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SPECIAL FEATURE: ORIGINAL ARTICLE

People, Technology and Governance for Sustainability: The Contribution of Systems and Cyber-systemic Thinking

Investigating the role of smartness for sustainability: insights from the Smart Grid domain

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Abstract

Over the past decades, information and communication technologies (ICT) established themselves as the key force towards more effective and efficient usage of resources in our society, namely via better use of available information, automation, stakeholder involvement, and decision support. By analyzing recent advancements in knowledge offered by ICT, it is possible to identify their strong correlation with the principles, aims, and interests of sustainability science, which can be highly inspired by ICT-intensive domains. In this paper, we study the theoretical background on system thinking as an interpretative lens able to support better understanding of dimensions and dynamics involved in the domain of sustainability, and examine the role of ICT in advancing sustainability goals. Then, we analyze the domain of the Smart Grid as a prominent example of complex technological contribution in face of the challenges of sustainability, and present the insights from this domain, which are turned into sustainability guidelines for other domains, linking smartness, and sustainability in the light of systems thinking and Smart Grid experience. In summary, the core recommendation of this work is the employment of information technology to widen the scope of the sustainability "game" by sliding activities in time and space, and in engaging more "players" in the game, which is now made possible thanks to the advancement in ICT.

Keywords Smartness · Information and Communication Technology · Sustainability · Smart Grid · Systems thinking

Introduction

In the last few decades, the global history has been challenged by several social and economic changes that underlined the uselessness of traditional managerial and governmental approaches (Barile et al. 2015a; Del Giudice et al. 2016; Savory and Butterfield 1998; Hill et al. 2014; Sciarelli and Rinaldi 2016). Events such as globalization, industrialization, the emergence of digital society, and increasing competitiveness have underlined an increasing incapability of traditional approaches in ensuring a suitable global balance (Barile et al. 2014; Evangelista et al. 2016; Norris 2001; Castells 2011). As a consequence of this, issues such as the environmental pollution, the scarcity of resources, and the unsustainability of work conditions are attracting an increasing attention of several research streams and domains (Schmidheiny 1992; Shrivastava 1995; Smulders 1995; Kates et al. 2001).

Several research questions have been analyzed with reference to the possible approaches to support the development of more sustainable society (Manzini and Vezzoli 2003; Maxwell and Van der Vorst 2003; Hopwood et al. 2005) able to ensure an effective balance among social, economic, and environmental dimensions of our environment (Barbier 1987; Elkington 1997; Dempsey et al. 2011; Goodstein 2011) by acting on the collaboration and contamination among industry, academia, and governance (Etzkowitz and

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Leydesdorff 2000; Dzisah and Etzkowitz 2008; Etzkowitz and Zhou 2008). Many researchers have in-depth analyzed the role and the interconnections among the dimensions of sustainability (Kemp et al. 2005; Liu et al. 2015). Some of them have proposed interesting conceptual framework to explain the link among society, economy, and environment (Weber 1978; Tracey and Anne 2008); the role of industry, academia, and governance (Bäckstrand 2003); and their evolution over time (Barile et al. 2015a).

Despite the relevance of all these contributions, the topic of sustainability still appears to be a conceptual domain in which multi- and trans-disciplinary approaches are only being compared one to another (Gasparatos et al. 2008), although the real issue is mostly related to the ways in which it is possible to manage these dimensions with the aim to ensure the satisfaction of present and future generations' needs (Chichilnisky 1996). Therefore, the relevant research question is: In which ways it is possible to face the cross-dimensional challenges of sustainability? More authors have addressed this research question focusing on the industrial processes (Wilkinson et al. 2001; Bakshi and Fiksel 2003; Graedel and Allenby 2010), on the organizational models (Dingwerth and Pattberg 2009; Linnenluecke and Griffiths 2010; Benn et al. 2014), and on the role of education (Warburton 2003; García et al. 2006; Barile et al. 2015c; Saviano et al. 2016b). With the aim to contribute to this debate, this paper focuses on the role of technologies in facing the challenges of sustainability. The principal aim is to investigate the ways in which technologies could be considered a meta level on which managerial and organizational models could rely when acting towards more sustainable approaches.

