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Unsustainable Green Information Systems

An Affordance-Based Conceptualisation of Conflicting Short and Long-Term Sustainability Outcomes of Green Information Systems in Organisations

Master Thesis

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Abstract

Over the past decade, research under the label of Green Information Systems (Green IS) has invested remarkable effort in examining and demonstrating the valuable role of Information Systems for environmental sustainability. Yet, so far Green IS scholars have largely neglected a more comprehensive perspective of sustainability covering not only the environmental but economic and social dimension as well. We consider this perspective relevant for research and practice as we demonstrate how these environmental initiatives might eventually lead to conflicting outcomes and negatively affect environmental user behaviour in the short and long-term. Therefore, we proffer an affordance-based framework explaining the relationship between Green IS affordances and conflicting sustainability outcomes. We further add to the current body of research by contributing a set of testable hypotheses and corresponding measurement constructs.

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The making of this thesis was shaped by many people. Some of them, I met during my stay in Brisbane; others found ways to support me without being physically present in Australia.

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Patricia, you accompany me on all of my trips, either walking next to me or being in my heart. Writing these lines, I realise I am at loss for words to describe my luck of knowing you. What I do know, though: There is hardly any other person in my life, who acknowledges and respects my personal dreams more than you do. Thank you for helping me chasing them. And if you require some help chasing yours, I will be there for you.

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Abbreviations

AST	Adaptive structuration theory
B-A-O	Belief-Action-Outcome
BMW	Bayrische Motorenwerke
ERP	Enterprise resource planning
IS	Information systems
IT	Information technology
KPI	Key performance indicator
OLAP	Online analytical processing
SAP	Sofwareanalyse und Programmierung
TAM	Technology acceptance model
TBL	Triple bottom line

1 Introduction

The harmful environmental impacts of the human being continue to be an alarming issue for our planet. Since 1990, global greenhouse gas emissions have increased by more than 50 per cent exhibiting accelerating growth rates; due to ongoing deforestation, the net loss in forest area makes up approximately 5.2 million hectares annually; despite the global usage of renewable freshwater resources of 9 per cent only, 40 per cent of the world's population is facing water scarcity. These developments have already considerably contributed to the emergence of global warming in the past and they are expected to further exacerbate the situation (United Nations 2015).

The criticality of this challenge also manifests in major supranational, national, and subnational agreements and declarations. At the end of 2015, the United Nations Framework Convention on Climate Change held its twenty-first session of the Conference of the Parties in Paris. As one important result, 195 nations signed a legally binding agreement (also known as the Paris Agreement) declaring the overall goal of limiting global warming to be well below 2 °C (United Nations 2016). In turn, such supranational agreements translate to national and subnational laws and instruments, as for instance the *Aktionsprogramm Klimaschutz 2020* in Germany (Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit (BMUB) 2014) or Australia's *2030 Emission Reduction Target* (Australian Government, Department of the Environment 2015).

As a result of these legal pressures and financial incentives also many organisations have started to reassess their practices in the light of environmental sustainability. For instance, Apple Inc. has committed to an annual *Environmental Responsibility Report* disclosing the company's major achievements in terms of eco-efficiency (e.g., reduction of energy consumption or reduction of toxic raw materials) and eco-effectiveness (e.g., extended sourcing of renewable energies or recycling of electronic waste) (Apple Inc. 2015); SAP, one of the leading global software solution providers, has established a corporate-wide environmental sustainability programme in 2009 with the goal of reducing the greenhouse gas emissions to year 2000 levels by 2020 (SAP SE 2016); and the BMW group, which has been recently rated as the most sustainable corporation worldwide in the 2016 Global 100 index (Corporate Knights 2016), are continuously driving their green mobility strategy by releasing new electric car models to the market in 2015 and 2016 (BMW Group 2016).

A high-level evaluation of those practices suggests that environmental sustainability is a multi-faceted endeavour, which is interpreted differently by companies. It can range from rather lose and non-pervasive actions, like environmental sustainability information

disclosure in the case of Apple and SAP, to more profound actions that are interwoven with the core business model, like an adapted eco-friendly product portfolio in the case of BMW. Notwithstanding the variety of interpretations, information systems (IS) have always been an important assistant in implementing environmentally sustainable practices. A compelling example makes Seidel et al.' (2013) case study of a leading global software provider that mainly relied on existing technology solutions to successfully introduce a corporate sustainability program.

However, IS have been attributed the role of a negative contributor to environmental deterioration for a long time (Zhang et al. 2011). Eventually, in the years 2008 to 2010, Gartner's annual *Top 10 Strategic Technologies* publications revealed a growing practitioners' interest in the beneficial use of IS in supporting the transformation to environmental sustainability (Gartner Inc. 10/9/2007, 10/14/2008, 10/20/2009). In turn, the growing practitioners' interest revitalised scholarly actions to actively participate in the development of technology-driven environmentally sustainable business practices (Watson et al. 2010; Elliot 2011).

Malhotra et al. (2013) demonstrate in their review that the research endeavours since 2008 can be divided into two main domains: Green Information Technology (IT) and Green IS. While the former mainly deals with IT energy efficiency and equipment utilisation (Watson et al. 2008) from a comprehensive technology lifecycle perspective (Murugesan 2008), the latter embraces "IS-enabled organizational practices and processes that improve environmental and economic performance" (Melville 2010, p. 2). Relating both research domains, we adduce Watson et al.'s (2010) understanding of Green IS to be more comprehensive and thereby inclusive of Green IT initiatives. Consequently, we will focus on Green IS in this thesis. The two literature reviews by Malhotra et al. (2013) and Recker (2016a), which jointly cover the literature within the AIS basket of eight leading IS journals (AIS 2011) from 2008 until 2015, reveal that the body of research mainly focuses on analysing and conceptualising the Green IS, whereas design and impact related research remain comparatively untouched. Avowedly, the immediate contribution of this paper falls as well into the first two phases (i.e., analyse and conceptualise). However, we are convinced that – once our hypotheses have been empirically validated – our findings will wield a remarkable impact on current Green IS design sciences and practices.

The basic assumption of this thesis is that, despite the overall increase of Green IS research activities since 2010, we assert that scholars are currently creating a gap between practice and research due to an isolated focus on environmental outcomes. So far, the more comprehensive and commonly practiced perspective of sustainability (Kolk 2004), covering not only the environmental but economic and social dimension as well, has been

widely neglected by Green IS researchers (Chasin 2014; Dao et al. 2011). We take this step. We consider the more comprehensive sustainability perspective and evaluate potentially conflicting individual and organisational outcomes along the different dimensions of this perspective (i.e., economic, ecologic, and social). In this thesis, we will demonstrate how these conflicting outcomes might not only lead to a short-term rejection of a Green IS initiative itself but also to organisationally induced corrective actions targeting the user or the Green IS.

Our main motivation is not to render all previous Green IS literature void. Instead, we position it in an expanded and extended context (i.e., sustainability) that is more encompassing yet also more complex than the one in which it was initially researched (i.e., environmental sustainability). Thereby, we support the overall Green IS research activities and our main goal is to enhance its current body of knowledge and bridge it to a so far mainly untouched research field we deliberately call *Sustainable IS*. Placing the Green IS domain into the more comprehensive universe of sustainability reveals tensions that should not be disregarded due to their potential long-term aggravating effects on employee behaviour. Eventually, our findings shall create a more integrated yet also more differentiated view on Green IS.

We will investigate two specific research questions within this thesis:

RQ 1: *How do Green IS lead to conflicting sustainability outcomes?*

RQ 2: *How do Green IS induced conflicting sustainability outcomes affect the user and the IS artifact in the short and long-term?*

In addressing these questions, we will draw on the theory of affordances (Gibson 1986), which has been a widely adopted theory in IS research (Leonardi 2011; Markus and Silver 2008; Hutchby 2001; Strong et al. 2014; Hutchby 2001) and also specifically in Green IS research (Seidel and Recker 2012; Seidel et al. 2013; Reuter et al. 2014; Seidel et al. 2014). It matches the requirements and focus of our research intention very well as it provides “a useful bridge between the analysis of IT properties and the explanation of IT effects” (Markus and Silver 2008, p. 617). In our case, the affordance perspective is more applicable than other theories (e.g., Technology Acceptance Model (TAM) (Davis 1993) or Adaptive Structuration Theory (AST) (DeSanctis and Poole 1994) for two main reasons: Firstly, it specifically considers characteristics of the IT artifact and the user simultaneously; secondly, it addresses both the individual and the organisational level of analysis (Strong et al. 2014). Thereby, affordance theory provides relevant mechanisms to explain the outcomes of IT utilisation in organisations and associated organisational changes (Pozzi et al. 2014).

Our contributions are twofold. *Theoretically*, we provide a testable theory of unsustainable Green IS, which explains how Green IS initiatives might result in conflicting sustainability outcomes. To date, scholarly investigations in the Green IS and Green IT domain are mainly limited to conceptual and analytical methods (Malhotra et al. 2013). However, our ambition is to stimulate the future empirical validation of our theory by offering entry points for researchers in form of two research models, corresponding measurement items, and an appropriate measurement strategy. Once tested, we expect the findings of our rather critical research approach (i.e., what can potentially happen in a worst case scenario) to be helpful for future positivistic approaches (i.e., what should happen), as for instance design research (Melville 2010). *Practically*, our critical viewpoint allows us to highlight and explain possible pitfalls during the implementation of Green IS initiatives. These findings can be understood as 'theorised lessons learned' and form valuable insights for practitioners.

The structure of this thesis outlines as follows. Next, we introduce the reader to the concept of sustainability (cf., chapter 2.1) and evaluate how it is currently perceived by IS research (cf., chapter 2.2). We conclude this chapter by demonstrating an existing research gap in the field of sustainable IS. Being the kernel theory of our conceptual framework, we provide a short overview of affordance theory (cf., chapter 2.3) and its application in IS research (cf., chapter 2.4). Chapter 3 forms the main part of our paper, in which we develop a theory of unsustainable Green IS. By applying our conceptual framework, which explains the socio-technical interaction between the IS artifact and the user (cf., chapter 3.2), we instantiate fictitious conflicting sustainability outcomes (cf., chapter 3.3.1) and conjecture their short and long-term impacts on the user and the IS artifact (cf., chapter 3.3.2). Based on these insights, we deduce testable hypotheses addressing our research questions. To support the future empirical validation of our hypotheses, we operationalise our theory by suggesting two feasible research models including measurement items and an appropriate measurement strategy in chapter 4. Before summarising and concluding our work in chapter 6, we discuss our contributions and limitations in chapter 5.

2 Background

This chapter introduces the reader to the fundamental underlying concepts and theories that are applied during the course of this paper. After presenting different conceptualisations of sustainability (cf., chapter 2.1), we summarise existing IS research specifically addressing the integrative concept of sustainability (i.e., economic, ecologic, and social sustainability). We demonstrate that research in Green IS has mainly ignored the comprehensive perspective of sustainability so far (cf., chapter 2.2). This gap will serve as motivational justification to embark upon the topic of investigating conflicting sustainability outcomes and their consequences. For investigation purposes, we need to define (1) how current Green IS research conceptualises an idealistic set of Green IS affordances and (2) how these affordances interact with the user. We select affordance theory as useful and rich mechanism to explain the socio-technical interaction system (cf., chapters 2.3 and 2.4) and rely on latest Green IS design research to identify an idealised set of Green IS affordances (cf., chapter 2.5).

2.1 Sustainability

The concepts of sustainability and sustainable development are abstract in nature and highly context-sensitive. This is reflected in the high number of existing definitions, which have been estimated to three hundred in total (Santillo 2007), as well as in the diverse domains (e.g., intergovernmental, governmental, and non-governmental organisations, private organisations, as well as independent scholars and research institutions) contributing to the ever growing body of knowledge (Harris 2003). Hence, we restrict our representative overview to the most common definitions and conceptualisations.

