Implications for Futures: The Missing Section in Sustainable Information Systems Research

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Completed Research Paper

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Abstract

This paper argues in favor of a deeper understanding of the importance of futures in information systems (IS) research and proposes an initial set of guidelines for the inclusion, in IS publications, of an optional section devoted to the discussion of futures. The proposal was inspired by reflections on the nature of disruptive innovations and was grounded on a cross disciplinary literature review in the areas of IS, management, and computer science. The proposal includes examples of preferable futures and a discussion of their exploration. The anticipation of sustainable futures has the potential to (1) enrich the debate in IS research, (2) contribute to the development of preferable futures, and (3) create knowledge bases of scenarios and trajectories for such development. As far as theory is concerned, the paper advances the incorporation of futures in IS research. For the practice of the discipline, the paper proposes an additional dimension for the publication of impactful research that takes into account the needs of today's managers, namely those who deal with uncertain environments.

Keywords: Implications for futures, preferable futures, sustainability, uncertainty

Introduction

Human organizations are constantly looking for better futures (Markus et al. 2000). This is possible because there is an option to choose among alternative paths, exploring the power of imagination to give "*form to unknown things*" (Weick 2006). Simon (1996) defines design as "*a kind of mental window shopping*" that engineers and managers commonly explore when they envision improved organizational practices and artefacts. Envisioning, is also the first stage of business process change (Kettinger et al. 1997) when knowledgeable actors of the firm analyze the business strategy and the prospects of IT "*in the hope of improving the firm overall performance*". Even when it is not possible to predict the positive and negative consequences that emerge from the use and adaptation of the technology and business processes (Paul 2007), it is important to envision them in order to generate improved versions of information systems that follow a responsible innovation path (Hovav 2014).

We are looking for preferable futures because we are able to socially construct them (Byrne 2005). The topic already captured the attention of information systems (IS) researchers (Chiasson et al. 2018; Gray and Hovav 2008, 2011; Hovorka and Peter 2019; Olla and Choudrie 2009) and it is now "*demonstrated that future-oriented research can make a contribution to the field of IS*" (Wakunuma and Stahl 2014). That contribution can be in the form of methods to speculate about change (Gray and Hovav 2011), speculations (Sawyer and Crowston 2006), strategic management and decision making (Galliers 1993; Grossman and Mccarthy 2006; Markus et al. 2000), foresight for responsible innovation with information and communication technologies (Markus and Mentzer 2014), sociotechnical imaginaries (Jasanoff and Kim 2009), and philosophical foundations for future-oriented research (Chiasson et al. 2018). However, it has recently been recognized that "*research focused specifically on 'the future' has yet to gain a strong foothold within the scholarly IS field*" (Chiasson et al. 2018) but we "*are ready to begin driving looking frontward* [instead of merely driving through the rearview mirror]" (Hovav 2014).

The future can be discovered, created, imagined, and fictionalized (Hovorka and Peter 2019). The first approach considers the future as an extension or extrapolation of the present/past, requiring good data quality and stability of the assumptions to uncover what's forthcoming. The second approach, presented by Hovorka and Peter (2019), assumes that humans question what could be different and create the future. Several techniques can be used for discovery and creation of futures, as presented by Gray and Hovav (2008), but imagining and fictionalizing are more problematic. The former relies on conceiving a shared vision that becomes enacted if it is socially accepted, with creativity being a key element. The latter communicates "*utopian and dystopian fictions (…) radical extrapolations or vivid imagination to expose values in the present* […that] *allow us to inhabit fully realized worlds*" (Hovorka and Peter 2019). Some authors already suggested the benefit of "*read*[ing] *a factual scientific project and its publications against a body of fiction* […concerning the technological imagination]" and the use of fictions to make better sense of information systems (Behren 2008). Despite this body of knowledge, it is accepted that (1) future studies have been insufficiently applied in IS (Chiasson et al. 2018), (2) future studies are essential to increase IS relevance (Chiasson and Davidson 2009), and (3) there is a lack of studies about the use of fiction and imagination to develop IS research. Contributions in the field are vital, because "*we learn by observing about what happens and by reflecting about possible futures with our thinking and imagination*" (Olbrich et al. 2017).

The extant literature about IS theory (Gregor 2006) is extremely rich, as are the products of theorizing, "*including discursive formations, questions, analogies, myths* [defined as dramatic narrative of imagined events], *metaphors, paradigms, concepts, constructs, statements, propositions, models and frameworks*" (Hassan 2014). However, envisioning is not currently used as a systematic practice and the discussion of sustainable futures are not usual products in IS publications. It is unquestionable that technological advances have the capacity to make some futures more probable than others, as evidenced by the impact of artificial intelligence and robotics in the workplace or the importance of big data analytics for decision making (van der Aalst et al. 2018). Yet, influencing desirable, responsible innovation futures (Hovav 2014) lacks relevance if they are not capable to hold up in uncertain environments. Researchers are aware of the importance of discussing the implications for theory and for practice, and they even address more immediate and pragmatic future work. Implications for futures is the missing section that this paper aims to uncover.

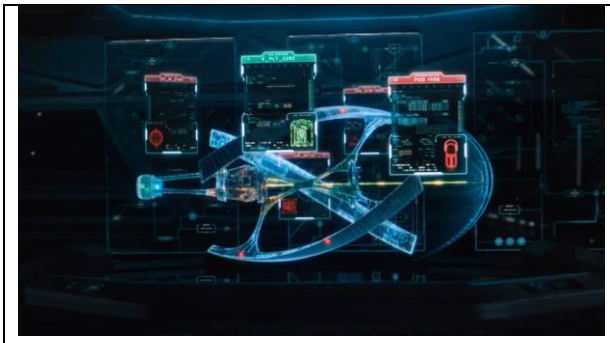
The remainder of this paper is organized as follows. The ensuing section explains the study motives and our two research objectives. Subsequently, we review key literature about futures and its potential for IS research. Then, a discussion and guidelines for increasing the role of alternative futures in IS are presented. We proceed to the Implications for Futures of the current paper, implementing the suggested guidelines. The paper closes presenting the main conclusions, implications for theory and practice, the study limitations, and opportunities for future research.