In this paper, we introduce a novel perspective on management towards sustainability derived from technologically intensive domains, where an enormous progress can be seen throughout the past decade. In particular, we have selected the Smart Grid domain (Kadlec et al. 2018), which is governing the Information and Communication Technology (ICT) enhancement of the electrical power grid, and as such employing information technology as an enabling factor of sustainable use of electric energy as one of the most critical resources in modern society. In summary, the most interesting findings from this and similar domains, which can be transferred to other domains of business management, are the following:

- ICT is significantly widening the potential impact of techniques improving effective use of limited resources, which is the key concept of sustainability of any kind (like the possibility of integrating new renewable energy resources in case of the Smart Grid). In this way, ICT can facilitate integration of previously unexploited types of resources in many other domains, and hence contribute to their sustainability.
- Thanks to ICT, the demand for limited resources can be efficiently distributed over space and time, and hence, the feeling of access to the resource is significantly increased without affecting the actual resource availability (like shifting the energy use from peak hours to non-peak hours in case of the Smart Grid). The domains that require sustainability should, therefore, identify such an enlarged scope to which the demand for the limited resources can be shifted.
- The scope of sustainability can be in the game-theoretical perspective extended to numerous new players who can be engaged in sustainability processes thanks to ICT (like electricity consumers in case of the Smart Grid, who can actively engage in effective energy use). Hence new research questions emerge for any domain on how to engage these new players in effective cooperation.

Methodologically, the work is conducted in the following steps, which also define the structure of the paper. First, we present an overview of conceptual and theoretical background on system thinking as a meta-level interpretative lens able to support better understanding of dimensions and dynamics involved in the domain of sustainability, and on the digital and information technologies as a facilitator towards effective and sustainable achievement of organizations' aims. Afterwards, the topic of Smart Grid is analyzed as a representative example of complex technological contribution in face of the challenges of sustainability, and insights from this domain are being presented and discussed to highlight the evidence about the link between smartness and sustainability. Moreover, a possible synthesis scheme is proposed to link smartness and sustainability in the light of systems thinking and Smart Grid experience. Finally, the sustainability guidelines are extracted and summarized, and conclusions together with future research directions are proposed and discussed.

Theoretical and conceptual framework

Our work builds upon system view of sustainability, being interlinked with the role of ICT in facing the challenges of sustainability. This section sets up the scene by offering a state-of-the-art overview of these two domains.

A systems view of sustainability

According to the World Commission on Environment and Development (1987), the sustainability requires to satisfy the needs of the present without compromising the ability of future generations to meet their own needs. It comprises of two key concepts: the concept of needs, in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs (p. 43). By recognizing the validity of this definition, it is possible to outline its in-depth connection with the systems thinking pillars.

More specifically, the sustainability overcomes the traditional reductionist approaches by underlining the need for embracing a holistic perspective able to link all (present and future) dimensions of social and economic development (Lozano 2015; Saviano et al. 2016a). At the same time, the sustainability reduces the boundaries on which reductionist approaches are based by highlighting the need for defining common pathways among all social and economic actors to ensure a shared satisfaction (Saviano 2014; Di Nauta et al. 2015; Caputo et al. 2016a, b; Polese et al. 2016; Calabrese et al. 2017; Tronvoll et al. 2017). Over the time, several researchers have analyzed the topic of sustainability by adopting the interpretative lens offered by the system thinking (Dovers and Handmer 1992; Porter 2008; Wiek et al. 2011). Some of the works have focused on the ways in which a system is able to organize itself to face the challenges of sustainability (Folke et al. 2002; Fiksel 2003), while others have pointed out the "recursion" as a relevant concept to explain dynamics and dimensions that address the sustainability both from organization and society point of view (Espinosa et al. 2008; Espinosa and Porter 2011). Among the different contributions that have analyzed the sustainability in the light of systems thinking, the promising research stream of Viable Systems Approach (VSA) appears to offer interesting advancements in knowledge (Barile 2009, 2013; Golinelli 2010; Barile and Polese 2011; Saviano and Caputo 2013; Barile et al. 2016; Saviano et al. 2017). Specifically, in the light of the VSA, each organized entity aiming at surviving over the time can be considered a system and it can be analyzed in the light of the foundational premises summarized in Table 1.