From an etymological perspective, the word ‘sustainability’ is a nominalisation of the composed words ‘sustain’ and ‘able’ both originating from Latin. While the former derives from ‘*sustinere’*, meaning ‘hold up’, ‘bear’, or ‘endure’, the latter is a word-forming element to express an ability or capacity (Latin: ‘*abilis’*) (Onions et al. 1982). While ‘sustainability’ represents the final aspired state, ‘sustainable development’ can be understood as the procedural attempt to achieve this state (Kates et al. 2005). Overall, the latter has received more public attention due to its famous definition stated by the Brundtland Commission in 1987 (World Commission on Environment and Development (WCED) 1987 Chapter 2, Paragraph 1):

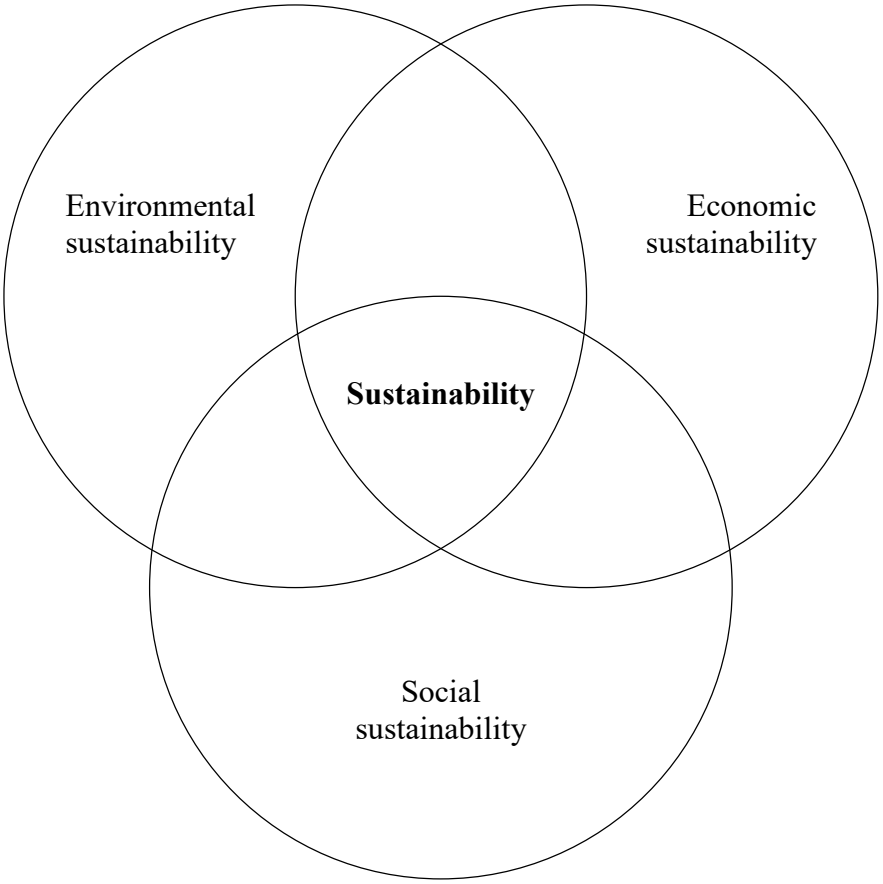

Figure 1: Triple bottom line (adopted from Dao et al. (2011))

"Humanity has the ability to make development sustainable – to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs."

Despite many interpretations and modifications (Giddings et al. 2002; Hopwood et al. 2005; Redclift 2005), the kernel of the overarching 'sustainability' concept persists from its etymological origin until today. The widely accepted core of it comprises three essential perspectives (also known as 'pillars'): Environmental sustainability, social sustainability, and economic sustainability (Adams 2006) (cf., Figure 1). The *economic* pillar embraces the ability of public and private organisations to manage resources (e.g., natural, human, and financial) in such a manner that it yields a sustainable economic outcome, as for instance, operational profit; the *social* pillar represents the capacity of social systems to achieve a sustainable social well-being including for instance health, education, or social justice (Elkington 1997); finally, the *environmental* pillar represents the maxim to consume natural resources at most at a rate that allows the "biosphere to absorb the effects of human activities" (World Commission on Environment and Development (WCED) 1987, p. 8). This pillar is awarded a special role as it embraces

society and economy, which in turn emerges from the aforementioned society (Kates et al. 2005). It thus can be understood as a fundamental finite factor limiting human endeavours (i.e., social and economic activities). Eventually, to achieve the aspired state of sustainability, organisations must strive for balancing all pillars simultaneously.

Despite the abundance of available information on the initial concept of sustainability, commonly agreed and detailed operationalisations of the three pillars are rare (Global Reporting Initiative 2013; United Nations 2015). In 1994, John Elkington (1994) initially took up the WCED concept and coined the term of the *win-win-win strategy*. His motivation was to promote the concept of environmental sustainability by rephrasing it in more business related terms and making it more accessible for stakeholders that were not familiar with environmental and sustainability sciences (Elkington 2004). Three years later, he repeatedly stressed the importance of recognising the operational – conflicting and reinforcing – interdependencies between the three pillars and coined the terms *triple bottom line* and *3Ps (people, planet, profit)* (Elkington 1997). Nowadays, these widely applied concepts occur in many different research domains (cf., Craig Deegan (2002), Dyllick and Hockerts (2002), Seuring and Müller (2008), Boxall and Purcell (2011)) and serve numerous companies to report their overall business value along these three perspectives (KPMG 1999; Slaper and Hall 2011).

In order to investigate potential conflicts between organisational outcomes from a sustainability perspective, we will therefore rely on the triple bottom line concept to structure organisational goals and outcomes based on the three pillars of sustainability.

2.2 Sustainability in Information Systems Research

While the previous section provides an overview on the most important sustainability conceptualisations, this chapter draws the connection between sustainability and the IS domain. It offers the reader a collection of current research on the sustainability value of IS. This review is not to be confused with existing literature reviews, which examine research on Green IS only, because it specifically focuses on sustainability as an integrative concept considering all three pillars simultaneously. The main objective is to identify publications in the IS domain that proclaim to apply the concept of sustainability. In turn, we investigate which dimensions of sustainability are actually addressed.

Methodologically, we conduct a representative literature review as proposed by Webster and Watson (2002) and Brocke et al. (2009). In the beginning, we identified two existing literature reviews on sustainability in IS research (Bengtsson and Ågerfalk 2011; Chasin 2014) that served as a starting point for our purposes. Bengtsson and Ågerfalk (2011)

cover the timeframe from January 2000 until May 2010 and Chasin (2014) investigates the period from January 2003 until January 2013. While the former apply an extensive pool of keywords (i.e., 'green', 'sustainable', 'sustainability', 'environmental', or 'environment') to query the '*basket of eight*' as well as the proceedings of AIS associated conferences (cf., following sub-section on *Ensuring collective exhaustiveness*) (Bengtsson and Ågerfalk 2011, p. 98)), the latter opts for a reduced and simplified search string (i.e., 'sustain*') and focuses on the '*basket of eight*' only (Chasin 2014, p. 343). Though different in scope, both reviews jointly provide a representative snapshot of the body of knowledge until 2010 and 2013 respectively.

Relying on this valuable groundwork, we performed two additional research steps that were considered necessary for our research focus (i.e., sustainability in IS). Firstly, we *ensured collective exhaustiveness* by conducting a review of the IS literature specifically for the period from January 2013 until April 2016. Secondly, we *ensured collective integrity and comparability* by normalising the findings of all three literature reviews.

a) *Ensuring collective exhaustiveness*

   As Bengtsson and Ågerfalk (2011) analyse journal and conference papers for the period from January 2000 to May 2010 and Chasin (2014) covers journal papers for the period from January 2003 to January 2013, we ensure up-to-date completeness by investigating conference literature from May 2010 to April 2016 and journal literature from January 2013 to April 2016 (cf., Figure 2). Therefore, we selected the keywords represented in both previously identified literature reviews (i.e., 'sustainability' and 'sustainable') to scan the AIS Electronic Library (AIS 2016) for conference proceedings. For reviewing journal papers, we added 'IS', 'information systems', 'IT', and 'information technology' to the final search string, which was then used to query the online database SCOPUS scanning title, abstract, and keywords (cf., Appendix A for the complete search string).

   Recognising the search parameters used by Bengtsson and Ågerfalk (2011) and Chasin (2014), we focus on articles in leading journals and conferences in the IS domain, which is also in line with Rowley and Slack's (2004) suggestions. Thus, we reduced the underlying information resources to the AIS Senior Scholars' Basket of Journals (AIS 2011) as well as the proceedings of AIS associated conferences:

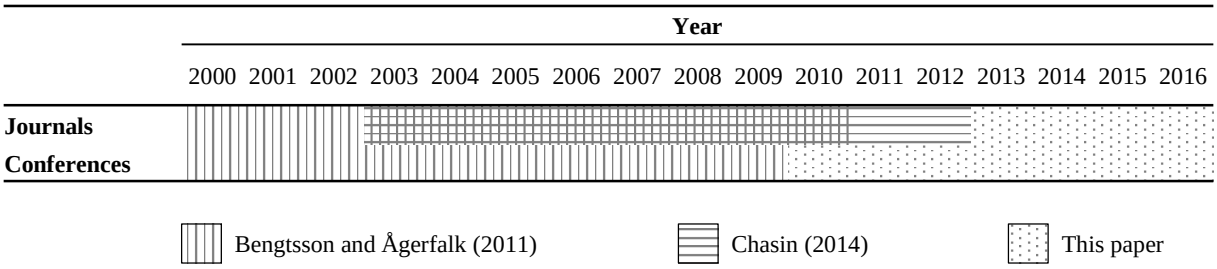

Figure 2: Covered timeframes of individual literature reviews

(J1) European Journal of Information Systems (EJIS)
(J2) Information Systems Journal (ISJ)
(J3) Information Systems Research (ISR)
(J4) Journal of AIS (JAIS)
(J5) Journal of Information Technology (JIT)
(J6) Journal of MIS (JMIS)
(J7) Journal of Strategic Information Systems (JSIS)
(J8) MIS Quarterly (MISQ)

(C1) Australasian Conferences on Information Systems (ACIS)
(C2) Americas' Conference on Information Systems (AMCIS)
(C3) European Conference on Information Systems (ECIS)
(C4) International Conference on Information Systems (ICIS)
(C5) Pacific Asia Conference on Information Systems (PACIS

b) Ensuring collective integrity and comparability

While Chasin (2014) uses the search key "sustain*" (p.343) for his search, Bengtsson and Ågerfalk (2011) apply a wider range of terms including "'green', 'sustainable', 'sustainability', 'environmental', or 'environment'" (p. 98). To ensure the integrity and comparability of all results as well as to cater for their applicability to our specific research context, a normalisation of the review findings is necessary. Therefore, we filtered Bengtsson and Ågerfalk's (2011) list of identified papers (p. 109) and Chasin (2014) review findings (p. 351) again excluding papers that did not contain 'sustainability' or 'sustainable' in their title, abstract, or keywords. This resulted in the elimination of five journal papers (cf., Berthon and Donnellan (2011), Bose and Luo (2011), Watson et al. (2011), Zhang et al. (2011), and Loock et al. (2013)) and seven conference papers (cf., Lodhia (2002), Courtney (2006), Pinto et al. (2006), Daly and Butler (2009), Hasan et al. (2009), Hedwig et al. (2009), and Sayeed and Gill (2009)).

c) Results

The normalised collection of the three literature reviews provides a good overview on research, which has been published with the proclaimed aim of addressing sustainability in IS (cf., Table 16 in the Appendix for list of journal (2014-2016) and conference (2010-2016) papers). The most important insights are highlighted in the following (cf., Figure 3).