Study Motivation and Research Objectives

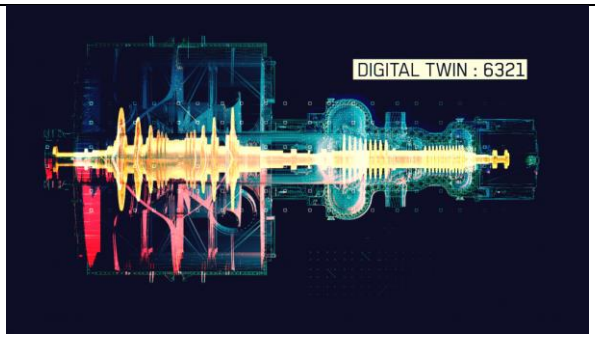
A growing body of literature is calling for more future-oriented research in IS (Chiasson et al. 2018). For example, Markus and Mentzer (2014) discuss the need to anticipate the consequences of technology and minimize its negative impact, particularly in the context of ethics, sustainability, and technology hazards. Instead of 'predicting the future', the purpose of anticipating complex sociotechnical futures "*is to generate useful knowledge about the potential negative societal consequences of technology, before such outcomes*

occur, in order to prevent or reduce those consequences" (Markus and Mentzer 2014). Failure to integrate future-oriented analysis and design methodologies in IS research may lead to artifacts that are 'fit for functionality' but fail in many other criteria. We agree with these authors when they state that "*IS scholars doing social science research have an especially important role to play in doing the kinds of 'big picture' studies that can inform designers, whatever their location in a web of technical components*". Those components must be studied with the lens of transformation, not merely "*test artefacts which are supposed to create future worlds against the experiences of the existing reality as we experience it* (…) [t]*he respective constructions cannot be invalidated by confronting them with empirical data, because they are purposefully different from reality*" (Olbrich et al. 2017). It is now clear for different areas of IS that "*with our research we will shape the future and finally our own lives*" (van der Aalst et al. 2018). Why is this so and what may we do about it?

Anecdotal evidence suggests that disruptive innovations are much closer to science fiction, as illustrated in the following example.



Passengers Movie (Tyldum 2016)



GE Digital Twin (Parris 2017)

Figure 1. The Thin Frontier Between Fiction and Reality

On the left, Figure 1 shows a representation of the digital twin (replica of the physical object) of Avalon, the interstellar ship in the movie Passengers, a science fiction romance released in December 2016. The movie includes several examples of automatic damage reports and a rich interaction between minds and machines. On the right, Figure 1 shows the existing digital twin of a General Electric turbine, that uses the concept of fleet (Parris 2017), artificial intelligence, and augmented reality. Although Passengers was written almost ten years earlier, fictions and disruptive digital innovations are evolving side by side.

Theories have the power to shape the future and there are two crucial questions that sustainable digital transformation should answer for the present day: "what could be?"; "what should be?". The concept of sustainability is used here in a broad sense, expressing "*the quality of being able to continue over a period of time*" (Cambridge Dictionary 2019a). In this sense, a sociotechnical system is sustainable when it remains in a desired stable state for a convenient period. The concept of sociotechnical sustainability can be illustrated by resorting to Actor Network Theory, an "*influential way of accounting for both stability and instability*" in sociotechnical systems (Jasanoff 2015). If we describe a sociotechnical system as an actor-network, the system becomes sustainable when an enduring balance of power is achieved between the actors that make up the network, without compromising the needs of future generations.

As technologies become more powerful and complex, and as consequences of errors and misuse become more serious, ethics dictates that researchers must consider the futures they may be enabling. The aim of our essay is to evaluate the opportunities to include futures studies in the agenda of IS research, and to propose concrete guidelines on how to do it. Accordingly, we have formulated the two consecutive research objectives:

- RO1: Understand the importance of futures for IS research;
- RO2: Propose a guiding framework to develop "Implications for Futures" in IS research.

To address our first research objective, we have conducted a structured literature review about futures and its adoption in IS. The second research objective emerged from the gaps in the extant literature identified while working on RO1: we could not find any study suggesting how to use alternative futures to enrich the discussion of IS research and increase its social impact in unknown environments.

Literature Review

The selected databases were Google Scholar for more general searches (e.g. "futures research" AND "information systems" returning 295 results since 2018) and AIS e-library (e.g. "alternative futures" with 68 results). We also made specific searches using the keyword combination of "design fiction" and fictions to evaluate its adoption if other related fields of management and human-computer interaction (HCI). Considering the scarce publications about futures in IS journals and conferences, we used snowballing (Wohlin 2014) to search for key references in recent publications about the topic (e.g. Chiasson et al. (2018); Hovorka and Peter (2019)).

Futures and the Construction of Reality

Over 20 years ago Phillips (1995) stated that fiction writers and researchers share methods of investigating social sciences and understand the reality. "*The future is not something to be predicted, but something to be made*" (Hovorka and Peter 2019). There are important studies on using fiction in research, for example in the field of HCI, with the growing popularity of design fiction (Lindley and Coulton 2015). This practice aims to create spaces for debate, rather than to anticipate how the future will unfold, "*a design fiction is (1) something that creates a story world, (2) has something being prototyped within that story world, (3) does so in order to create a discursive space*" (Lindley and Coulton 2015). Dourish and Bell (2014) suggest that "*design-oriented research is an act of collective imagining — a way in which we work together to bring about a future that lies slightly out of our grasp*". Consequently, fictions are useful to identify trends of technology, but also to influence them in the collective imagination. The comparison of mobile phone shapes and Star Trek communicators is used to exemplify this mutual influence between possible futures and technology evolution (Dourish and Bell 2014; Wakkary et al. 2013). Futures studies, in the form of narratives or in the form of design concepts, has been extensively studied in two influential lines of research for the IS field, namely, management (Phillips 1995) and technology (Dourish and Bell 2014).

Futures can be imagined, "*subjective depictions of possibilities yet to be realized; no matter how strongly backed with valid data, they are nonetheless speculations, extrapolations, imaginative works*" (Raven and Elahi 2015). It is important to understand the world (context), the story (sequence of events), and then carefully address the narrative (account of a specific story), "*as such, a design situates the plot (desired sequence of action) into the story-world (context, possibility and constraints) in a manner which, in the vast majority of cases, assumes a human purpose or need; even a system or object designed to do some thankless task in some remote location is meeting a human desire to achieve that end without a human having to go there and do it*" (Raven and Elahi 2015). However, these authors also point out risks: as in science fiction, the person watching the movie reads the (inherently subjective) message in a way that may not be the one intended by the author.

Sociotechnical imaginaries emerged from the need of politicians and society in general to imagine the future and produce strengthened systems of meaning (Jasanoff and Kim 2009) and sensemaking (Weick 2006). These systems of meaning are increasingly affected by new technologies that shape (and are shaped by) society (van der Aalst et al. 2018). For instance, national sociotechnical imaginaries are described as "*collectively imagined forms of social life and social order reflected in the design and fulfillment of nation-specific scientific and/or technological projects*", where imaginaries "*describe attainable futures and prescribe futures that states believe ought to be attained*" (Jasanoff and Kim 2009). They often have a focus on narrative (Hovorka and Peter 2019). We adapt the definition to our purpose to describe preferable futures that researchers and/or practitioners believe ought to be attained in a sustainable form.