Recognizing the validity of VSA as an interpretative meta-level useful both in understanding and managing social and economic entities and of its foundational premises, some relevant implications can be derived with reference to the topic of sustainability. More specifically, it is possible to state that:

- Each system aims at being sustainable, because in this way, it can survive in compliance with its context.
- The sustainability requires to investigate both structural and dynamic dimensions. While the first one refers to the availability of resources and possible pathways, the latter one refers to the ways in which the available resources and pathways are managed to achieve the aim of shared satisfaction.
- The sustainability involves both decision-making and problem-solving processes, because it requires development of shared strategical pathways and identification of suitable processes aligned with everyone's expectations and needs.
- The sustainability is a collective domain that overcomes individual boundaries to act on the collaboration and contamination among several systems.
- The sustainability overcomes hierarchical and transactional approaches, because its challenges can be faced only by including all the actors and valorising their possible contributions.

Reflecting upon these assumptions, the VSA offers a new perspective in analyzing the ways in which the three dimensions of sustainability (Economy, Society, Environment) and the involved systems (Industry, University, Governance) interact (Barile et al. 2015b). It overcomes the static description of their links by underlining their dynamic evolutions and changing roles over the time through the definition of the challenging helix shown in Fig. 1.

Despite the relevance of all these contributions and the advancement in knowledge proposed by the VSA, relevant questions are still open with reference to the ways in which it is possible to ensure a suitable interaction among industry, academia and governance in the three domains of society, economy, and environment (Carayannis et al. 2017). To bridge this gap, a possible solution could be offered by computer science, and specifically by Information and Communication Technology (ICT), being enforced by the increasing

Table 1 Foundational premises of VSA Source: Authors' elaboration on Barile (2009)

Foundational premises	Description
Survival	A viable system has the aim to survive in a specific context
Eidos	From an ontological viewpoint, a viable system can be considered in both a structural and a systemic perspective
Isotropy	In terms of behavior, a viable system distinguishes an area of decision-making and one of acting
Acting	Its aim is to reach a result, an objective, through the interaction with supra and subsystems from which the system receives, but to which it also supplies indications and rules
Exhaustiveness	External entities are also Viable Systems, which are components deriving from a superior level

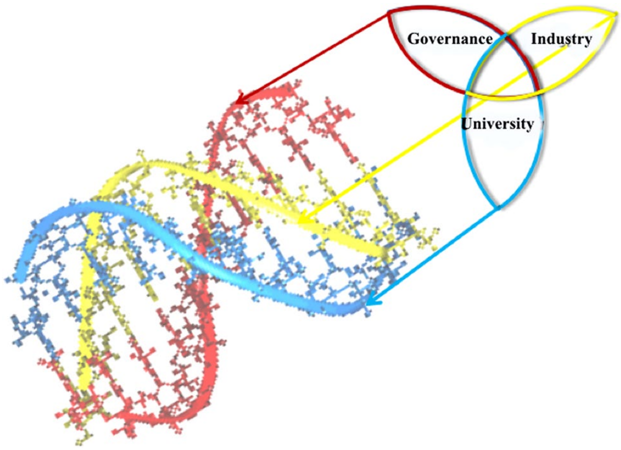


Fig. 1 *VSA* representation of Sustainability helix Source: Saviano et al. (2014)

attention in the topics of Information and Communication Technology and smartness in the light of service logic.

The role of ICT in facing the challenges of sustainability

Over the time, several contributions have analyzed the role of ICT in ensuring a more effective use of available resources (Berl et al. 2010), their contributions to the emergence of sustainability-oriented configurations (Erdmann et al. 2004), and the multiple advantages that they can provide in the adoption of smart approaches and models for sustainability (Vilajosana et al. 2013). Unfortunately, despite the multiple contributions provided by the previous managerial and organization literature about the multiple links between sustainability and ICT, several key points are still unclear with reference to the opportunity for building sustainability-oriented approaches thanks to the contributions of ICT in the light of Smartness (Kramers et al. 2013).