Overall, the interest in the concept of sustainability in IS research notably picked up in the period from 2006 to 2008 when conferences (i.e., ACIS, AMCIS, and PACIS) served as initial platforms to promote the topic. With a time lag of approximately two years, the first journal papers with a declared sustainability focus were published in 2009 and 2010 (cf., Petrini and Pozzebon (2009), Melville (2010), and Watson et al. (2010)). Being still in its infancy, those publications were mainly motivated to instil new efforts for researching the role of IS in the sustainability movement. Again, it must be noted that the community perceived sustainability as an environmentally driven concept. Thus, even though adducing the triple bottom line definition of sustainability, the publications focused mainly on the environmental dimension (cf., Melville (2010) and Watson et al. (2010)).

The research activity culminated in the period from 2011 to 2013 with 48 identified conference papers and eleven identified journal papers. While the focus on environmental issues was still predominating the research stream, the number of publications regarding sustainability as an integrative concept (i.e., 12 out of 59 papers) slightly increased in both conference publications (cf., Katchuck and Port (2011), Krishnan and Teo (2011), Krishnan et al. (2011), Kurnia et al. (2012), Nishant (2012), Winkler von Mohrenfels and Klapper (2012), and Moeller et al. (2013)) and journal publications (cf., Bengtsson and Ågerfalk (2011), Dao et al. (2011), DesAutels and Berthon (2011), Elliot (2011), and Malhotra et al. (2013)).

During this period, the scholars' intention moved slowly away from its initial justificatory position, demonstrating the validity of sustainability research in the IS domain, towards more progressive sub-streams analysing the design (cf., Seidel et al. (2013)), implementation (cf., Elliot (2011)), and organisational impact (cf., Nishant (2012)) of appropriate IS (Malhotra et al. 2013). As this development took mainly place under the umbrella term of 'Green IS', it is a matter of fact that the focus of the sub-streams largely remained on IS supported environmental sustainability. However, papers that adopted the holistic view of sustainability tended to address the integrative concept in greater depth than ever before (cf., Dao et al. (2011), Katchuck and Port (2011), Krishnan and Teo (2011), and

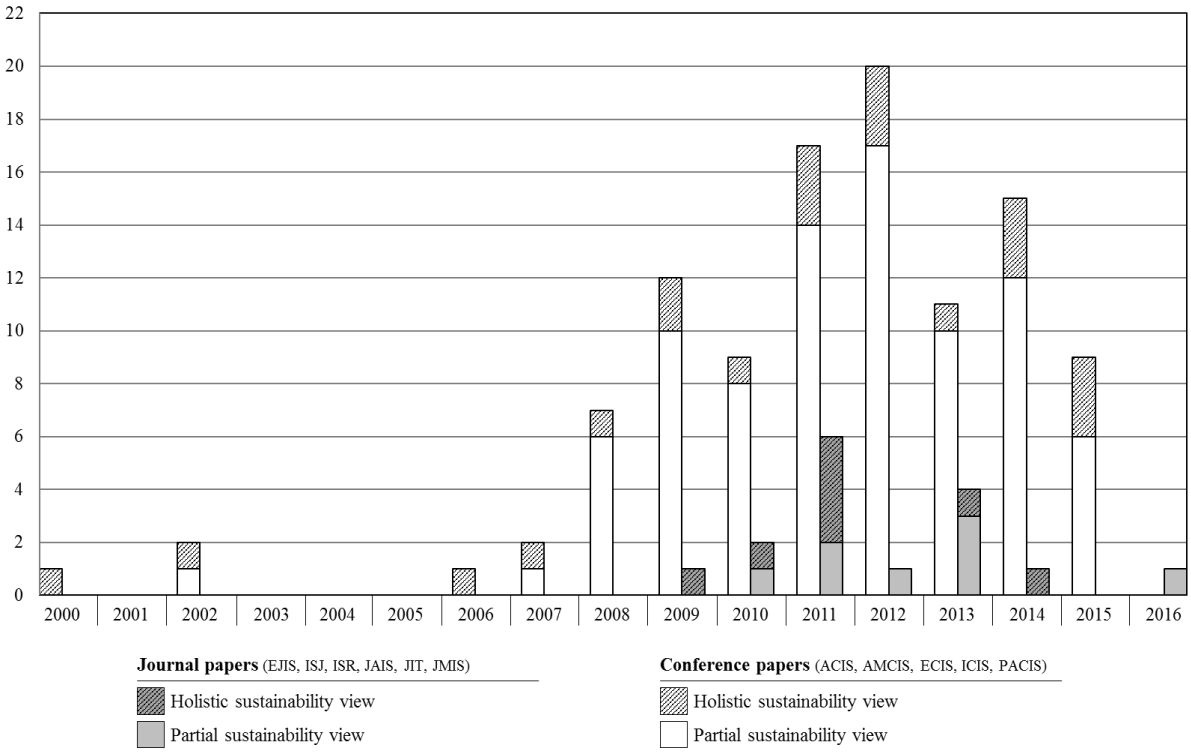

Figure 3: Overview of literature review

Moeller et al. (2013)). Yet, the comprehensive view on sustainability remained to be underrepresented in IS research during this period.

For the post 2013 period, the situation changed noticeably. While the identified number of conference papers (i.e., 24) shows decent ongoing interest of academia in the topic of sustainability in IS, the journal publications decreased to only one identified contribution in 2014 (cf., Henfridsson and Lind (2014)) and one identified contribution in 2016 (cf., Hedman and Henningsson (2016)). Out of the 24 conference papers, six applied the holistic view of sustainability but investigated the concept in different depths and on different levels of analysis (i.e., individual, organisational, and societal). For instance, Chung et al. (2014) use the individual level of analysis to propose a design concept for sustainable social shopping systems. Even though they consider all three pillars of sustainability, they do not investigate any complex interdependencies between them. A similar situation witnessed in the work of Sutherland and Hovorka (2014), Abraham and Mohan (2015), and Ziemba (2015), who all recognise the holistic view of sustainability but, due to their research focus, remain rather on the surface of the complex construct. Granath and Axelsson (2014) and Heales et al. (2015) stand out from the identified papers as the former explicitly evaluate trade-off situations that emerge due to conflicting sustainability dimensions on a societal level, and

the latter investigate potential situations, where one sustainability dimension has a reinforcing effect on other dimensions on a conceptual level.

With regard to the quantitative appearance of the individual dimensions, the *environmental pillar* is by far the most represented one, with only three papers (i.e., approximately 2%) not considering environmental aspects (cf., Kanungo (2002), Jeffers and Joseph (2009), and Thöni et al. (2014)). The majority of the publications can be summarised under the research streams of 'Green IT' or 'Green IS' and cover topics, as for instance, eco-efficient IT lifecycle management or IS-enabled organisational change towards more sustainable work practices respectively. The *economic pillar* is oftentimes investigated in conjunction with the environmental dimension reflecting its role to justify investments in sustainable IS (Bengtsson and Ågerfalk 2011). The major underlying motivation of these papers is to investigate mutually reinforcing factors, as for instance, the acquisition of a competitive advantage through environmental initiatives (cf., Seidel et al. (2014)). The *social pillar* is comparatively underrepresented in IS literature. Less than 30% of all identified papers addressing sustainability in IS elaborated on this dimension. A possible explanation is provided by Bengtsson and Ågerfalk (2011) who assume that the technology-driven viewpoint of IS scholars (i.e., technical artefacts are the main cause for sustainable – beneficial as well as harmful – effects) leads to a lack of social considerations in sustainable IS research.

With the social dimension being the limiting factor, the holistic and thus by far more complex concept of sustainability remains mostly unexplored. From a joint literature review perspective, out of 122 identified sustainability papers in the IS domain only 29 (i.e., less than 25%) have been identified as research addressing the holistic sustainability view. Furthermore, the level (i.e., depth) and direction (i.e., context) among these 29 cases varies greatly. As Chasin (2014) already ascertains in his review, there exists a large number of papers demanding to adopt the holistic sustainability perspective on the one hand (cf., Malhotra et al. (2013), Melville (2010), or Elliot (2011)), and a small number of papers that actually manage to do so on the other (cf., DesAutels and Berthon (2011)). We can only speculate on possible reasons for this development. We proffer to characterise them as reasons due to a *lack of understanding* and reasons due to a *lack of interest*.

Reasons due to a *lack of understanding* mainly originate from the fuzziness and ambiguity of the definition of sustainability, which historically developed outside

the IS domain (cf., chapter 2.1). As a result, scholars who apply sustainability to the IS domain rely on varying conceptualisations and consequently include it differently in their research. Two main interpretations of sustainability have prevailed as organising principles in the IS domain: The *triple bottom line* (cf., Erek et al. (2009), Melville (2010), Katchuck and Port (2011), Kurnia et al. (2012), Moeller et al. (2013), Sutherland and Hovorka (2014), and Abraham and Mohan (2015)) and *ecological sustainability* (cf., Chen et al. (2008), Molla and Abareshi (2011), Nanath and Pillai (2012), Granath and Axelsson (2014), Ziemba (2015), and Hedman and Henningsson (2016)). The former conveys a renowned tendency to overly focus on the economic aspect while defining the environment as the key externality (Magee et al. 2013). The latter, as already implied by the prefix 'ecological', represents the environmental aspect of sustainability and directs the remaining dimensions (i.e., economic and social) to fully serve the eco-goals by applying eco-efficient, eco-effective, or eco-equity strategies. Both aforementioned evaluations of the main conceptualisations explain why the lack of a complete understanding of the definition resulted in a strong focus on environmental and economic aspects in the IS domain.

The second explanation that we suggest links to the case where the involved stakeholders (i.e., practitioners or researchers) are aware of the holistic sustainability view but still largely ignore the social perspective. This *lack of interest* originates from the perceived type and complexity of the interdependencies between the three pillars. One major, if not the most prevalent, stream in the IS domain centres around the *business value of IT*, which unmistakably relates to the economic aspect of sustainability. Consequently, endeavours to integrate sustainability in IS are thus oftentimes driven by the question of economic benefits gained through environmental sustainability initiatives. As a matter of fact, the interdependencies between these two pillars are commonly perceived by the community as beneficially reinforcing. In contrast, the interdependencies between the economic or environmental and social pillars are not well researched and oftentimes perceived as complex and contradicting. This expounds why social aspects of sustainability have been of minor interest to practitioners and scholars so far.

Our literature review illustrates an existing research gap in the area of sustainability in information systems which also resonates well with the findings of Bengtsson and Ågerfalk (2011) and Chasin (2014). The developments in the Green IT/ IS research streams shall not be disparaged; to the contrary, they have provided many important insights in how IS can support organisations becoming more environmentally efficient

and effective and what must be considered to capitalise on the benefits. However, it is also "important not to confuse environmentalism with sustainability [as green initiatives do] not automatically imply a more sustainable economic and social outcome" (Bengtsson and Ågerfalk 2011, p. 99).

Consequently, in our paper we particularly apply the holistic sustainability view and contribute a theory on unsustainable Green IS to substantiate the actual relevance of this perspective. Hereby, we build a bridge between existing research in Green IT/ IS and the so far limited body of knowledge which we deliberately call 'Sustainable IS' (cf., Table 16 in the Appendix). We explicitly address both the *lack of understanding*, by illustrating how the focus on one pillar can lead to conflicting organisational outcomes, and the *lack of interest*, by explaining why disregarding the comprehensive sustainability perspective can exert negative impacts on the overall long-term success of the Green IS.