There are patterns of action that may be repeated in the future (habitualization), allowing institutionalization of practices (Byrne 2005). Despite the existence of these patterns (that are useful to design a preferable outcome), the future is uncertain, and the social construction of reality is complex. Nevertheless, anticipating futures can (1) challenge our present decisions or recommendations for practice (envisioning futures as a way to improve our current research outcomes), (2) anticipate consequences and

take appropriate actions now (aiming to suggest improved patterns of action), (3) get ideas for the present (looking for research opportunities starting with something unreal). However, "[d]*esign for distant futures would be wholly impossible if remote events had to be envisioned in detail. What makes such design even conceivable is that we need to know or guess about the future only enough to guide the commitments we must make today*" (Simon 1996). Therefore, the most important aspects of the future must have "*implications for present commitment*" (Simon 1996). Simon (1996) highlights the importance of focusing on alternative futures in which "[t]*he heart of the data problem for design is not forecasting but constructing alternative scenarios for the future and analyzing their sensitivity to errors in the theory and data*". The scenarios can be built as a story about the developments between the present moment and the future state or as "*a day in the life*": "*a description of the world at that date that may or not look back on how the world got to be that way*" (Glenn and Gordon 2009).

Important concepts need to be clarified and distinguished. While the concept of social fiction refers to something that is not real, social imaginaries describe "ways of understanding the social that become social entities themselves, mediating collective life" (Gaonkar 2002). Science fiction can combine both concepts, as described by Dourish and Bell (2014), because it "d*oes not merely anticipate but actively shapes technological futures through its effect on the collective imagination*". A speculation is a different concept, which can be described as "*the activity of guessing possible answers to a question without having enough information to be certain*" (Cambridge Dictionary 2019b) or, as noted by Achinstein (2018) in scientific terms, making assumptions lacking sufficient evidence. Finally, scenarios assume a narrative format to "*organize myriad future data while simultaneously demonstrating causal links from choices and consequences*" (Glenn and Gordon 2009). Scenarios provide guiding images of what may take place in the future, providing a reflection about the possible trajectories of technologies in their interactions in a constantly changing environment, while discussing the main issues, problems and opportunities for sustainable futures (Glenn and Gordon 2009; Hovav 2014).

Futures studies also face challenges, and it is common to identify words like "alternative" and "radical" in the conclusions combining futures and scientific outcomes (Frank 2017; Phillips 1995). First, futures studies and imagination do not fit perfectly the existing frameworks of theoretical development in IS. Therefore, it does not seem to be sufficient to merely importing concepts from other areas of research, for example, from design fiction that merges science fiction and design (Dourish and Bell 2014; Wakkary et al. 2013). Second, the illusory potential of knowing the future (Reeves et al. 2016), because humans do not have the capabilities or tools to do it. According to Reeves et al. (2016) the two main tactics to deal with this problem are (1) to improve our prediction abilities or, alternatively, (2) to "*try to bring the future into the present by acting in ways that we expect to be seen as correct from the vantage point of the future we are trying to create*". The latter has been studied in social sciences in the past two decades and proposes a socio-constructed future where present visions and expectations can direct our actions (Nik Brown 2000). The search for a better version of the future can be found in the critical research tradition, and its purpose to fight injustices, as presented in Iivari et al. (2017). Third, "grand visions" for the future (defining a complex societal context) may be difficult to adopt in small scale developments (e.g. an IT system) that are influenced by specific organizational scenarios. Fourth, it is important to ensure social legitimacy of the design, letting the future connect to the past (retrospectively), to understand not only what *could* or *should* be developed but also, as Reeves et al. (2016) puts it, *what should have been* designed. Fifth, the quest for plausibility – credibility and believability of a concept, has risks of creating disappointment because visions of futures are intentionally not existing (Coulton et al. 2016). Considering the potential risks of mixing evidence-based research and unreal elements, it becomes crucial to clearly identify the "imaginary" part (which can be an entire paper or only a part of it) and its relationship with the reality.

Having confirmed the importance of alternative futures for scientific advances in management and technology, the next section aims to understand the process of building futures (Hovorka and Peter 2019).

Methods for Futures Studies

Creating images of the future can help researchers "*not only as a barometer, but as a regulative mechanism which alternately opens and shuts the dampers on the mighty blast-furnace of culture. It not only indicates alternative choices and possibilities, but actively promotes certain choices and in effect puts them to work in determining the future. A close examination of prevailing images, then, puts us in a position to forecast the probable future*" (Polak 1973). These images exist in people's minds and can support

their actions (Rubin 1998) and, in the case of researchers, it would be important to know "*how their different images of the future lead to specific actions, or inactions, in the present, and how present actions or inactions themselves create certain aspects of the future*" (Dator 1998). According to Dator (1998), these images usually fall into one of the following categories, each one with potential interest for IS research: continuation (e.g. IT adoption); collapse (e.g. system failure, environmental problems), disciplined society (e.g. values and norms that rule the future organization), and transformational society (e.g. smart products).

One possible approach to identify scenarios of probable, possible, and preferable futures is the ethnographic futures research adopted by Olla and Choudrie (2009) to predict the use of mobile technologies in developing countries. The book presented by Dunne and Raby (2013) adds the "*plausible future*", also known as the 4Ps of alternative futures. Olla and Choudrie (2009) report positive results and suggest that "*if appropriate stakeholders are present a detailed and achievable plan of action can also be elucidated for the defined time horizon that achieves the most probable future*".

Several other techniques can be used to conduct future-oriented technology analysis, with over 50 methods explained by Cagnin et al. (2008). The examples include visioning, technology watch, literature reviews, risk-analysis, trend analysis, Delphi, scenario management, and many others. The use of scenarios is an interesting solution for future-oriented IS research, as it does "*not to try and describe a predictable future but to create a set of diverse futures and analyze the drivers* [particularly, social acceptance and technological development] *and consequences of each*" (Hovav 2014). The task of anticipating the future is challenging and it is possible to combine quantitative and qualitative approaches to that end (Cagnin et al. 2013). Nevertheless, each technique has a specific purpose and guidelines to ensure rigor and validity in future-informed research of sociotechnical developments (for a detailed analysis of different methods see Cagnin et al. (2008)).

The need to consider alternative futures in IS developments can be found in the work of Salmela et al. (2000). Other examples include Tobin and Carroll (2003) using scenarios for envisioning the future, Grossman and Mccarthy (2006) for decision making, Bengtsson and Lundström (2013) for visualizing alternative scenarios, or Henfridsson et al. (2009) in the path creation of digital innovations. The importance of fictions has also been discussed in the study of Behren (2008), contrasting the fictionalist paradigm with the positivism and interpretivism.