According to Steinmueller (2001), ICT has the relevant role to support companies and organizations in a more effective use of available resource. In the same direction, Sonnenschein et al. (2015) propose a widen perspectives through which the ICT is considered the key element on which act to face the challenges of sustainability. Again, Markovic et al. (2012) focus the attention on the opportunity for defining innovative processes and paths thanks the ICT through which social and consumer behavior better align to sustainability insight.

All these contributions trace a relevant picture in which ICT is a sort of instrument 'to use' to ensure an alignment of actors' behaviors and visions to the sustainability key concepts. Despite the relevance of these contributions, it seems to be strongly affected by a reductionist view in which the attention is focused on the elements and not on their evolution over the time (Caputo et al. 2017).

Enlarging the perspective, several key elements can be identified on which one can reflect to highlight a widen role of ICT in facing the challenges of sustainability. ICT can be considered a relevant lever able to influence social and economic life style (Anderson and Tracey 2001). ICT can play a disruptive role in human life and perspective (think for example of the Internet of Think or 3D printing) (Hacklin et al. 2004). From the adoption of new ICT, new life style can emerge and different behavior can be embraced (Pedró 2006). Recognizing these roles of ICT in affecting our everyday life, its contributions in facing the challenges of sustainability must be analyzed in the light of a more widen perspective that is well summarized by the concept of smartness as described in the following sections.

Insights from the Smart Grid domain on advancing sustainability

As summarized above, Information and Communication Technology (ICT) is capable of transforming all domains of modern society and interactions within it, and can become a powerful tool of their advancement towards sustainability. One of the most insightful domains in this sense is the Smart Grid domain, presented in this section.

Key concepts of the Smart Grid

Smart grid is an ICT-enabled energy grid that extends the classical energy grid with multiple levels of intelligence aimed at improving its efficiency, load balancing, enabling large-scale integration of renewable resources, and engaging its customers in optimal energy use (SGIP 2010; Kadlec et al. 2018). In effect, the concept of Smart Grid takes advantage of ICT to enable more efficient and sustainable energy production and consumption.

The U.S. NIST and the Smart Grid Interoperability Panel (SGIP) created the Smart Grid Conceptual Model (SGIP 2010) which describes seven primary domains that comprise Smart Grid: Bulk Generation, Transmission, Distribution, Customer, Markets, Operations, and Service Provider (see Fig. 2). The Smart Grid Conceptual Model is a set of views (diagrams) and descriptions that are the basis for discussing the characteristics, uses, behavior, interfaces, requirements, and standards of the Smart Grid. From our perspective, the most interesting domains are the customer (see Fig. 3) and bulk generation (see Fig. 4), which are the most critical drivers in terms of sustainability (Fig. 5).

Since the energy grid is, in general, the most critical infrastructure of the modern society, which all other services rely upon (Walletzky et al. 2018; Rosecky et al. 2015),

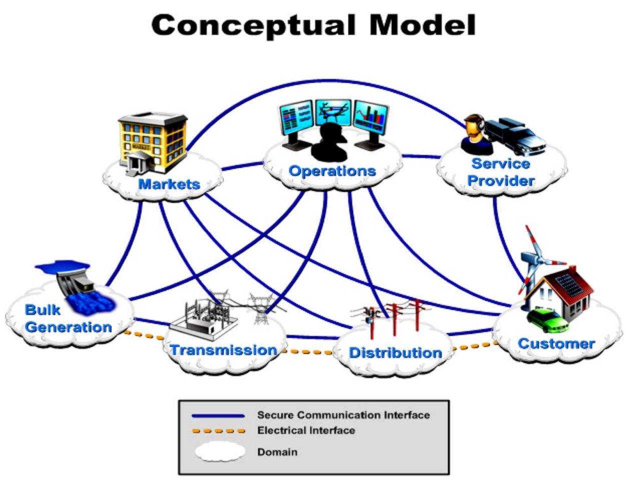


Fig. 2 US NIST Smart Grid Conceptual Model Source: SGIP (2010)

any involvement of ICT to control the grid needs to be done very carefully, to avoid the risk of Smart Grid breakdown, whether because of software failure or cyber attack (Kadlec et al. 2018; Gesvindr et al. 2014).