2.3 Affordance Theory

The IS concept of *functional affordances* (Markus and Silver 2008) is based on the findings of the ecological psychologist James Gibson, who, for the first time, coined the term 'affordance' in 1979. Initially referring to the "complementarity of the animal and the environment" (Gibson 1979, p. 129), he invented the term to conceptualise the meaning or value of things to animals and human beings and shed light onto the underlying value shaping and perception processes.

The kernel observation made by Gibson reflects upon the value of an object perceived by human beings or animals to be driven by its affordance and not by its physical characteristics. In turn, he defines an affordance to be something which is offered, provided, or furnished to an individual (both human and animal) by any object (Gibson 1986). Taking other refining and consensus forming contributions into consideration (cf., Michaels (2000), Hutchby (2001), Chemero (2003), and Stoffregen (2003)), the following four implications are regarded as constituent properties for the development of IS affordance theory (cf., Seidel et al. (2013) and Strong et al. (2014)) introduced in chapter 2.4:

a) *Affordances are functional and relational*
   Though already inherent in Gibson's theory from 1979, Hutchby (2001) is very specific on the difference of the functional and relational nature of an affordance. From the *functional perspective*, affordances offer a finite number of possible utilities. This assumption inherently defines affordances to be either enabling or constraining (Chemero 2003). In other words, in a certain environment an artifact

can convey a certain number of functional affordances to an individual while it simultaneously limits the possibility space for other actions.

From the *relational perspective*, an affordance varies from one individual to the other (Hutchby 2001). A very bold but illustrative example would be a urinal that does not have the same affordance to women as it has to men. Stoffregen (2003) elaborates on that specificity characterising affordances to be "relational (i.e., emergent) properties of the animal-environment system" (Stoffregen 2003, p. 123), which "exist only at the level of the animal-environment system" (Stoffregen 2003, p. 124). Thus, the affordance is independent of both individual or environment and only emerges as a relational feature.

b) *Affordances are opportunities for action*

As already mentioned in the previous paragraph, affordances should be interpreted as possibilities for action (Chemero 2003). They do not have to be realised or even perceived by an individual to exist as an affordance. Thus, an object carries a finite set of affordances, which is reduced to an individually *perceived* subset of affordances (i.e., opportunity space). Based on his/ her intention, the actor can then *realise* one or more affordances available in his/ her perceived opportunity space. This transition, which Hutchby (2001) calls 'manifestation', marks the frontier between the perceived opportunity space and realised actions. Stoffregen (2003) relates to it as 'behaviour', which he defines to happen "at the conjunction of complementary affordances and intentions or goals" (Stoffregen 2003, p. 125).

c) *Affordance realisation is actor and goal dependent*

The concept of 'intention' reveals that the affordance realisation or manifestation is heavily dependent on the actor and his/ her goals. Thus, the perceived opportunity space mentioned before will differ from individual to individual depending on their distinct goals and intentions. In turn, this property also entails that the majority of potential opportunities is ignored by the individual as they do not complement his/ her current intentions (Stoffregen 2003). Besides intentions, another relevant aspect addresses the actor's abilities, which define whether he/ she is able to perceive and utilise the offered functional affordance (Chemero 2003). If, for instance, an individual never saw someone else using a flint stone before, he/ she is not aware of the stone's affordance to ignite a fire.

d) *Affordances are learnable*

The previous example illustrates that affordances must be perceived before they can be actualised. This property also implies that an affordance is learnable and

can consist of multiple sub-affordances, whose perception unfolds consecutively while the individual interacts with the object (Chemero 2003). This can be demonstrated with the more progressive example of a flint stone, the lighter. Imagine an individual, who has never experienced a lighter before. Still, the round shape and the deliberate installation of the friction wheel on top of the lighter might potentially be perceived by the individual as an opportunity to spin. Note, that at this point in time the affordance of igniting a fire is not yet perceived by the individual. As a matter of the physical material properties of the friction wheel and the flint inside, the spin – even though not intended – causes a spark, which eventually ignites the propane gas streaming out of the lighter. This cause and effect is perceived and remembered by the individual. The next time he/ she will see a lighter, the affordance of igniting a fire will be immediately recalled.

2.4 Affordance Theory in Information Systems Research

Affordances, as conceptualised in the field of ecological psychology, are considered by many IS scholars to be a powerful instrument to analyse the impact of IT artifacts on individuals and organisations (cf., Zammuto et al. (2007), Markus and Silver (2008), Leonardi (2011), Seidel et al. (2013), Volkoff and Strong (2013), and Strong et al. (2014)).

Being some of the first IS scholars applying the theory, Zammuto et al. (2007) use "*affordances for organizing* as a bridging concept that emerges from the intersection of IT systems and organization systems" (Zammuto et al. 2007, p. 752). Similar to Markus and Silver (2008), they have realised that the goal-oriented but non-deterministic actualisation of affordances and its fundamental 'individual-object relationship' (i.e., 'animal-environment system' (Gibson 1979)) is a fully applicable and highly diagnostic concept for researching effects of IT artifacts on organisations.

The former two research groups contribute theoretical findings to the IS body of knowledge by introducing the concept of affordances from ecological psychology. Leonardi (2011) extends this view and explores organisational change, induced through flexible routines and flexible technologies, by applying the "*metaphor of imbrication* […] for explaining the interweaving of human and material agencies" (Leonardi 2011, p. 151). He construes affordances to act as a catalyst for imbrication of the two agencies named before, which eventually create or change organisational routines. To be more specific, Leonardi (2011) observes that perceived *enabling* affordances oftentimes result in changed organisational routines, while perceived *constraining* affordances frequently

lead to the adaptation of the technology. Please note, we deliberately use the words ‘oftentimes’ and ‘frequently’ to prevent conveying the impression of a fully deterministic causality between affordances and changed organisational routines or constraints and changed technologies. Beyond doubt, cases exist where the perception of a constraining IS functionality led to changed organisational routines instead of an adapted IS.

Even though Zammuto et al. (2007), Markus and Silver (2008), and Leonardi (2011) have a large share in establishing affordance theory in the field of IS, Volkoff and Strong (2013) have contributed another major development by extending the level of analysis from individual to organisational. Therefore, on the *actor side* they explicitly distinguish between an individual, an individual representing an organisational role (incl. organisational goals), and a group of individuals (i.e., organisation). On the *technology side*, they distinguish between simple and complex (i.e., multi-component) artifacts. Consequently, affordances emerging from the relation between complex artifacts and actors fulfilling organisational roles or groups of actors are referred to as “organizational affordances” (Volkoff and Strong 2013, p. 829). This extension enhances the explanatory power of the IS affordance theory allowing scholars to also consider the organisational level and more complex IT artifacts simultaneously. In their 2014 work, they propose several other extensions to the traditional affordance theory (Strong et al. 2014) of which three of them are highlighted particularly, as we refer to them in the development of our conceptual framework (cf., chapter 3.2).

The *first extension* introduces the “affordance-actualization lens” (Strong et al. 2014, p. 78), which specifically distinguishes between affordances (i.e., opportunities for action) and actualisations (i.e., realised actions). This separation enables IS scholars to research IT-driven organisational change processes in greater detail. The *second extension* to traditional affordance theories comprises the parallel consideration of single-level and multi-level analysis, which permits scholars to identify and investigate organisational affordances. Therefore, the authors adduce the literature of collective constructs to capture the interdependent emergence of individual outcomes and organisational effects (Kozlowski and Klein 2000; Burton-Jones and Gallivan 2007). The second extension adds three measures (i.e., consistency, extent, and alignment) to the theory, which specify the relationship between realised individual immediate outcomes and the overall organisational development (e.g., how well does a realised individual outcome contribute to the overall organisational goals?). The *last extension* theorises the complex reinforcing or inhibiting interdependencies among collections of affordances. It enables a more sophisticated explanation of co-existing or unfolding affordances in an organisational context and can be represented by dynamic dependency diagrams (Strong et al. 2014, p. 76). Such diagrams are depicting interacting affordances of two dependency

types: Cascades (i.e., one actualised affordance triggers the actualisation of another affordance) or feedback loops (i.e., one actualised affordance reinforces or inhibits the repeated actualisation of a previous affordance).

In general, we consider Strong et al.'s (2014) extended theory to be an appropriate kernel theory for our conceptual framework, as it provides a thorough and comprehensive framework for explaining IS-driven organisational change: Firstly, IS affordance theories do not convey any excessive focus on either technology or organisational structures but provide a balanced and integrative view on the socio-technical system by assuming the actor-system relationship as fundamental for the emergence of affordances. Secondly, it addresses both the individual and organisational level of analysis, which we require in our framework to explain long-term feedback mechanisms. And thirdly, the concept of interacting affordances provides us with the necessary level of dynamism and dependency mechanisms in order to analyse the complex bundles of functional affordances that are proposed in literature for the development of Green IS (Recker 2016b) (cf., chapter 2.5).

Our theoretical analysis of the concept and the summary of its most important applications in the IS domain demonstrate the applicability and appropriateness of IS affordance theory for our research endeavour. The theory and its identified core principles provide a high level of explanatory power, which allows us to dissect the impact of Green IS on individuals and organisations and use these findings to demonstrate the unsustainable face of Green IS by revealing potentially conflicting sustainability outcomes.

2.5 Design Theory for Green Information Systems

To date, design research in the field of Green IS is sparse (Malhotra et al. 2013). The majority of existing work is mainly focusing on substantive research contributions identifying highly context-dependent design requirements for specialised types of Green IS. We recognise Recker's (2016b) Green IS design theory to extend this substantive body of knowledge by providing an abstract-level theory, which aims at merging all other so far documented requirements of specific Green IS types. Based on those requirements, the author deduces necessary functional affordances (cf., chapter 2.3 for detailed definition of functional affordances), exemplary material properties, and corresponding suitable symbolic expressions of Green IS and structures them along an adapted version of the *Belief-Action-Outcome* (B-A-O) framework offered by Melville (2010). The framework conceptualises sustainable organisational behaviour (i.e., the *outcome*) to result from *belief* and *action* formation on micro (i.e., individual) and macro (i.e., organisational) levels. In the following, we shortly introduce the rationales behind the B-

A-O levels and their corresponding functional affordances, which form the building blocks in Recker's (2016b) Green IS design theory.

The *Belief formation* comprises the development of psychic states with regard to the ecological environment, as for example, beliefs, desires, and opportunities (Melville 2010). In terms of functional affordances, IS should support the belief formation with, for instance, *sensemaking or attitude reflection affordances*, which eventually create environmental sustainability awareness among employees (Recker 2016b). The process of transforming psychic states to environmentally conserving actions is conceptualised as *Action formation* (Melville 2010). In turn, IS should support this process by offering, for example, *delocalisation affordances* allowing the user to carry out daily business in a virtual manner (Recker 2016b). Finally, Melville (2010) captures the consequences of realised actions in the *outcome* construct. Here, Recker (2016b) slightly adapts the original model. Instead of conceptualising the outcome as the functioning of organisations (Melville 2010), he proffers to split the outcome (i.e., environmentally sustainable functioning) into environmentally sustainable work practices and environmentally sustainable decisions. In turn, functional affordances should support the user in assessing the environmental impact of these practices and decisions by offering *reflective monitoring and evaluation functionality* (Recker 2016b).

We strongly support the categorisation of the affordances alongside the *scopes of operation* (i.e., B-A-O) and use this part of the design theory to define the material properties of the IS artifact and their corresponding Green IS affordances in our framework model. However, we pay less attention to the *levels of operation* (i.e., micro and macro), as we find our understanding of organisational (i.e., macro level) affordances better supported by Strong et al.'s (2014) conceptualisation interpreting them as a collective construct, which emerges from aggregated results of multiple individual (i.e., micro level) affordance realisations.