The method proposed by Halicka et al. (2015) for the analysis of battery technologies suggests three main stages of (1) understanding the technology, (2) fleshing out potentials, and (3) forecasting likely development paths. In each stage, researchers can use different techniques such as (in 1) life cycle analysis and technology readiness assessment, (in 2) R&D profiling, area identification, and potential applications identification via bibliometric data, literature reviews, or patents, and (in 3) Delphi, scenarios, or road mapping (Halicka et al. 2015). The authors also note that it is not possible to separate the social environment to identify potential routes of technology developments, which gather unanimity in the different fields of futures studies (Cagnin et al. 2013; Frank 2017; Halicka et al. 2015; Olla and Choudrie 2009). The participation of experts or non-experts in futures studies can be considered. On the one hand, experts may be able to provide more probable indications for the future, as stated by Olla and Choudrie (2009). On the other hand, non-experts "*can bring with it organizational accountability and generate greater social legitimacy than expertise-based predictive activity*" (Reeves et al. 2016).

The Present of Futures in IS Research

The IS community is aware of the importance of futures, as evidenced by the ICIS paper presented by Olla and Choudrie (2009), or by top journals like EJIS (Chiasson et al. 2018). Despite the significant examples found, the studies discussing futures in our field are scarce. More recently, IS researchers point to the gains in engaging with practitioners in the difficult work of thinking the future with the aim of creating a better world and increasing IS relevance (Hovorka and Peter 2019). Chiasson et al. (2018) propose philosophical foundations for futures-oriented research in IS. Developing previous work about the relevance of IS practice for the future (Chiasson and Davidson 2009), the authors address the growing "*need to generate insights on, and to inform, possible sociotechnical futures*". In fact, the success of forecasting is not in the event of its validation but in reducing "*the gap between desired (normative) and likely (exploratory) futures by supporting the development of policies designed to increase the likelihood of desirable outcomes, or decrease the likelihood of undesirable ones*" (Chiasson et al. 2018).

The work of Wakunuma and Stahl (2014) discusses how futures and foresight in IS field can contribute to more responsible innovation. The authors used in-depth interviews with IS professionals to understand their perspectives of future technologies and their ethical concerns. These were found not to be substantial, although only a descriptive approach to ethics was adopted. The ethics of digital transformation and the evidence that in "*an ever-changing world, such an approach* [analysis and explanation of the past] *bears the risk to produce pictures of a moving target without providing a substantial orientation for change. That suggests that methods should develop and investigate images of the future* [... and could] *aim at developing grounded scenarios of possible future worlds that serve those who create the future as useful orientation*" (van der Aalst et al. 2018). Frank (2017) suggests that conceptual models and narratives are useful instruments "*for creating possible future worlds*", in which "[possible] *neither means that it will become reality, nor that there is a deterministic way to achieve it*". A possible future world, in the vision of Frank (2017), should be justified according to its feasibility (even if not possible in the current stage of the world development) and attractiveness (to support orientation towards the desired future).

Researching futures "[does] *not necessarily provide a solution. Rather, these methods can be used as a tool to investigate potential 'futures' and subsequently as a basis for analyzing what if a certain course is taken*" (Hovav 2014). The author argues that futures methodologies enable shifting from an observation role to active participation, for example, to identify potential outcomes of an emerging technology and propose mechanisms to anticipate the consequences in potential futures. We agree that "*IS research and practice are best served by not separating futures discourses from the central discourses of the IS community* [...offering an opportunity to change current practice in which] *'Socio-technical Imaginaries' and 'Perfect/Imperfect Futures', where the future is actively or radically imagined, are almost entirely part of commercial or artistic discourses*" (Hovorka and Peter 2019).

The next two sub-sections discuss the prevailing perspectives of futures studies in IS, namely as, (1) tools and (2) speculations.

Uncovering IS Futures with Tools

Gray and Hovav (2008, 2011) presented three methods for studying the future in IS, namely, environmental scanning, Delphi, and scenarios. According to the authors, these methods rely on main assumptions that (1) the future can be constructed and is not solely influenced by past events, (2) the present conditions will continuously evolve according to specific lines unless natural events or extreme changes occur, for example, the appearance of a disruptive technology. The authors enumerate some conditions to use these methods, for example, when uncertainty is high (lack of historical data) and when many stakeholders are experts in the problem. A recent example of using Delphi in IS to evaluate the risks of social media is presented in Di Gangi et al. (2018). Another perspective of "futures as tools" can be found in its relation with research methods that are widely used in the IS field, for example, action research (Ramos 2006), or ethnography (Olla and Choudrie 2009).

There are multiple methods available for those who want to explore alternative futures. Glenn and Gordon (2009) consider particularly useful for teachers: the (1) Futures Wheel, which is similar to a brainstorming about the consequences of future events; (2) Cross-impact, to study the interrelations among specific variables or trends; and (3) Causal Layered Analysis, to understand specific trends and events, considering an empirical layer (data), systems (mechanisms to produce data), worldview/paradigm (beliefs, values, and assumptions), and myth/metaphor that explains the intended behavior of groups and the society.

Participative methods (e.g. Delphi) offer an interesting potential for involving practitioners and researchers in the evaluation of futures, for example, with technology forecasting and strategic formulations. Complementing the techniques of foreseeing and envisioning (Gray and Hovav 2008; Tobin and Carroll 2003) and the examination of the philosophical foundations (Behren 2008; Chiasson et al. 2018), futures can enrich the discussion of multiple forms of IS research. For example, Gray and Hovav (2011) suggest futures studies for analysis (description and explanation) and prediction, assuming a specific line of evolution and the participation of experts. However, in some situations such as "a day in the life" (Glenn and Gordon 2009), the line of evolution does not exist and it is also possible to include non-experts in the study, for example, to gain increase social legitimacy (Reeves et al. 2016). The line between the reality and the unknown become thinner and the unreal emerges as a guide for action, as presented in the next section.

Speculating IS Futures

Sawyer and Crowston (2006) speculated on the next 25 years of IS research. The authors made a justified projection for the future based on existing literature, considering two main areas where researchers could make relevant contributions, namely, "*to advance conceptualizations of ICT and to better develop socio-technical theories of ICT*" (Sawyer and Crowston 2006). There are many other examples of envisioning future states of research and technology development (van der Aalst et al. 2018) with the aim to inform present developments (Tobin and Carroll 2003). But, on the other end of the speculations spectrum, we can find cases that may not be supported by present evidence, but merely represent the possibility of an alternative future, for example, using "*temporary* [unreal] *structures created for the purposes of sense-making*" (Behren 2008). Envisioning alternative futures based on well justified elements of the present and complete visions of a "day in the life" situations are two extremes of the real-fiction continuum that may offer multiple possibilities for research. However, the combination of evidence-based research and a discussion of sustainable futures is rare in the IS literature. One possible example is the use of plays in case study developments, where the author creates a dramatic story (Van Der Blonk 2003).