Insights from the Smart Grid domain

All the aspects discussed above make the Smart Grid one of the most insightful domains, taking advantage of ICT to both improve the sustainability of energy production and consumption, and to ensure the top quality of infrastructure and processes running upon it (Chren et al. 2016; Kadlec et al. 2017). Specifically, in the case of Smart Grid, we have an amount of resources that we are already using, to provide the service. This amount of resources/service can be extended if there is demand to do so—but only in case when this enlargement is effective and is able to generate higher value. The way to explore this possibility and find the most optimal way to add more resources without risking a disruption of the whole system is obviously utilized by ICT technology

Fig. 3 US NIST Smart Grid Conceptual Model: Customer Source: SGIP (2010)

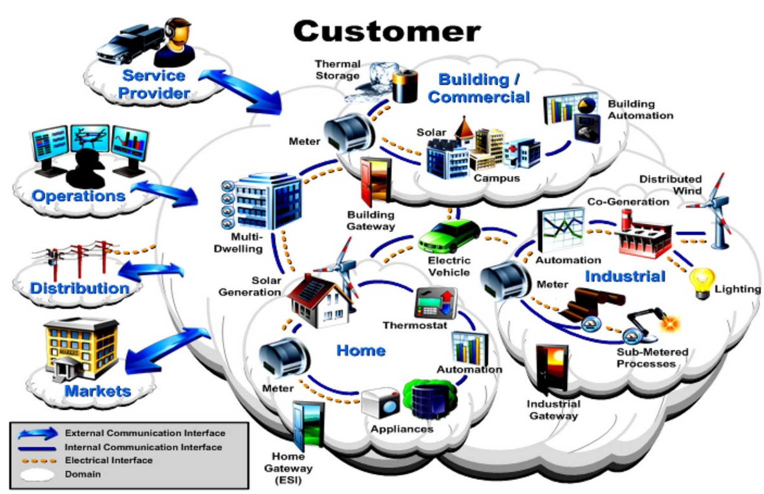
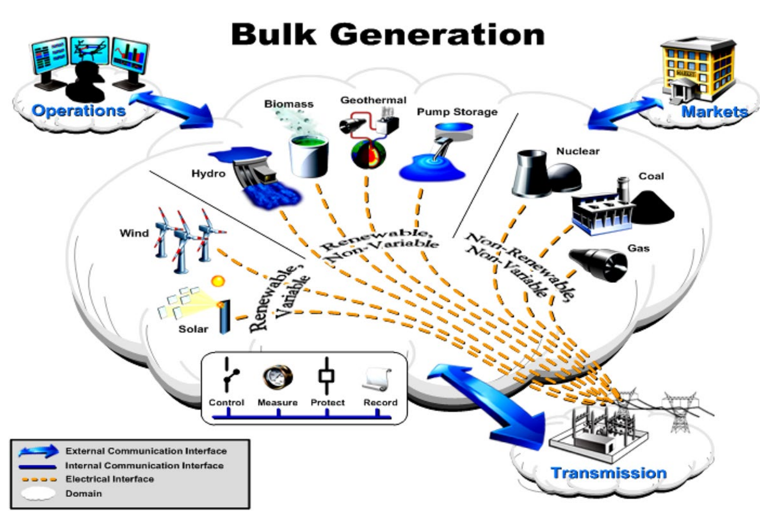


Fig. 4 U.S. NIST Smart Grid Conceptual Model: Bulk Generation Source: SGIP (2010)