3 Theory Development

This chapter forms the main part of our thesis. It introduces the reader to our theory of unsustainable IS. After clarifying the purpose and the boundaries of the theory (cf., chapter 3.1), the reader is introduced to our conceptual framework (cf., chapter 3.2) theorising the impact of Green IS (i.e., interaction between IS artifact and user) on the user and the organisation. Being so far a general concept framework, we subsequently instantiate it with two sustainable outcome conflicts (cf., chapter 3.3). Based on the thought experiment's findings, we are then able to deduce a set of hypotheses, which we use for our theory operationalisation in chapter 4.

3.1 Purpose and Leading Assumptions

We set out to provide a theory of unsustainable Green IS, which explains how, why, and when the implementations of Green IS result in conflicting sustainability outcomes. We furthermore theorise how conflicting sustainability outcomes will eventually affect the user and the IS artifact in the short and long-term. The purpose of this theory is to highlight shortcomings of existing Green IS research and thereby stimulate a minor course correction of current Green IS research. To invite future scholars to empirically validate our theory, we provide enactments of our conceptual framework in form of two operationalised research models (Briel and Recker 2016). Applying Gregor's (2006) taxonomy of theory types in IS research we classify our theory to be a *type IV theory for explaining and predicting* (Gregor 2006, p. 626).

Certain contextual and conceptual assumptions apply signifying the boundaries of our theory (cf., Rivard (2014)). *Contextually*, we restrict our investigations to IS that assist "individuals, organizations, governments, and society to transform towards environmental sustainability" (Recker 2016b, p. 4474). Though the level of analysis is mainly concerned with the interaction of individual (i.e., user) and object (i.e., IS artifact), we include the organisational level in order to be able to reflect long-term dynamism in terms of organisational feedback loops. Thus, our theory is supposed to be applicable in any organisational context independent of its *raison d'être* (e.g., industry, business model, or company vision) as long as the organisation is composed of human individuals, who use IS to support environmental sustainability initiatives.

Conceptually, we adopt affordance theory as kernel theory to explain organisational change. This comes with a set of assumptions, which link to the properties of affordances discussed in chapter 2.3. Firstly, we assume affordance perceptions and realisations to emerge from the relationship between an individual (i.e., user) and an object (i.e., IS

artifact). Please note, that we understand affordances to exist independently inside any object. This spans an object-related opportunity space of possible affordance actualisations, which the interacting individual can then realise based on his/ her intention. Secondly, we assume that all individuals can potentially perceive the affordance, meaning we reduce the setting to an extent that the only sources for an emerging affordance are the artifact and the user. Thirdly, as mentioned already in the previous paragraph, our framework implies the dynamic adaptability of user goals and learning of new abilities over time, which brings us to the fourth and last conceptual assumption being fundamental to our framework validity. We assume the individual to be a conscientiously working employee, who compares his/ her immediate individual result of an actualised affordance against his/ her own goals, which derive from organisational goals. Otherwise, our conceptualisation of the long-term feedback dynamism would not hold.

3.2 Framework

Our conceptual framework integrates the affordance-actualisation framework by Strong et al. (2014) and the design theory for Green IS by Recker (2016b) (cf., Figure 4). The former provides a sound procedural framework to explain *how* a Green IS impacts an organisation and its collective individuals in the short and long-term. The latter is an abstract-level conceptualisation proposing *what* affordances an ideal Green IS should provide. Thus, our integrative framework provides the necessary explanatory power to derive two research models that we consider appropriate for empirically testing our hypotheses addressing the research questions framed in the beginning. We continue and conceptualise the major constructs of our framework and provide explanations for relevant relationships among them (cf., Rivard (2014)).

3.2.1 Construct Development

This chapter introduces the constituent constructs of our conceptual framework. Where applicable, first and second-order constructs are separated from each other and described individually. While this chapter describes what our framework is comprised of, chapter 3.2.2 explains how some of these constructs feedback to each other. The framework draws on and merges multiple existing theories, of which the two kernel theories are explained in chapter 2.4 (i.e., affordance theory) and chapter 2.5 (i.e., Green IS design theory).

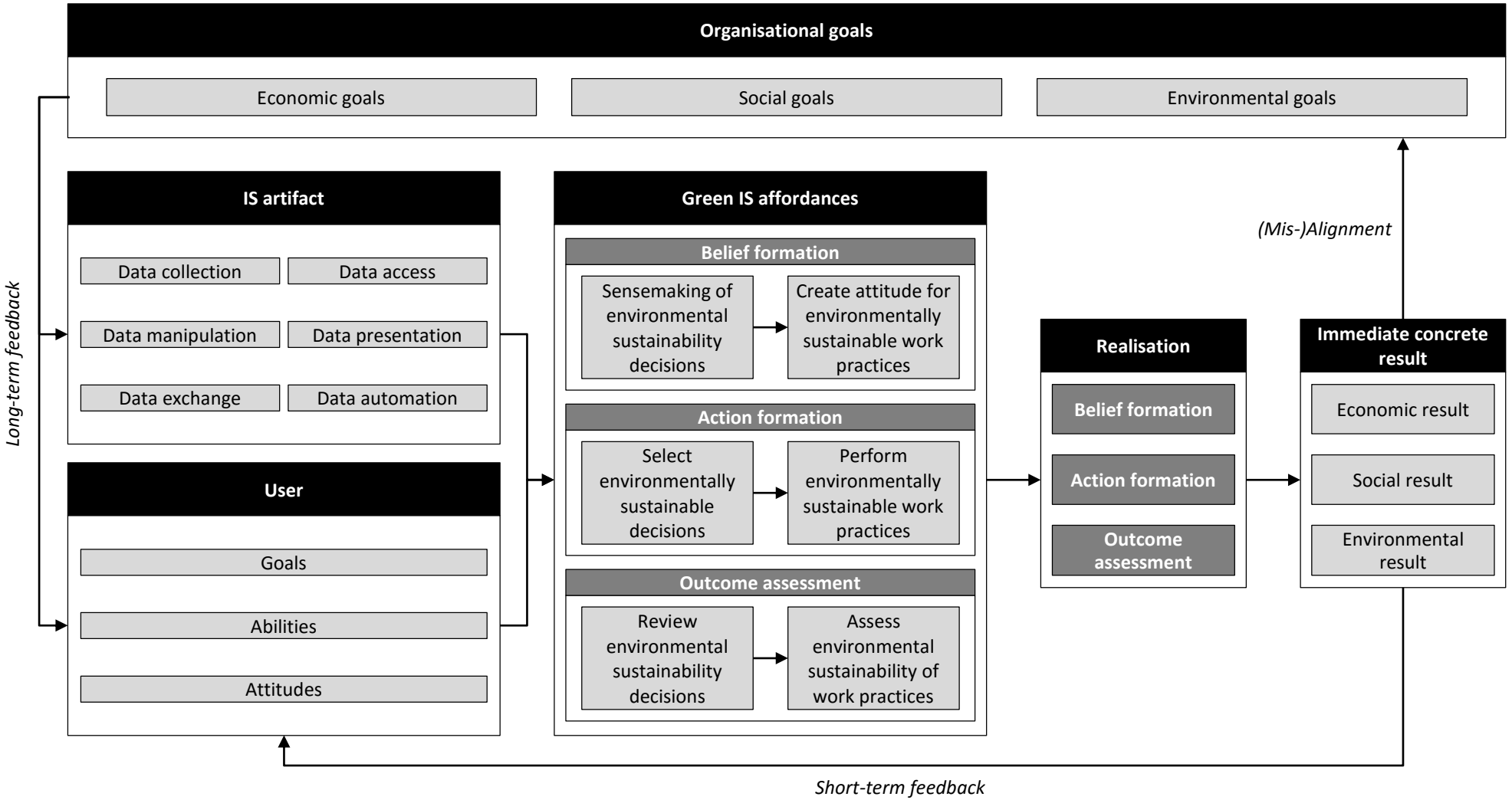

Figure 4: Conceptual framework

3.2.1.1 IS Artifact

We define IS artifacts to be manufactured technical objects (Hutchby 2001) possessing perceivable material properties (Seidel et al. 2013) that eventually provide individuals with the opportunity (i.e., affordance) to perform goal-directed actions. We are particularly interested in opportunities to perform environmentally sustainable work practices and decisions (Recker 2016b). In our framework, we identify six different, yet combinable, material properties (i.e., functionality) necessary to offer the majority of Green IS affordances framed in existing Green IS literature (cf., Seidel et al. (2013) and Recker (2016b)): *(a) Data collection*, *(b) Data access*, *(c) Data manipulation*, *(d) Data presentation*, *(e) Data exchange*, and *(f) Data automation*. To facilitate the easy differentiation to functional affordances, we descend to the data level to opt for a rather technical and neutral definition of material properties. This further implies that the actual Green IS affordance only emerges once the material property is perceived by the user to be supportive in achieving environmental sustainability goals.

a) Data collection

This material property enables all processes concerned with the acquisition and storage of data in the IS. It features both the manual and automated collection of data. Manual instantiations of this material property comprise, for instance, (un-) structured data entry functionality, like a commentary functionality in a 'green' company wiki. Automated instantiations of data collection features include, for instance, the automated collection of carbon emission data (e.g., from a supply chain planning software), which is used for a carbon emission system dashboard afterwards (cf., *data automation* material property).

b) Data access

The foregoing material property usually comes with the feature of persistent database storage. This is fundamental to the *data access* functionality that enables the retrieval of data, which can be temporally and spatially independent to its original creation process (cf., *data collection* material property). Exemplary manual instantiations comprise, for instance, the retrieval of previously stored comments in the 'green' company wiki or more complex database queries executed in the carbon emission tracking system in order to display historic emission data. An automated example is the data interface between two individual systems that do not share the same underlying database (e.g., electronic data interchange (EDI)).

Second-order construct	First-order construct	Definition	Traditional IS examples	Green IS examples
IS artifact	Data collection	Features (un-) structured acquisition and storage of data	- Office suites - ERP transaction logs	- Commentary function in 'green' company wiki
	Data access	Features time and spatial independent retrieval of data	- Enterprise wiki - EDI	- Carbon emission tracking
	Data manipulation	Features processing of data (i.e., updating, deleting, and interrelating)	- Office suites - OLAP	- Carbon emission tracking
	Data presentation	Features display of data and information (i.e., video, audio, or text)	- Office suites - Video, audio, text editing software	- 'Green' newsletter - Decision tree
	Data exchange	Features exchange of data and information between users and systems	- Instant messaging	- Video conferencing - Online collaboration
	Data automation	Features automation of processes	- Workflow engine	- Printer configuration

Table 1: Conceptualisation of the *IS artifact* construct

c) Data manipulation

Once stored data has been retrieved from the system, *Data manipulation* functionality offers the possibility to process it in terms of updating, deleting, or interrelating. Usually, this process transforms raw data into relevant information, which is of more value to the user (i.e., context-dependent). Exemplary artifacts with manual *data manipulation* material properties are data analysis tools that support, for instance, time series analyses (e.g., dashboard in carbon emission tracking systems). Automated *data manipulation* functionality comprises for instance an automatically generated monthly report based on defined templates.

d) Data presentation

All previously introduced functionalities are usually combined with a *data presentation* material property ensuring the proper display of data and information to the user. It allows for sophisticated editing of information to make it more easily accessible for the user (e.g., 'green' newsletter). This material property includes

functionality to present information in form of video, audio, or text. Manual examples of this material properties group with other properties, as for instance, text editing properties (e.g., office suites), which come along with *data manipulation* functionality (cf., previous paragraph). Automated instantiations comprise, for instance, pop-up windows providing the user with instant feedback on executed actions (e.g., information on saved carbon emissions).

e) Data exchange

So far, the discussed material properties cover features that are mainly used by a single user only. Still, an important feature provided by IS is the electronic exchange of data and information linking several users and subsystems. This property supports the interaction and coordination in terms of communication as well as file and application sharing and can have strong impacts on the level of work virtualisation within an organisation. Manual instantiations of *data exchange* material properties comprise for instance text or video messaging functionality (e.g., video conferencing or online collaboration software). An exemplary automated instantiation is the automatic text reply message in case of received emails during absence of the user (e.g., email applications).

f) Data automation

All previously discussed material properties can be partially automated with the help of underlying algorithms, which in turn usually aligns with business rules. The *data automation* material property encapsulates these automated features and highlights the importance of IS in supporting individual users and groups of users to streamline their daily business in terms of effectiveness and efficiency (i.e., standardisation affordance). *Data automation* is effective when it, for instance, defines how certain business processes should be executed (e.g., workflow engine with predefined workflow processes or configured printer default settings). Further on, it is efficient when it ensures that these defined business processes are standardised in such a way that for an intended output, the least necessary input is used (e.g., printer configuration with duplex and black and white printing).