The result of using speculations can involve the entire project/publication, for example, in the form of a fiction, aiming at representing a preferable sociotechnical future. Fictions can be created by non-experts and do not require "a line" from the present to the future (which may not be probable or preferable, just possible). There are key influences from the area of HCI (Lindley and Coulton 2015) that may inspire IS researchers in the construction of sociotechnical fictions, for example, contrasting a specific research outcome with an imaginary context. Some examples can be found in top conferences like ICIS (Behren 2008), but the popularity of the term is drastically different when compared to management studies or human-computer interaction (Lindley and Coulton 2015; Phillips 1995; Wakkary et al. 2013). The use of fictions opens opportunities to evaluate past research in the light of alternative futures, trying to minimize the negative consequences or suggesting guidelines for the future, influencing organizations and society in their efforts to design and use information systems.

When using unreal elements such as design fictions, speculations, or scenarios, we consider that it is mandatory to discuss the implications of "what could be" to present actions (Simon 1996). It is recommended to justify the selected future world model (Olbrich et al. 2017). Moreover, researchers should facilitate traceability between the future and the past, or "what should have been" according to Reeves et al. (2016), assisting who may want to understand (retrospectively) how the future was analyzed and the impact of alternative courses of action. However, the studies that we found do not yet enable conclusions about the real potential of importing design fictions to the area of IS that merge the social and the material realms (Orlikowski and Scott 2008), requiring additional research that is out of the scope of this paper.

The next section puts forward a new form of including sustainable futures in IS discourse.

Discussion and Proposal

Three main conclusions can be drawn at this stage. First, sustainable futures are important for impactful research results, but few IS studies address the topic. Second, there are methods available to conduct futures studies in IS. Third, most of the IS papers we have found aim to study futures as the main goal (e.g. evaluate IS evolution, identify technology opportunities for the future, address philosophy and methods for future research). The most relevant opportunity in this topic emerges for other types of papers in IS where futures can be complementary to the main goal of the research. If we agree that envisioning alternative futures has the potential to improve more forms of IS publications, then it is necessary to propose a way to do it.

What Could Be? Implications for Futures in IS Publications

The overwhelming majority of research publications do not use futures methods (as tools) or adopt a core fictive approach, as it happens in design fiction (Lindley and Coulton 2015). However, we argue that a vast majority of publications with a projective stance can benefit from discussing implication for futures. In our proposal, unreal elements can be cautiously used, as complements, to guide the discussion on the sustainability of the results.

Implications for theory and for practice are inherently discussed in scientific publications. In some cases, implications 'for the future' are considered, however, this is different from the concept of implications 'for

futures', where alternative futures can be created to enrich the discussion of the findings. Moreover, we suggest that it is more effective to separate futures discussions and the "real" elements of the paper. There are two main advantages: First, it allows an immediate identification of an area of the paper that is not about the 'results', but rather focused on 'perceptions' and envisioning futures as a guide to improve sustainability goals. The discussion of futures implications may involve fictions, visions, metaphors, and other unreal elements that are intertwined with the main part of the study. We also suggest keeping the reflections on alternative futures (e.g. actions for different scenarios) in the same section. It is possible to explore trajectories in sequence of events because "*we have the advantage of being able to deal with multiple trajectories – to use dynamic theory's useful expression – with ensembles of trajectories*" (Byrne 2005) or a "day in the life" (Glenn and Gordon 2009).

Alternative futures challenge IS researchers to envision their results in probable, possible, plausible, and preferable situations. First, it may help to understand the future impact of research in different scenarios and, hopefully, identify possible improvements – for the current stage of investigations or as future research work. Second, it may enrich our field with added-value information for the future: (1) identify how IS researchers saw the future in a specific moment, (2) contrast that to *what should have been done*, and (3) align IS research efforts with the emergent needs of organizations to envision an alternative future to effectively design, deploy, and use information systems. Finally, as "Impacts for futures" grow in our literature, new research will be possible, to evaluate the role of futures in IS and in which futures we are aiming to shape. The future of IS research is highly dependent on how we can create improved sociotechnical futures. As Carol Sanders once stated, this paper also "*view[s] the present as a knife edge between the past and future. Thus, I choose not to linger on the present, but rather to focus on what I would like to see in the future for MIS*" (King et al. 2010).

The model represented in Figure 2 is inspired in the cones of futures (Dunne and Raby 2013) that represent the possible, plausible, probable, and preferable visions.

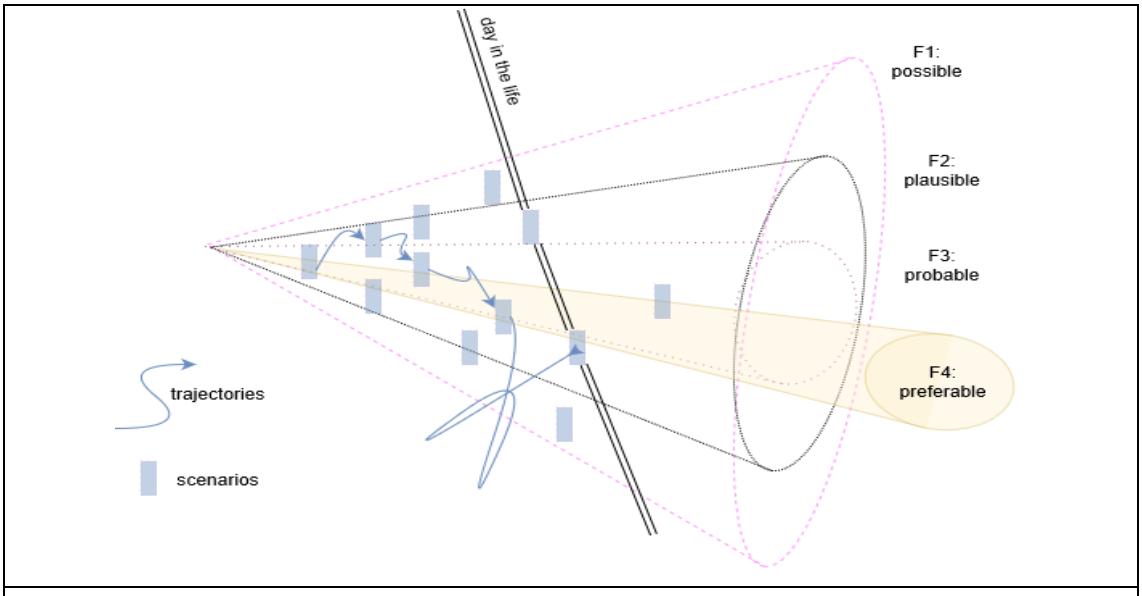


Figure 2. Implications for Futures: Performing Agential Cuts in the Real-Unreal Continuum