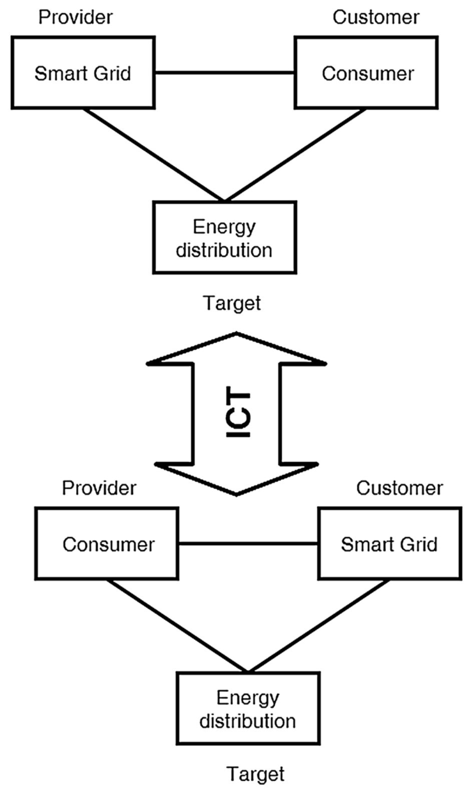


Fig. 5 Duality in service system: Smart Grid example Source: Authors' elaboration

and its applications. If one wants to add more power stations (solar, winds, etc.) to the smart grid network, they need to be sure that the network can accept them and can use those resources to improve the value which it provides. ICT plays here the role of an extension tool, enabling addition of the subsidiary resources.

Another way to contribute to the sustainability in the Smart Grid context is to concentrate on the resources that we are already using. In this case, the following two actions can be highly beneficial:

- Shift the resource usage in time (postpone some specific task to low-demand hours).
- Shift the resource usage in space (to utilize the energy surplus in another location).

The main problem, addressed by ICT, is how to determine the best time and/or best place to use the resource. If the customer wants to start a particular device (washing machine) in the time of cheapest energy, or wants to start charging the car accumulator when it is optimal for their journey, it results in interesting optimization tasks. ICT turns out to be of invaluable help, partly thanks to combining different information sources, based on used services and linked information found in related services.

However, reduction of ICT to just a tool for finding optimal solution would be unreasonable. ICT is also a key factor for the development of every service. The key factor of optimization comes (not surprisingly) from the ability to get the correct information at the right time. The critical information is not coming from the provider side only, but needs to be integrated with information from the customer side, as depicted in Fig. 3. According to this, we need to ask:

- What are customer preferences? Do we know them? How they can be explored?
- Are the requirements of the customer fitting to provider's ability to provide the service?
- Is the customer willing to participate?

In nutshell, the domain of Smart Grid shows that the consumer engagement, managed by ICT, is the key factor of providers' ability to modify the service, its utility, and co-create higher value for the customer. And through this bring also higher value for the provider. In our example of the smart grid, we can see a nice example of Dual Service System, defined by (Hocová and Staníček 2010). Dual Service System is defined as two related service systems, operating on the same target, where each agent plays the role of a service provider and simultaneously a service customer, and this situation is supported by bidirectional value proposition.

Dual Service System can be created upon the target Energy distribution, where we can identify strong cooperation between two services—the first service is the energy usage, provided by the Smart Grid. In the second system, Smart grid needs the information about consumer behavior and energy needs to be able to provide it. Those two systems are linked via ICT to be able to work together, and make it apparent that similar interactions might emerge among different stakeholders, who, in this context, include energy producers (power plants owners and households), energy distributors, legislation bodies (to protect privacy and cybersecurity), consumers, operators, and others.

Dual Service System has also very perspective feature of higher stability—when the customers are identifying their role in both systems, their willingness to leave the relationship with the provided seems to be lower comparing to the situation which they are "just" receivers of the service. If the customers are also providers of the resources used for the service development, they feel in some way more responsible for the whole system.

We can find some very similar examples in other complex service networks—like Smart City services. If the customers are engaged in the development of the city via proper ICT tools (to suggest new functionality of the Smart City Services or suggesting new ways to combine and use them), their perception of the Smart City utility seems to be higher comparing to the situation when they are just passive receivers of the service.

Summary of Smart Grid effects on sustainability

The key effect of the smart grid is that it serves as an enabler of the sustainability of the key resource in modern society, which is the electric energy. The sustainability in this sense is achieved by two means, which are: (1) the increase of the inflow of the resource, i.e., electric energy, into the electric grid, and (2) efficient usage of the available resource, i.e., electric energy. Both these aspects are essential characteristics of sustainable systems, which we detail further in the context of smart grids and ICT that enables them.