3.2.1.2 User

In our framework, we define the user to be a goal-oriented actor, who possesses abilities and attitudes that either constrain or enable him/ her to perceive and utilise material properties of an IS artifact (Markus and Silver 2008; Strong et al. 2014). We therefore identify *(a) user goals*, *(b) user attitudes*, and *(c) user abilities* as first-order constructs

that eventually define the behaviour of a user in our framework. Beyond doubt, more extensive and sophisticated conceptualisations of the user construct in IS research exist (cf., Loock et al. (2013)). Yet, the extended level of sophistication comes usually with an increased conceptual and empirical complexity. Following existing affordance-based Green IS literature (Seidel and Recker 2012; Seidel et al. 2013; Strong et al. 2014), we select the three previously named constructs to characterise the user in our framework.

a) User goals

The lexical definition outlines a *goal* to be an "end [result or achievement] toward which effort [(i.e., behaviour)] is directed" (Merriam-Webster 2016a). This end result can also be interpreted as "reference point [acting as guidance to achieve a] future desirable state" (Loock et al. 2013, p. 1318). We proffer to distinguish between *personal* and *role incumbent* (i.e., professional) *goals* as well as *organisational goals* (Strong et al. 2014). While the former two types relate to the micro (i.e., individual) level, the latter type is obviously concerned with the macro (i.e., organisational) level. In our framework, when using the concept of *user goals*, we refer to *role incumbent goals*, which emerge from the allocated professional role (e.g., *Head of Sales* or *business analyst*) and its corresponding *organisational goals*. Therefore, *role incumbent goals* are usually extrinsically imposed by the organisational context. They can either take the form of qualitative (e.g., 'every employee strives for a better environment') or quantitative statements (e.g., 'until 2020, every employee will reduce his/ her carbon dioxide emissions by 20%').

b) User attitudes

Our understanding of *attitudes* is based on the definition by the psychologist Ajzen (1991). He conceptualises an *attitude* as the "degree to which a person has a favourable or unfavourable evaluation or appraisal of the behaviour in question" (Ajzen 1991, p. 188). His theory, which has been directly and indirectly used in Green IS research (cf., Molla et al. (2011), Loock et al. (2013), or Seidel et al. (2013)), implies that an attitude has a strong influence on behavioural intentions, which in turn precede actual behaviour. For our purposes, we additionally refer to Molla et al. (2008), stating that an attitude "measures the extent to which both IT and business are aware and interested about the economical, […], environmental and social concerns related to the use of IT" (Molla et al. 2008, p. 673). Furthermore, we posit that information is the main driver to effect an attitude and, in turn, behavioural change (Bhattacherjee and Sanford 2006).

Second-order construct	First-order construct	Definition	Examples
User	User goals	End results or reference points toward which effort (i.e., behaviour) is directed	- *Qualitative*: 'Every employee strives for a better environment' - *Quantitative*: 'Until 2020, every employee will reduce his/ her carbon dioxide emissions by 20%'
	User attitudes	Degree to which a person has a (un-) favourable evaluation or appraisal of the behaviour in question	- Positive stance that influences the selection of a company car with lower carbon dioxide emissions
	User abilities	Physical or mental power or skill to perceive and utilise the functional affordance	- Perceiving the Windows key as affordance to open the start menu - Utilising the default settings functionality to introduce duplex printing standards in the company

Table 2: Conceptualisation of the *User* construct

c) User abilities

In our context we define *abilities* as "the physical or mental power or skill" (Cambridge Dictionaries Online 2016) to perceive and utilise the functional IS affordance. Thus, whether a user perceives and utilises the material properties of the artifact depends not only on his/ her goals but also on his/ her *abilities*, which act as either enabling or constraining factors in the affordance-actualisation process (Recker 2016b). Further, it should be noted that an *ability* is a normative construct, which is not guaranteed to become actualised (Chemero 2003). It is normative in that sense that individuals with certain *abilities* are expected to correctly actualise them and thereby function in a particular way. As individuals occasionally fail to behave accordingly, abilities should not be understood as a deterministic construct. Instead, we consider them to be dynamic implying that they can be learned by the individual while interacting with the IS artifact (Grgecic et al. 2015).

3.2.1.3 Green IS Affordances

The most common definition of affordances in the IT literature understands 'functional affordances' as "the possibilities for goal-oriented action afforded to specified user groups by technical objects" (Markus and Silver 2008, p. 622). As already mentioned in chapter 2.3, affordances emerge when an individual perceives and interprets *material properties* available in an IS. Thus, the actualisation of an affordance involves three drivers: *Symbolic expressions*, *user abilities*, and *user goals* (Markus and Silver 2008). Our understandings of *material properties* as well as *user abilities* and *goals* are described in the previous chapters 3.2.1.1 and 3.2.1.2. This chapter provides information on Green IS affordances conceptualising them as a collection of class-specific (i.e., Green IS) functional affordances. Therefore, we will rely on the abstract-level Green IS architecture proposed by Recker (2016b) in order to define *what* the idealised Green IS in our framework should consist of.

While Recker (2016b) distinguishes the architecture into principles of form (i.e., combination of material properties and symbolic expressions) and function (i.e., functional affordances), we will primarily draw upon the principles of function to specify the Green IS affordances in our framework. We are less interested in investigating the influence of combinatorial instantiations of material properties and symbolic expressions (i.e., principles of form) but aim to provide an explanatory conceptual framework that centres around the generic definition of Green IS functional affordances (i.e., principles of function). Furthermore, as we already draw upon Strong et al.'s (2014) affordance-actualisation theory and the included concept of collective constructs to address IS-driven change on organisational (i.e., macro) level (cf., chapter 2.4), we will exclude Recker's (2016b) distinction between micro and macro level affordances from our conceptual framework.

To summarise, we define *Green IS affordances* in our framework to be the idealised collection of environmentally relevant functional affordances (cf., first paragraph of this chapter for a detailed definition of functional affordances) that perform "belief formation about environmental sustainability, action formation for environmental sustainability, and outcome assessment of environmental sustainability" (Recker 2016b, p. 4477). We therefore identify *(a) Belief formation affordances*, *(b) Action formation affordances*, and *(c) Outcome assessment affordances* as second order constructs that constitute Green IS affordances. In the following we elaborate on each of these three functions separately.

Second-order construct	First-order construct	Definition	Examples
Green IS affordances	Belief formation affordances	IS provided possibilities for action enabling the user to *make sense* of environmental sustainability *decisions* and *create attitude* for environmentally sustainable *work practices*	- *For decisions*: Internal community platform for information democratisation - *For work practices*: Internal company newsletter for attitude reflection
	Action formation affordances	IS provided possibilities for action enabling the user to *select* environmentally sustainable *decisions* and *perform* environmentally sustainable *work practices*	- *For decisions*: Scenario planning software for decision support - *For work practices*: Video conferencing software for work virtualisation
	Outcome assessment affordances	IS provided possibilities for action enabling the user to *review* environmental sustainability *decisions* and *assess* environmental sustainability of *work practices*	- *For decisions*: Management dashboard or report for decision review - *For work practices*: Navigation system with real-time feedback on current performance

Table 3: Conceptualisation of the *Green IS affordances* construct

a) Belief formation affordances

According to Melville's (2010) B-A-O framework, *belief formation* describes "how psychic states (beliefs, desires, opportunities, etc.) about the natural environment are formed" (Melville 2010, p. 6). In order to facilitate this process, an Green IS should offer two central functional affordances: Firstly, it must allow the user to *make sense of potential environmental sustainability decisions* (Recker 2016b) by offering, for instance, information democratisation affordances (e.g., 'green' social network) (Seidel et al. 2013). Secondly, it must facilitate an *attitude creation for environmentally sustainable work practices* by affording, for instance, attitude reflection functionality (e.g., 'green' newsletter) (Recker 2016b). In sum, IS facilitated information availability and propagation is crucial in the process of forming an attitude towards a certain issue (Dumont and Franjeska-Nicole 2008).

b) Action formation affordances

Action formation describes the process "how psychic states about the natural environment translate to actions" (Melville 2010, p. 6). Green IS can support this process by offering two functional affordances: Firstly, they should support the individual in *selecting environmentally sustainable decisions*. This can be, for instance, achieved through any decision support engine allowing for live decision review (e.g., scenario planning software) (Recker 2016b). Secondly, they should enable the user to directly *enact environmentally sustainable work practices*. For example, any software that provides work virtualisation possibilities is considered to contain *action formation affordances* as they offer possibilities to immediately act in an environmentally sustainable manner (e.g., video conferencing software) (Recker 2016b).

c) Outcome assessment affordances

In Melville's (2010) work, an *outcome* is understood as the social and organisational impact of sustainability actions. For the purpose of his design theory, Recker (2016b) proposes that a Green IS should, at this stage, provide support through reflective disclosure and monitoring features that enable the user to *review or monitor the outcomes of any environmental sustainability decision or action*. A typical example for enabling the review of environmental sustainability decisions is reflected in a management dashboard or monthly report that aggregates and presents key performance indicators. An example for an IS that affords the assessment of environmental sustainable work practices is, for instance, a navigation system providing feedback on the current performance in real time while the actual work practice is conducted (Seidel et al. 2013).

3.2.1.4 Realisation

As the name already implies, the affordance-actualisation theory by Strong et al. (2014) distinguishes between *affordances*, defined as potentials for action, and *actualisations*, defined as realised potentials. This distinction caters for the non-deterministic nature of affordances, which posits that a perceived affordance must not always be realised by the user (Recker 2016b). Other, previously described, factors (i.e., user abilities, user attitudes, and user goals) have a strong influence on the actualisation process. We include this distinction in our conceptual framework as well. In order to avoid shared denotations with the B-A-O framework, whose double meanings might lead to confusion of the reader, we deliberately adapt Strong et al.'s (2014) original denotation of the *'Action'* construct and use *'Realisation'* in our framework instead.