According to the model presented in Figure 2, researchers may prefer to focus on the details of a specific image of the future ("day in the life") or on the possible trajectories and their implications in the time continuum. Implications for Futures require an agential cut (Barad 2007) to magnify the details (Kautz and Jensen 2013) of each alternative for a sustainable future. The agential cut represented in the figure can have infinite configurations and angles, for example, researchers may prefer to focus the F2: probable and F4: preferable alternative futures making the cut almost parallel to the surface of the cones F3 and F4. The ensemble of scenarios included in the selected agential cut composes the narrative used to discuss the

research. Increasing or decreasing the average distance of all the ensemble of scenarios from "F3: probable", may provide additional insights about ways to change the future (e.g. improve sustainability of a digital innovation to achieve competitive advantage). Conversely, selecting more elements pertaining to F3: probable, may be useful to discuss the research according to the most likely estimations. It is out of the scope of this paper to discuss all the possible configurations (for a detailed discussion of using predictive/explorative/normative scenarios for different futures, see (Börjeson et al. 2006)), however, major advances will grow as researchers explore the possibilities of futures studies and report their own experiences and lessons learned in doing futures.

"How can a specific target be reached" (Börjeson et al. 2006) and be sustainable in IS seems to be the most useful form of using alternative futures in the short term. It may inform how we can build preferable sustainable futures but also to improve current outcomes of the research, creating links between the present and the future. Moreover, this suggestion offers the potential to improve the richness of IS discourse and the traces will be valuable for upcoming researchers – new sources of data that we are leaving to them. However, introducing assumption when we are not certain that there is evidence that supports them, can't be "*done freely without constraints*" (Achinstein 2018). Based on the literature review, the following guidelines for developing Implications for Futures can be proposed.

Guideline 1: Differentiate the Implications for Futures Section

Clearly separate the section from other parts of the paper. Merging images of futures and evidences in the paper (which is common in cases that specifically address speculations or forecasting, but not in others) poses severe risks to paper readability and to the evaluation of the implications for theory and for practice. We recommend starting the section with a sentence informing the reader that is going to enter in an area that uses images of the future (e.g. scenarios) to guide the sustainability of the results aiming at preferable futures.

Guideline 2: Create a "Futures Window" to Contextualize the Reader

Implications for futures, as represented in Figure 2, is a subjective selection made by the researcher. It obviously raises ethical concerns that may be addressed with contextual information about the ensemble of scenarios selected for evaluation. One possible solution that may be tested (as exemplified in this paper) is the Futures Window that:

- *Justify the purpose of including an Implications for Futures section*;
- *Summarize the relevance of envisioning,* for example, address consequences of the research, clarify the importance of the findings for preferable futures, explain decisions made in the present (regarding sustainability), contrast alternative futures and suggest actions to deal with adverse situations. Considering that we are not referring to pure speculative papers, it is important to contrast the alternative futures (a guide for sustainability) with the evidences of the core contribution;
- *Classify the agential cut (day in the life; analysis of trajectories)*;
- *Identify real elements used to create the section (e.g. in design science research, the resulting artifact can be used to discuss its importance for probable scenarios of stakeholders)*;
- *Explain the methods used for the envisioning (e.g. fiction narrative, scenarios, …) and the basis/sources for the assumptions*. For example, research supporting specific challenges of the society (e.g. sustainable development goals of the organization), background literature, or predictive analytics models (Shmueli and Koppius 2011).
- *Provide other elements that may assist the audience in the interpretation of the alternative future(s)*. For example, specific references that adopted the same vision (sources such as books, movies, prototypes, other papers). Visions may be reused, contrasting them with different real artefacts.

The futures windows can be developed in plain text, using a table or other graphical element that help intertwining the main results of the paper and the images of futures (Dator 2009).

Guideline 3: Identify the Types of Alternative Futures and Point to the Preferable Direction

The reader must be able to understand each sentence in the space represented in Figure 2. One possibility is to use a superscript indication (e.g. [F1]), as illustrated in the next section. The four types of futures (Dunne and Raby 2013) can be:

- *Possible* (in mathematical terms, a non-null possibility that may be desirable or not). Can be used cautiously (and related to the research) to frame the vision and open opportunities for future work;
- *Probable* (likely but may or may not be what we prefer to happen): researchers can direct their efforts to that part of the spectrum of futures. Managers can take actions to anticipate consequences or improve competitiveness. Can be used to contrast our findings – challenging our implications discussion;
- *Plausible* (that deserve applause; it is an acceptable option for alternative futures) does not include what we do not want to happen. Can be used to evaluate which of the plausible futures has better effects on sociotechnical setting reported;
- *Preferable* (what we aim): Take actions for design and action, introducing changes. Discussing the importance of our research for preferable futures. Incorporate present functionalities in systems that contribute to that future. Guidelines to use artifacts that increase the preferable future 'likeliness'.

Guideline 4: Adopt Quality Criteria in the Section Development

The work of Wiek and Iwaniec (2014) present some criteria that can be adopted for envisioning. The most important suggest to (1) include elements of aspirational surprise when dealing with desired states (*visions*), (2) feature transformation of structures and processes compliant to specific principles (*sustainability*), (3) adopt a holistic representation of the vision with linkage between the elements (*systemic*), (4) discard contradictions and use compatible goals (*coherent*), (5) integrate *plausible* examples and (6) *tangible* goals, (7) address *relevant* social goals, (8) highlight *priorities*, (9) be capable to inspire and *motivate*, (10) and support convergence supported by different stakeholders (*shared*).

Guideline 5: Make Sense of the Past, Present, and Futures

Discuss both how the future can inform current research and the consequences of current proposal for the preferable future. The discussion must be based in the narrative presented to the reader (if there are multiple scenarios it is necessary to describe them in detail). Trajectories can be included in the debate: how to develop specific scenarios and sequences of events to reach preferable futures. The discussion is the most important part of the section and may include also a justification for some opportunities for future research (for example, explaining how authors classify priorities for future work) and actions to improve the sustainability of the desired situation, as presented in the subsequent guideline.