Increase of the available resource

The increased inflow of electric energy into the grid is enabled by the integration of renewable resources (e.g., solar and wind), with entry points distributed across the whole-energy grid network, which would not be possible without ICT. The role of ICT is real-time monitoring and diagnostics of the state of the smart grid, which allows the administrators to detect local problems soon enough to prevent them, and to control the grid towards redistribution of the available energy within local areas.

Higher efficiency in resource usage

One of the key insightful aspects of the Smart Grid is that energy consumption efficiency relies in the first place on the level of customer engagement on optimal usage of the available energy, although this might mean a certain level of inconvenience, for instance when the customers are asked to reduce their consumption during peak hours, or to consume energy during the hours where the energy production is unexpectedly high (e.g., due to the effect of weather on renewable energy power sources). Since it needs to be the will of the customers to get engaged in this way, a body of knowledge exists on the psychological aspects of such engagement, which can be borrowed also to other domains where the people engagement is critical (basically any domain with sustainability goals).

In some cases, the importance of people engagement can be relaxed by predicting the preferred behavioral scenarios of the involved people, because then the technological aspects of the whole system (in the Smart Grid that is the energy production) can be made to fit the expected people behavior (in our case the energy consumption) without forcing the people to adapt their behavior substantially. Therefore, the behavioral analysis is a key ingredient of such systems.

Linking smartness and sustainability

According to (Cellary 2013), “the essence of smartness is converting data into innovative e-services that help to improve the quality of life” (p. 91). With reference to this, it is possible to define the quality life as “the individual’s perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards, and concerns” (WHOQoL 1993). Reflecting about these definitions, it is possible to identify the existence of a strong correlation between the concepts of smartness and sustainability.

Specifically, according to the definition of (Cellary 2013), the final aim of smartness is to support the improvement of “quality life”. This latter concept encloses the multiple dimensions of well-being and, for this reason, it can be considered a more tangible representation of sustainability domain (Dodds 1997). Clarified the existence of the strong link between smartness and sustainability, it is needed to better define the way in which this relationship emerges and evolves over the time. As underlined with reference to the specific domain of Smart Grid, technologies support the definition and satisfaction of collective needs by defining more efficient, effective, and sustainable pathways.

According to this, smart technologies can be considered a “mediator factor” able to “translate” the strategies for sustainability defined by Governance, Industries, and University in tangible pathways with reference to the domain of Economy, Environment, and Society. Acting in this way, the smart technologies support the definition of a Smartness Cycle for Sustainability (SmaCySu) as shown in Fig. 6.

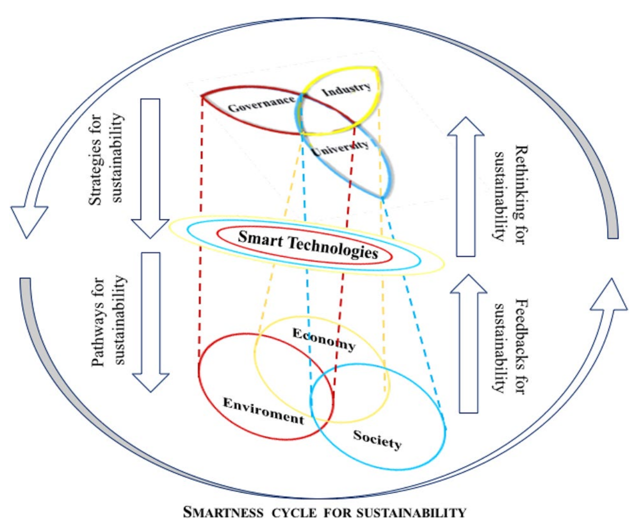


Fig. 6 Smartness Cycle for Sustainability (SmaCySu) Source: Author’s elaboration

The synthesis scheme proposed in Fig. 6 shows in which ways smartness and sustainability are linked by defining four steps for the implementation of shared approaches for sustainability. More specifically, the figure shows that:

- Governance, Industry, and University define possible strategies for sustainability by identifying shared (presents and future) needs.
- The Smart Technologies translate these strategies in possible pathways on the base of available knowledge and resources and they support their declination in the domains of Environment, Economy, and Society.
- After the building and testing of possible pathways, some feedback is provided by the involved actors.
- Thanks to the support offered by the Smart Technologies, these feedback is translated in readable information for Governance, Industry, and University; and it is used to rethink the approaches for sustainability.