Using the lexical definition of *realising* (i.e., "to bring something into concrete existence" (Merriam-Webster 2016b)) as starting point, we proceed in accordance with Strong et al.'s (2014, p. 70) definition of an actualisation and define the *realisation* construct in our framework as the user's act of purposefully manifesting (i.e., bringing into concrete existence) one or more affordances using the material properties of the IS artifact in order to achieve an anticipated immediate concrete result (cf., chapter 3.2.1.5 for definition of an immediate concrete result), which is in support of certain organisational goals. Upholding the B-A-O structure from the previous chapter, we continue with the conceptualisation of the second order constructs *realisation of belief formation affordances*, *realisation of action formation affordances*, and *realisation of outcome assessment affordances*.

a) *Realisation of belief formation affordances*
   With the *belief formation affordances* defined as IS provided possibilities for action enabling the user to *make sense* of environmental sustainability *decisions* and *create attitude* for environmentally sustainable *work practices*, we conceptualise the *realisation* of those as the goal-directed interaction between a user and the IS artifact in order to *make sense* of environmental sustainability *decisions* and *inform* about environmentally sustainable *work practices*. Referring to the alleged examples from the previous chapter, a user, who actively (i.e., read and write) participates in a 'green' social network provided by a company, or a user, who reads the company's 'green' newsletter, is realising *belief formation affordances*.

b) *Realisation of action formation affordances*
   The same logic between affordance and actualisation holds true in this construct definition. Therefore, we conceptualise the *realisation* of the *action formation affordances* as goal-directed interaction between a user and the IS artifact to *select* environmentally sustainable *decisions* and *perform* environmentally sustainable *work practices*. Exemplary cases comprise for instance the application of the scenario planning functionality of a decision support system in order to select the most appropriate decision or a meeting that is held via video conferencing software.

c) *Realisation of outcome assessment affordances*
   Again the logic between affordances, as defined in the previous chapter, and actualisation applies. Thus, we conceptualise the *realisation* of the *outcome assessment affordances* as the goal-directed interaction between a user and the IS artifact to *review* environmental sustainability *decisions* and *assess* environmental

Second-order construct	First-order construct	Definition	Examples
Realisation	Realisation of belief formation affordances	Goal-directed interaction between user and IS artifact to *make sense* of environmental sustainability *decisions* and *inform* about environmentally sustainable *work practices*	- *For decisions*: User participates (i.e., read and write) in online community - *For work practices*: User reads internal company newsletter
	Realisation of action formation affordances	Goal-directed interaction between user and IS artifact to *select* environmentally sustainable *decisions* and *perform* environmentally sustainable *work practices*	- *For decisions*: User applies IS supported scenario planning for decision support - *For work practices*: User holds video conference
	Realisation of outcome assessment affordances	Goal-directed interaction between user and IS artifact to *review* environmental sustainability *decisions* and *assess* environmental sustainability of *work practices*	- *For decisions*: User visits management dashboard to review decision results - *For work practices*: User assesses CO_2 emission reductions with help of real-time feedback from navigation system

Table 4: Conceptualisation of the *Realisation* construct

sustainability of *work practices*. Examples comprise the active consultation of a management dashboard to review the outcomes of a decision or the real-time CO_2 emission feedback that an actor receives from a navigation system to directly adapt his/ her driving behaviour.

Please note the usefulness of the distinction between affordance and actualisation. It is especially valuable when investing cases, where an affordance is perceived but not realised. For instance, a user who recognises the unread newsletter waiting in his/ her inbox perceives the possibility for action (i.e., affordance) to read it. Still, he/ she might decide – influenced by factors, as for instance goals, attitudes, and abilities – not to read it and delete it instead. Thereby, the user does not actualise the affordance.

3.2.1.5 Immediate Concrete Result

Besides the *'Realisation'* construct, Strong et al.'s (2014) actualisation concept includes the *'Immediate concrete outcome'*. The risk of double meanings, in terms of shared construct denotations, between the affordance-actualisation theory (i.e., *'Immediate concrete outcome'*) and the Green IS design theory (i.e., *'Outcome assessment'*) occurs at this point again. We thus change the original denotation *'Immediate concrete outcome'* to *'Immediate concrete result'* in our framework to avoid any confusion.

Consequently, Strong et al.'s (2014) semantically adapted definition conceptualises an immediate concrete result to be "a specific expected [result] from actualisation […] that is viewed as useful for realising overarching organisational goals" (Strong et al. 2014, p. 70). Further, they additionally understand the immediate concrete result as a user-anticipated end, which induces the user to realise the associated affordance in the beginning. This means, when a user visually perceives one or more material properties of an IS artifact, he/ she – based on his/ her goals, abilities, and attitudes – perceives a certain Green IS affordance and associates a specific end result to it.

In our opinion, this definition comes with limitations: So far, Strong et al. (2014) consider the end result as *always* "expected" and "useful for realising overarching organisational goals" (Strong et al. 2014, p. 70). We suggest to adapt this proposition to make it applicable to cases, in which the immediate concrete result turns out to be *not* useful for achieving *all* overarching goals. Cases with conflicting goals are common (Melville 2010) and of special interest in this paper. To be more specific, we explicitly set out to conjecture cases with conflicting sustainability goals in terms of the comprehensive *triple bottom line* understanding (Elkington 1994). We therefore proffer to define an *immediate concrete result* in our framework as an economic, environmental, or social positive or negative consequence arising from the user's purposeful manifestation of any Green IS affordance. Being aware of the definition's high level of abstractness, we define *(1) Economic immediate concrete result*, *(2) Environmental immediate concrete result*, and (*3) Social immediate concrete result* to be the first-order components of this construct. In the following, we describe them in greater detail.

a) *Economic immediate concrete result*

   We define an *economic immediate concrete result* to be a consequence arising from a user's purposeful manifestation of any Green IS affordance, which is considered as either positive (i.e., enabling) or negative (i.e., constraining) for achieving individual's economic goals. In turn, individual economic goals derive from organisational economic goals, which are defined in chapter 3.2.1.6. A

Second-order construct	First-order construct	Definition	Examples
Immediate concrete result	Economic immediate concrete result	Consequence from a user's purposeful manifestation of any Green IS affordance, considered as positive (i.e., enabling) or negative (i.e., constraining) for achieving individual's *economic* goals	- *Positive*: Ancillary cost reduction effects due to introduction of duplex printing default settings - *Negative*: Decreased employee productivity due to inefficient Green IS workflow engine
	Environmental immediate concrete result	Consequence from a user's purposeful manifestation of any Green IS affordance, considered as positive (i.e., enabling) or negative (i.e., constraining) for achieving individual's *environmental* goals	- *Positive*: Increased awareness of environmental issues due to company newsletter - *Negative*: Deprecating environmental attitude due to flawed company newsletter
	Social immediate concrete result	Consequence from a user's purposeful manifestation of any Green IS affordance, considered as positive (i.e., enabling) or negative (i.e., constraining) for achieving individual's *social* goals	- *Positive*: Ancillary socialising effect due to company internal social networking - *Negative*: Weakening and depersonalising social bonds due to video conferencing or company wiki

Table 5: Conceptualisation of the *Immediate concrete result* construct

positive example of an economic immediate concrete result is the emergence of *ancillary cost reduction effects* caused by the realisation of output management affordances (e.g., introduction of duplex printing as default setting) (Seidel et al. 2013). Conversely, a negative case covers for instance a *decreased employee productivity* due to a flawed Green IS workflow engine (e.g., procedural inefficiencies or organisationally mismatching access rights).

b) Environmental immediate concrete result

Similarly, we define an *environmental immediate concrete result* to be a consequence arising from a user's purposeful manifestation of any Green IS affordance, which is considered as either positive (i.e., enabling) or negative (i.e.,

constraining) for achieving individual's environmental goals. To name but two, we adduce the *increased awareness of environmental issues* and *increased awareness of company's environmental performance* resulting from the realisation of belief formation affordances (e.g., active consumption of environmental newsletter information) and outcome assessment affordances (e.g., review of monthly CO_2 emissions via a management dashboard) respectively. We expect constraining examples to mainly arise from defective implementations of Green IS affordances, as for instance, a newsletter containing obviously wrong environmental information. Once detected by the user, it will eventually lead to future *decreasing attitude towards re-realising the same Green IS affordance*.

c) *Social immediate concrete result*

Lastly, we define a *social immediate concrete result* to be a consequence arising from a user's purposeful manifestation of any Green IS affordance, which is considered as either positive (i.e., enabling) or negative (i.e., constraining) for achieving individual's social goals *and* for fulfilling individual's physical and psychological needs. This immediate concrete result represents a special case among the first-order constructs. The result might not only be evaluated based on existing user goals, which have been derived from organisational goals. But it is also evaluated based on physical and psychological user needs. Meaning, even though the result is in line with the individual's social goals, it can simultaneously conflict with fundamental physical and psychological human needs (Melville 2010). A positive example of a social immediate concrete result is the *ancillary socialising effect* caused by the realisation of information democratisation affordances to create environmental awareness among the employees (e.g., company internal social networking). A negative case could show, for instance, *weakening and depersonalising social bonds* between employees as a result of an increased amount of realised work virtualisation (e.g., video conferencing or other online collaboration software).

3.2.1.6 Organisational Goal

The last construct in our framework addresses *'Organisational goals'*. We include them in order to reflect long-term impacts of the IS artifact on the user and on the artifact itself. As already defined in chapter 3.2.1.2, we understand a *goal* to be an "end [result or achievement] toward which effort is directed" (Merriam-Webster 2016a) and a "reference point [acting as guidance to achieve a] future desirable state" (Loock et al. 2013, p. 1318). Furthermore, Johnson et al. (2016) refer to an *organisational goal* to be a "general

statement of aim or purpose" (Johnson et al. 2016, p. 13), which is aligned with the overriding organisational purpose (i.e., mission). They can be qualitative and quantitative in nature.

The different level of analysis becomes obvious, as we are discussing *goals* as macro-level constructs (i.e., *organisational goals*). The *collective constructs* literature (cf., Morgeson and Hofmann (1999), Kozlowski and Klein (2000), Burton-Jones and Gallivan (2007), or Bloomfield et al. (2010)) understands an *organisation* (i.e., a *collective*) to be an "interdependent and goal-directed combination of individuals" (Morgeson and Hofmann 1999, p. 251). We therefore define an *organisational goal* to be a general statement of aim or purpose, which acts as reference point for a collective of individuals in order to achieve a collective's future desirable state. Thus, they are also seen as a common instrument to measure the current organisational performance and assess the as-is state of an organisation.

Since the 1980s, the understanding of *organisational goals* has undergone a notable shift from shareholder value (Porter 1980) to stakeholder theory (Freeman 1984; Reich 1998). While the former measures the company's performance solely against shareholder return, stakeholder theory attributes more responsibilities to additional dependent groups (i.e., stakeholders) others than only shareholders (e.g., employees, customers, or suppliers). Simultaneously to the emergence of stakeholder theory, society and governments commenced to show an increased level of awareness to organisational impacts on the environment and community (Hubbard 2009). These developments were accompanied by the emergence of new measurement systems to track organisational performance in terms of economic, environmental, and social impact (e.g., Global Reporting Initiative (2013)). As already mentioned in chapter 2.1, the three impact dimensions have been cohesively introduced by Elkington's triple bottom line in 1994. As a consequence, we reflect these three sustainability dimensions in our framework by defining them as first-order components of the *organisational goal* construct.

a) *Economic organisational goal*

   We define an *economic organisational goal* as future-directed general statement of aim or purpose, acting as reference point for a collective of individuals in order to ensure the collective's sustained economic viability. Economic viability is commonly expressed in terms of above industry-average profit margins and other growth indicators. Organisational statements of economic goals should always contain indicators that serve as measurable reference points. Typical examples of *economic organisational indicators* comprise return on investment, profit margin,

Second-order construct	First-order construct	Definition	Examples
Organisational goal	Economic organisational goal	Future-directed general statement of aim, acting as reference point for a collective of individuals to ensure the *collective's sustained economic viability*	- Increase 2016 corporate sales by at least 10% in 2017 - Reduce 2016 operating cost by at least 15% in 2017
	Environmental organisational goal	Future-directed general statement of aim, acting as reference point for a collective of individuals to ensure the *planet's sustained environmental well-being*	- Increase the share of renewable energies in the total energy consumption to at least 45% until 2020 - Reduce the total CO_2 emissions by 50% in 2017
	Social organisational goal	Future-directed general statement of aim, acting as reference point for a collective of individuals to ensure the *individuals' and global society's sustained social well-being*	- Increase 2016 employee satisfaction score by at least 2 points in 2017 - Decrease the 2016 number of employee sick days by 15% in 2017