Guideline 6: Evaluate the Opportunities for Future Work

If negative consequences are identified, then it is expected that researchers propose actions to address those consequences. Another possibility is to propose new developments that may transform the nature of the alternatives, for example, shifting from plausible to probable.

The next section exemplifies the adoption of guidelines 1-4.

Illustrative Case: Narrative Fiction for an Industry 4.0 Research Paper

This section describes a sociotechnical future in the context of the fourth industrial revolution (industry 4.0 or i4.0), presented as a drastic change in digital production systems with major social implications (Xu et al. 2018). It is common to present i4.0 with fictions and speculations, for example, in the video of the World Economic Forum (2016). The revolution can be defined as the use of artificial intelligence, robotics, augmented reality (AR), mobile systems, 3D printing and other advanced technologies to change industry worldwide. The topic already captured the attention of several IS researchers and recent publications point to the importance of envisioning the industry transformation due to political priorities, as happens in the Austrian parliament (Weber et al. 2019). We will discuss a "day in the life" using the example of a research aiming to include industry 4.0 technologies in a traditional ceramics manufacturer. The work explains the

sociomaterial transformations in the adoption of 3D printing, cloud-based manufacturing execution systems, and augmented reality for product simulation by the end customers (Barata and Cunha 2018).

Futures Window	
Purpose	Illustrate a possible narrative to discuss Implications for Futures
Relevance	Industry 4.0 is a priority for the entire world. Investments in new technologies by traditional industries is challenging and many projects fail in the initial phases of adoption. Companies should envision scenarios that affect the sustainability of the investments and the evolution of pilot projects
Agential cut	Day in the life, possible in the next decades; adopts the 4Ps: possible (F_1), plausible (F_2), probable (F_3), and preferable (F_4) futures
Real elements / Evidences to support the discussion	The (1) concept of cybernetic factory anticipated by Beer in 1979, proposing the Viable System Model for organizational studies; (2) the definition of industry 4.0 and its impact in the society expected by the World Economic Forum; (3) design principles for Industry 4.0 scenarios (Hermann et al. 2016); (4) challenges already faced for sustainable (social, environmental, and economic) development; and (5) cases of IT adoption success and failure in a ceramic company evaluated by the authors in previous work (Barata and Cunha 2018)
Methods for envisioning	Environmental-scanning (Gray and Hovav 2011) of literature and policy initiatives towards Industry 4.0. Internal factors of a ceramics company and the sociomaterial transformation of traditional industries (Barata and Cunha 2018)

Table 1. Futures Window for "Cybernetic Ceramic Industry 4.0"

The cybernetic factory (Beer 1979) *became a reality with industry 4.0 advances in traditional ceramic industries, allowing to autonomously operate with no humans, with self-protection, self-optimization, self-configuration, and self-healing capabilities* (Xu et al. 2018) *(F_3). But industry also faces three major challenges for sustainable growth, namely: (1) the lack of resources that pushed science in the creation of many artificial materials – requiring much more industry production efforts and energy; (2) an environment that is struggling to keep balance all forms of life and an overcrowded society: and (3) the need to reconfigure social activities in a digital world (F_3). Humans are connected to machines, allowing to support a collective intelligence mechanism, formerly known as machine learning and now labeled as the 'world learning and forecasting system' (F_2). Some factories achieved end-to-end digital integration of supply chains and important economic gains, including energy reduction using artificial intelligence (F_4). However, there are also problems, namely, accidents with humans are difficult to investigate because machines are not accountable, and factories are not forced to include reliable blockchain systems for traceability of goods and services (F_1). Investments in augmented reality systems for product simulation are now economically viable due to the generalization of 3D printing production (requiring the same 3D models used for product simulation) (F_3). Yet, ceramic companies that didn't invest in these digital technologies have been excluded from global supply chains and struggle to be viable (F_1).*

A part of the society is claiming for the accountability of machines, making factory owners responsible for the consequences of all their actions (F_2). Most humans are now factory owners and control 3 robots on average due to the law of decentralization of critical resources (limiting the number of robots for each human) (F_1). Workers are spending too much time near the machines and interacting with nonhumans, which is a major concern for work conditions and stress management (F_3). Although most of the factory data is now property of regulatory entities, independent from the government but with public responsibilities in each sector of the economy, most drones do not yet implement human protection systems. Factory managers do not have a rule engine that explains how their factory impacts the environment and the social value of their existence. For example, the real value for the local community and circular economy efforts (F_1).

Over 50 years ago, several managers decided to quit industry 4.0 because the prototypes did not work as expected over time, and the maintenance cost was prohibitive. Many i4.0 projects did not consider the rapid evolution of technologies, making systems obsoletes and struggling with the lack of adherence from customers and partners of the supply chain (F_3). For example,

> *in ceramic industry, some customers stopped using AR for simulation stating that the real product was always different from the models and that not all digital twins of the company product portfolio were available for simulation* (F1). *There are reports associating the product digitalization using cloud, mobile, simulation, and augmented reality with an increase in counterfeit products of this industry sector* (F1). *Some factory owners become suspicious about industry 4.0 investments in a way that is sustainable and ethically accepted (F1).*

The image of the future presented above is relevant to discuss implications for pilot projects or sociotechnical transformations in the context of Industry 4.0. The narrative fiction (Phillips 1995) is based on creativity but could be used, for example, to make recommendations in current developments of a specific technology to minimize some of the negative consequences described and explore opportunities for preferable futures. The vision highlights the need to prepare the investments in digital transformation, particularly in global supply chains (e.g. homeware production and distribution). The image of the future is interesting for managers because also points to risks that must be addressed for a sustainable adoption of industry 4.0 technologies. Other envision techniques could be used to support the section discussion (e.g. scenario planning, Delphi). Therefore, this example is merely illustrative, rather than prescriptive, and particularly addresses guidelines 1-4 because more details are necessary (included in the original paper) for implementation of guidelines 5-6. A more complete example is presented in the next section.

Implications for Futures: Unveiling the Missing Section

This section uses a normative scenario (desired or target-seeking) to answer "*how can a specific target be reached*" (Börjeson et al. 2006). Among its two possible versions we selected the preserving scenario type (contrasting to the transforming scenario alternative), used when "*it seems possible to reach the target within a prevailing structure of the system*" (Börjeson et al. 2006). Our option for a desired scenario of responsible innovation (Hovav 2014) emphasizes that, rather from being a significant transformation of IS research structure, Implications for Futures contributes to enrich the multidisciplinary and sustainable nature of pluralistic IS. The purpose is to strengthen the need to include future studies in IS research and discuss consequences for our field. It envisions a preferable scenario of using images of the future (possible (F1), plausible (F2), probable (F3), and preferable (F4)), when applicable. The evidences supporting the need of unveiling this section are the discussion of future-informed research (Chiasson et al. 2018) and the increase of IS relevance (Chiasson and Davidson 2009).