The SmaCySu summarizes the link between smartness and sustainability by overcoming the reductionist technological view in which smart technologies are considered simple instruments on which act to implement ex-ante defined strategies. It shows in which ways that the smartness can be considered the general framework able to ensure the emergence of sustainability approaches by enabling an effective integration among all the involved actors. In accordance to this, the smartness could be considered the missing link to translate the several conceptual idea and frameworks about sustainability in effective pathways direct to satisfy in the better way present and future needs.

Guidelines and recommendations on linking smartness and sustainability

Building upon the reflections proposed in the previous sections, some compact guidelines and recommendations with reference to the linking between Smartness and Sustainability could be formalized as follows.

Employ ICT to increase available resources

Sustainability of any kind relies on effective use of limited resources. The significant contribution of ICT in this context is that often the available resources can be extended by integrating new resources that were previously not available due to various limitations that can be mitigated by ICT. A typical example in case of the Smart Grid is the integration of renewable energy sources (like wind or solar), another example in human-response intensive domains (where human response is the limited resource) is the possibility of being accessible anytime thanks to mobile devices and supportive online services.

Wider scope of resource consideration thanks to ICT

The limits of the available resources can easily be reached in some points of time and space due to peak locations or peak hours, while it might be that, in other places and times, the resource is being used only scarcely. The contribution if ICT in this sense is that it can facilitate efficient distribution of the demand for limited resources over space and time, and hence create the feeling that more resources are available, without affecting the actual resource availability (like shifting the energy use from peak hours to non-peak hours in case of the Smart Grid). The domains that require sustainability should, therefore, identify such an enlarged scope to which the demand for the limited resources can be shifted.

Engagement of new players in the sustainability game

The scope of sustainability can be in the game-theoretical perspective extended to numerous new players who can be engaged in sustainability processes thanks to ICT (like electricity consumers in case of the Smart Grid, who can actively engage in effective energy use). Hence, new research questions emerge for any domain on how to engage these new players in effective cooperation, because non-trivial effort is required on their side for the cooperation being truly beneficial towards sustainability.

Sharpening the understanding of smartness and sustainability

When the smartness and sustainability are being interlinked, new insights can be gained about the understanding of these concepts, which can be summarized as follows.

Smartness and sustainability are the double faces of the same perspective

An effective approach to smartness requires to build collaborative approach among the involved actors in the light of Sustainability Science.

Smartness and sustainability are not firm-centered concepts

They can be analyzed, coded, and linked only adopting a holistic view about the way in which each actor as system interacts with its context to achieve the final aim of viability.

Sustainability cannot be considered an ex-ante defined aim imposed through a top–down approach

It must emerge as consequence of actors' alignment. The ICT has a relevant role in ensuring this alignment.

Conclusions and future directions for research

In this paper, we show how the smartness for sustainability is supported by ICT. Furthermore, ICT cannot be reduced to just a tool linking all participating parties together. ICT and its usage have direct influence on the level of adaptability and sustainable development of the next generation of Smart Services.

ICT also plays a key role in consumer engagement and adapting the feedback from the customer into the service development. In Smart Grids, we can identify examples of the close cooperation among stakeholders. Moreover, the feedback of the consumer, their willingness to share information and knowledge, is the main precondition to the development of the whole branch.

This fact is encouraging us to concentrate further research attention to investigation of the effect of Dual Service Systems in the network of Smart Services and their role in sustainable development of the whole environment of Smart Services. Moreover, it brings many open questions, which are together with the presented findings and recommendations going to be further examined by our team to confirm their validity via empirical research. Thanks to the widening popularity of ICT in different domains, quantitative data are now becoming available that could help us to fully understand the effects of studied recommendations in a wider scope.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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