to experiment "sandbox" area.

The public authentication allows to use different areas:

(i) Trial area lasting one month in which there is the possibility loading data in its work area;

(ii) personal area that can be used with only Piedmont systems authentication;

(iii) Firms area.

The platform is linked with different social network to improve the sharing between people and devices. The people can link the smartphones or other devices or share the information with community through post or post (Box 1).

Box 1. - The BUSSOLA project in Yucca

BUSSOLA (BUS Services mobilizing Living lAb) is a project that improves the concept of living lab. Living lab is an interesting approach that uses the citizens and the researcher to create new solutions for traffic, air quality, security and tourism.

The project shifts the attention on the transport of people (tourist bus or public transport) to improve the innovation services who exploit and sustain the *SmartDataNEt* platform ecosystem by focusing on air quality monitoring, security monitoring and tourism and Geomarketing.

In this project, the citizens are encouraged at to participate with the researchers to contribute at the innovation process trough the sharing of feedback and information.

As regards the air quality monitoring the data are collected with sensors and devices installed on transports. Furthermore, the sharing of information with smartphones and devices that use the GPS technologies allow to improve the quantity of data in the *SmartDataNet* platform ecosystems. This topic has different effects because increases the information and improves the manage the policies on pollution to a better quality of life.

Furthermore, *BUSSOLA* allow to monitor the flow of passenger on transports and tourists lines. This monitoring regards the passenger on bus to control the overcrowding, the low frequency and safety on board.

The solutions can be (i) the webcam or sensor on transports; (ii) app for tablet or smartphone that use the specific communication channel as Bluetooth Low Energy; (iii) buttons or buzz in the event of alarm or Demand for attention of the tourist; (iv) wearable devices.

BUSSOLA collected the data in quality travel and experience of tourist and the aim is to facilitate to access the services, information and a better quality.

The devices are, for example (i) radar of travel that allows to get the information on traffic of tourists and travel to create new innovation services; (ii) monitor; (iii) Geomarketing (for example QR Code or FNC) to improve the integration with the travelers; (iv) app to promote the travel activity.

All devices used to bus or touristic lines and the sharing of information allow to improve the quality of trip. Furthermore, the smart objects installed on bus and transport can increase the information on pollution and better quality of life in big cities.

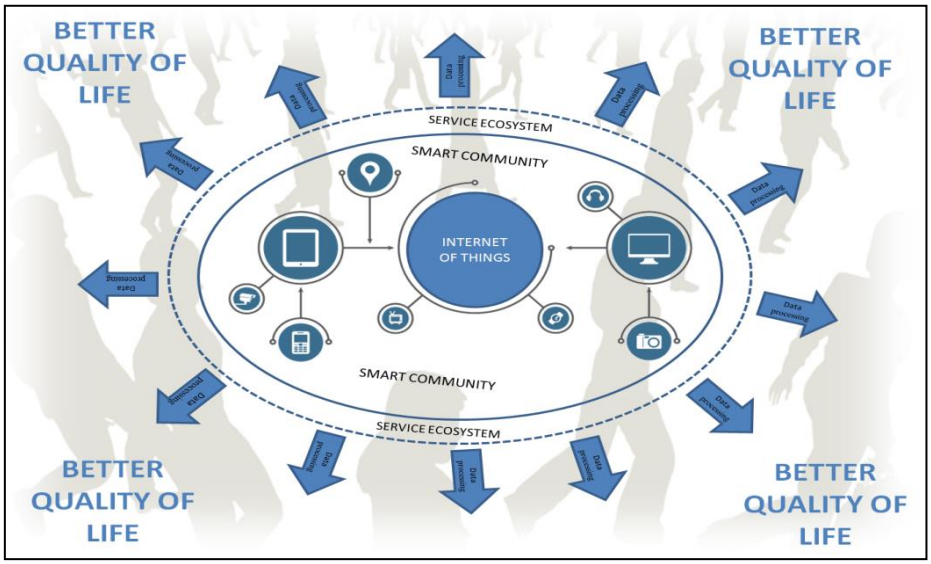
Source. http://www.smartdatanet.it/

5. Discussion and main conclusions

The information generated by things which are interlinked by Internet -shared and integrated through and within the community- are able to create value for all the actors involved in the area of interest. The platform is the space of connection and allows different process of value co-creation in relation to the objective, the information and resources of actors. These promote the integration of resources and actors that are a condition to start the value co-creation process. (Lusch and Nambisan, 2015).

The new information generated by the integration of information who come from fixed and mobile sensors and of the community are able to better life quality (Fig. 2).

Figure 2. The IoT for value co-creation



Source. Our elaboration

In the case of Yucca, citizens and operators can analyze the elements of interest and share in real-time data and images captured in the field by means of Tablet and Smartphone. The final user is stimulated to evolve from mere beneficiary to protagonist of the study by creating a virtuous circle the exchange of information and experiences.

With the emerging popularity of smart personal devices, smart community and the Internet of Things (IoT), all information collected and redrafted in classes of interest improve the quality of life in terms of stress, health, urban decorum, and consumption.

The development of Smart Community that uses the IoT devices have great potential and facilitate to create a set of new services for daily life (Xia et al., 2011).

In the smart community, the members – who interact with each other by means of information technologies and social networking services- consist in one of the most representative types of online communities.

So, the smart community can be roughly understood as a group of connected (social) objects that interact with each other over ubiquitous networks and deliver smart services to possibly all members (Xia et al., 2011).

In the smart community, the members can discuss and exchange the information to co-create a new shared knowledge to emerge (Sawhney et al., 2000; Sawhney et al., 2005; Füller et al., 2007; Kelleher et al., 2012).

These platforms, flike Yucca, can be identified as "service platform" that is "a modular structure that consists of tangible and intangible components (resources) and facilitates the interaction of actors and resources (or resource bundles)" through clear protocols of exchange (Lusch et al., 2015). Furthermore, the service platform supports the value co-creation process (Vargo et al., 2004) enabling the resource integration.

These ecosystems of service (Fig. 2) are spatial and temporal structures of largely loosely-coupled value-proposing social and economic actors interacting through institutions and technology, to co-produce service offerings, to exchange service offerings and resources and to co-create value. (Spohrer et al., 2007; Vargo et al., 2008; Lusch et al., 2014; Sigala et al., 2015; Morabito, 2015).

In a smart service ecosystem, any stakeholder is an actor aiming to interact and exchange resources with other actors for value co-creation. (Vargo and Lusch 2008; Sigala et al., 2015).

All participants learn from, contribute to the collective knowledge of the community and a new knowledge is generated through the community relationships (Sawhney et al., 2000) that created a new value proposition to improve the better quality of life (Xia et al., 2011; Xia et al., 2012; Ahmad et al., 2016; Nahrstedt et al., 2016; Balaji et al., 2017).

The analysis of case has shown as the platform that connects the IoT and Smart community (smart objects, application, sensors and people) represents a space to integrate the different resources and to co-create the value.

The paper contributes to improve the knowledge about the resource integration process and the value co-creation in the smart spaces that connect Internet of Things and people.

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