> *Our research will be more appealing to managers if they recognize more easier how small steps in scientific advances can contribute to make specific futures more sustainable than others* (F3). *Some managers may even prefer to start reading our papers from the Implications for Futures section, trying to see alternative futures shaped by the IS field, guiding their decisions in digital transformation* (F2). *In specific sectors of the economy (as illustrated for the digital transformation of traditional ceramics sector) Implications for Futures can inspire researchers and practitioners in the redesign of work practices supported by IT that shape preferable futures, taking into consideration the social and the material realms that are intertwined in a connected reality* (F4). *Our field is particularly suitable to envision sociotechnical futures in the intersection of management and engineering* (F4).
>
> *Implications for futures open the possibility for new studies that retrospectively evaluate futures in IS publications, providing new classifications and improving our understanding of the decisions made by the researchers* (F1). *Moreover, new indexes of IS impact in industry can be developed, assessing how futures materialize in organizational settings and what is the impact of those futures for competitiveness* (F2).
>
> *There are also risks in making visible this missing section* (F1). *The first risk is the few studies available in the topic and the justified doubts that may exist in the discussion of futures integrated in IS research* (F3). *Researchers will claim for more guidelines and examples (e.g. which techniques can be more useful in action research?)* (F2). *An excessive influence in the future actions of society is also undesirable, requiring measures of transparency in our publications, namely, the role of supporting organizations* (F4). *Futures can introduce biases in the discussion of present evidences that must not be neglected, therefore, a separate section is promising* (F4).

We welcome the missing section with an expectation of constructive criticism. It is "alternative" but also "inspirational". First, because it requires additional debate. Second, because we see many benefits in including sociotechnical futures in the agenda of sustainable and impactful IS research. However, we are not used to think about futures when arguing about evidences collected over months and years of research.

It is also possible and desirable to create a knowledge base of envisions (alternative futures can be reused in different research projects) contributing to inform the present and the future of IS research. Moreover, the benefits of discussing implication for futures largely surpass the possible adversities, creating new traces for research between the past-present-future chain of events, anticipating consequences and acting more effectively, and improving our publications in a new and innovative way.

Conclusion

This paper discusses the incorporation of preferable futures in sustainable IS research and proposes guidelines to create a new form of discussion section: Implications for Futures. Sustainable and impactful IS research must contrast evidence-based research with the potential of sociotechnical imaginaries (Jasanoff 2015) and the ambition to create preferable futures. Managers claim for research that assists them in dealing with the unknown of technologies and social contexts. There is space, necessity, and opportunity, to include futures discussions in pluralistic IS research.

From the theoretical point of view, by unveiling the "missing section" in IS research, we suggest a new use for images of the future. Our contribution extends the work of several researchers suggesting the necessity to include futures in IS discourse (Chiasson et al. 2018; Chiasson and Davidson 2009; Majchrzak et al. 2016). Chiasson et al 2018 stated that "*discussions of future(s) in IS research publications tend to be limited to implications for practice, the generalisability of theory to other settings, and future research topics*". Our work offers a possible way forward, by means of a separate section aligned with the vision of Jasanoff (2015)'s imaginations of modernity that can serve both as ends of research and as instruments of legitimation. Valid tools are available to envision the future (Glenn and Gordon 2009) which can be grounded on the literature (Sawyer and Crowston 2006) or fictions (Behren 2008; Phillips 1995) and incorporated in different types of research. From the practical point of view, we suggest an improvement to the development of scientific publications, including a section that separates facts from imaginaries, exploring their synergies for sustainable IS research.

Our study has limitations that must be acknowledged. First, despite the recent studies that suggest exploring futures in IS, there is an absolute lack of guidance on how to do it. Implications for Futures is an additional contribution "*to gain comfort and experience with these new forms and goals for scholarly IS research*" (Chiasson et al. 2018). Second, there is a natural limitation in the sources of literature selected, namely in IS, HCI, and management. Futures studies is a vast area of research and other contributions can enrich this debate. Third, although identifying influential work in sociotechnical futures, this paper proposes an initial set of guidelines to start the process. Additional research is necessary to balance the interest of researchers, organizations, and society in the debate of different types of futures. Fourth, there are multiple techniques for envisioning (e.g. scenario building) and each one has specific purposes. Additional work is necessary to evaluate the proper use of each technique in futures discussion. Fifth, it will be necessary to evaluate the benefits and drawbacks of envisioning in different types of IS research (e.g. design science, action research, ethnography, or case studies). Our proposal may not be applicable to all types of research. In fact, we prefer to present it as a possibility to researchers who need to discuss how technological developments may hold up in preferable (unstable) sociotechnical futures. We argue that the IS field is well positioned to build preferable futures. By "preferable", we mean the futures that achieve the best interests of ethics, sustainability, and decreased technology threats (Markus and Mentzer 2014).

This essay opens several opportunities for future research, in addition to those put forward in the Implication for Futures section. First, it is necessary to deeply evaluate the role of futures in each type of IS theory, answering "what could be" and "what should be". Second, identifying and reporting sociotechnical futures (e.g. how to relate those futures with the research findings) needs additional contributions. For example, to improve the structure of the Implication for Futures section. Third, it is crucial to ensure ethics in futures research publications. Examples include stating the conflicts of interest, the participating institutions and the possible anticipation of commercial products involved. Therefore, the researchers should justify their futures discussion with specific sociotechnical interests (e.g. overcome injustices, protect resources, improve the conditions for future generations, assist organizations in using specific technologies) with clear use cases. If future scenarios are too vague, the exercise is pointless; if they are too specific, it may be difficult to include the most relevant futures in concise research papers. Exploring alternative futures can inform the present and guide actions for the future; it is not an opportunity for

guessing and create pointless predictions based on past facts. Developing a privileged space that merges business and technology should, in our view, include a discussion of preferable sociotechnical futures.

In the mid 1950s, the Walt Disney Studios produced a series of fiction shows devoted to the anticipation of space exploration, including "Man in Space" and "Man and the Moon". When, in 1961, the US announced its space program, these films were still very present in the minds of the scientists and policy makers involved. It should thus be no surprise to learn that on that day in 1968 when millions of people were watching on TV the Apollo spacecraft circling the moon, Wernher von Braun, a top rocket expert and one of the key consultants of the Disney series, placed a phone call to Ward Kimball, the series director, and said (Smith 1978): "*Well, Wahd, it looks like they're following our script*". We would like to hope that the authors of some information systems publications of the future could one day be able to make similar claims.

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