Table 6: Conceptualisation of the *Organisational goal* construct

sales, or market share (Blackburn 2007). Compared to the other two types of goals, economic organisational indicators are fairly easy to quantify.

b) Environmental organisational goal

Similarly, we define an *environmental organisational goal* as future-directed general statement of aim or purpose, acting as reference point for a collective of individuals in order to ensure the sustained environmental well-being of our planet. A sustained environmental well-being of our planet will be achieved by restricting the organisational consumption of natural resources to a rate that (1) leaves enough resources to meet current and future needs of the society and (2) allows the "biosphere to absorb the effects of human activities" (World Commission on Environment and Development (WCED) 1987, p. 8). *Environmental organisational goals* are slightly more complicated to measure against indicators than *economic organisational goals*. Examples of

environmental organisational indicators include energy use per unit or emissions, effluent, and waste per unit (Hubbard 2009).

c) *Social organisational goal*
Lastly, we define a *social organisational goal* as future-directed general statement of aim or purpose, acting as reference point for a collective of individuals in order to ensure the social well-being of the collective's individuals and the global society. We understand an individuals' and social well-being as a state in which individual human needs (e.g., self-actualisation, esteem, safety, etc. (Maslow 1943)) and societal needs (e.g., education or community life) are met. *Social organisational goals* are the most challenging construct to measure against indicators. Examples of *social organisational indicators* comprise employee sick days, employee satisfaction score, or illiteracy rate (Blackburn 2007).

3.2.2 Relationship Types

Our framework is peculiar in terms of the different relationship types it contains. We specifically mention these different relationship types as they play a special role in answering the research questions. Firstly, it includes rather *abstract relationships* that describe the emergence of constructs based on antecedent constructs. For instance, we consider the emergence of Green IS affordances based on the relationship between IS artifact and user as an abstract relation. Please note the abstract and non-deterministic nature of this formative relationship, as we are dealing with affordances, which are by definition highly dependent on the actual form and function of the artifact and on the goals, abilities, and attitudes of the individual user.

Secondly, it includes *procedural relationships* that describe causal relationships between constructs. In this case, one construct causes another construct. For example, we understand immediate concrete results as the procedural consequence of a realised Green IS affordance. In this paper, we use the combination of abstract relationships (i.e., *IS artifact + user → Green IS affordances*) and procedural relationships (i.e., *Realisation → Immediate concreate result*) in our conceptual framework to provide reasonable hypotheses to our first research question, which investigates how Green IS can lead to conflicting sustainability outcomes.

And thirdly, we depict feedback loops in our framework that we deliberately call *feedback relationships*. For instance, a user reflects on his/ her immediate concrete result by comparing it against his/ her initial intention, which is in turn based on his/ her goals, abilities, and attitudes (Strong et al. 2014). The feedback relationships form important

concepts in our framework as we use them to explain short-term changes of user abilities and attitudes (i.e., *Immediate concrete result* → *user*) and long-term changes of the IS artifact or user (i.e., *Immediate concrete result* → *Organisational goals* → *IS artifact* or *user*). These explanations are specifically addressing the second research question.

3.3 A Theory of Unsustainable Green Information Systems

With our finalised conceptual framework, we are now able to theorise unsustainable outcomes of Green IS and their potential short and long-term impact on the individual and the organisation. This allows us to address both research questions issued in the beginning of this paper (cf., chapter 1). While chapter 3.3.1 deals with research question 1, chapter 3.3.2 focuses on research question 2.

3.3.1 How Green IS Lead to Conflicting Sustainability Outcomes

Our central statement claims that Green IS can cause conflicting sustainability outcomes. In order to substantiate this statement, we derive several exemplary results that obviously conflict between economic, social, and environmental goals. Furthermore, we then investigate possible reasons for these conflicting results by tracing them back to their antecedents using our conceptual framework presented in chapter 3.2. The findings of this thought experiment will be used to inform research question 1:

RQ 1: How do Green Information Systems lead to conflicting sustainability outcomes?

For the derivation of exemplary outcome conflicts, we draw upon Dyllick and Hockerts' (2002) criteria of corporate sustainability (i.e., eco-efficiency, eco-effectiveness, eco-equity, sufficiency, socio-efficiency, and socio-effectiveness), which rely on the triple bottom line as comprehensive sustainability perspective (Elkington 1994). They explicitly address the potentially conflicting three nexuses between the individual pillars of sustainability. Dyllick and Hockerts (2002) understand the parallel satisfaction of the six original criteria (i.e., two criteria for each nexus between the pillars) as desirable end result for managers, who target corporate sustainability. We therefore investigate four criteria, which we consider relevant for our research purposes, and negate them to reflect result states, in which the nexus between environmental sustainability and economic sustainability or environmental sustainability and social sustainability is unbalanced and thus conflicting.

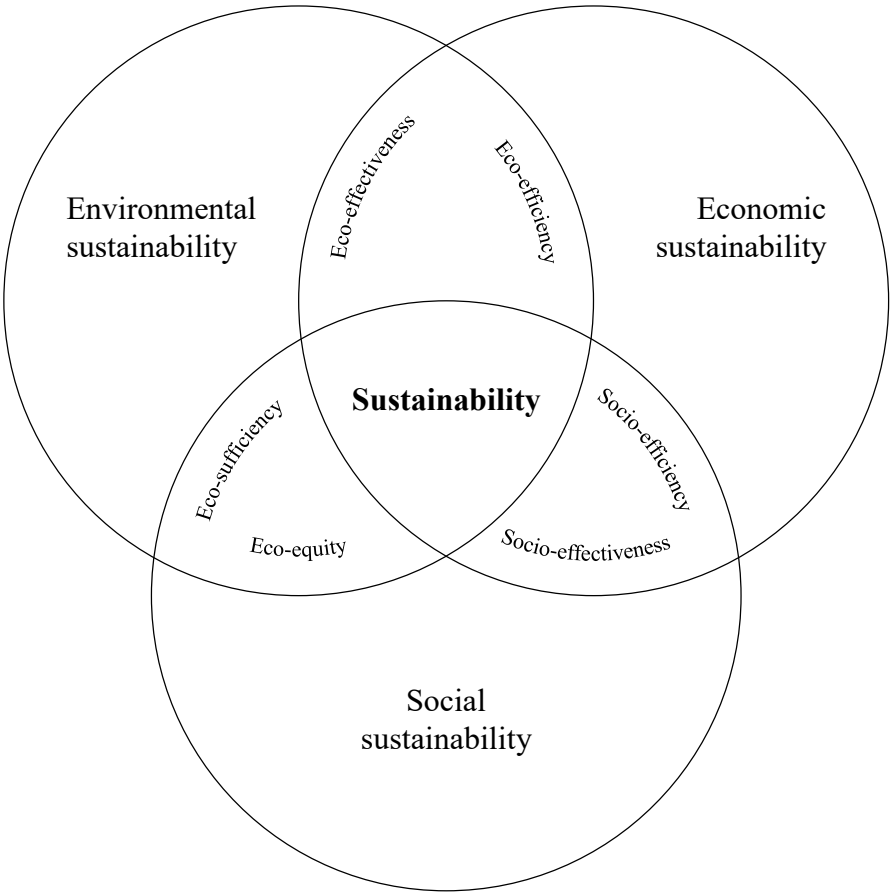

Figure 5: Extended triple bottom line (adopted from Dyllick and Hockerts (2002))

We arrive at four different conflicting sustainability outcomes: (1) *eco-inefficiency*, (2) *eco-inequity*, (3) *eco-ineffectiveness*, (4) *eco-insufficiency* (cf., Table 7). We classify results as *eco-inefficient*, if they serve environmental goals but simultaneously inhibit the achievement of economic goals (i.e., mainly due to inefficiency losses). Similarly, *eco-inequitable* results serve environmental goals but, in parallel, inhibit the achievement of social goals (e.g., due to socially harmful ancillary effects). With *eco-ineffectiveness*, we face the reversed situation. We define *eco-ineffective* results to serve economic goals while environmental goals are largely neglected. Results that serve social but no environmental goals are classified as *eco-insufficient*.

During this initial screening of negated corporate sustainability criteria, we decided to focus our forthcoming analysis on scenarios, in which IS artifacts have been implemented with the objective to support environmental sustainability initiatives. *Eco-inefficient* and *eco-inequitable* results are confirming an environmentally successful implementation of the IS artifact as they are in line with the project's intention to support organisations in improving their environmental performance. In contrast, *eco-ineffectiveness* and *eco-insufficiency* are considered as not successful implementations of the IS artifact, as they

		Conflicting sustainability outcomes			
		Eco-inefficiency	Eco-inequity	Eco-ineffectiveness	Eco-insufficiency
Results	Economic	×	-	✓	-
	Social	-	×	-	✓
	Environmental	✓	✓	×	×

Table 7: Conflicting sustainability outcomes (✓: positive; ×: negative; -: neutral)

do not achieve their initial goals to enable organisations achieving environmental sustainability. Consequently, our paper will focus on the first two outcomes, while the latter two are excluded from our investigation.

Based on these outcomes and our conceptual framework, we proceed and dive into each outcome type and provide fictitious conflicting scenarios caused by the realisation of Green IS affordances. For each scenario, we describe the progression of events and its actual conflicting outcome. We then apply our conceptual framework (cf., Figure 4) to identify underlying material properties of the involved IS artifact and theorise root causes that might provoke the conflicting outcomes.

3.3.1.1 Eco-Inefficient Outcomes

Eco-inefficient results are probably the most commonly occurring conflicts in organisational settings. This is due to the historic development of the concept of sustainability in an organisational context. The initial sustainability focus of organisations was to harmonise economic and environmental goals. Still, as organisational economic development was considered as superior precept, the ongoing debate between environmental and economic supporters resulted in an extra-ordinary high publicity for eco-inefficient conflicts (Dyllick 1999; Reinhardt 1999).

In the domain of Green IS, we instance three different affordances, which eventually lead to eco-inefficiency scenarios. We explicitly use one *belief formation*, one *action formation*, and one *outcome assessment* affordance, as discussed by Recker (2016b), to highlight the fine line between these two pillars of sustainability.

a) Eco-inefficient newsletter

Imagine a scenario, in which the user receives a weekly e-mail newsletter that presents latest news on environmental topics distinguishing (1) political (e.g.,

summary of the Paris Climate Change Conference), (2) organisational (e.g., progress report of solar panel construction site on company premises), and (3) individual level (e.g., appraisal of environmental champions of the week). Being a dutiful employee, who is interested in environmental issues, he/ she takes his/ her time to open the newsletter and studies it thoroughly.

After completion, the employee feels better informed about environmental issues. From an environmental sustainability perspective, the e-mail newsletter has achieved its intended goals. However, imagine it took the employee two hours to read through the provided information. From an economic sustainability perspective, this time is considered to be lost as it cannot be used for productive tasks aimed to achieve economic goals. These results characterise an eco-inefficient situation.

Before we can identify possible root causes of this eco-inefficiency, we apply our conceptual framework (cf., Figure 4) to structure the scenario. We classify the e-mail newsletter as *belief formation affordance* offering the user to create an attitude for environmentally sustainable work practices. Based on his/ her *goals* (e.g., creating knowledge and awareness of environmental issues), *attitudes* (e.g., caring for the environment matters), and *abilities* (e.g., making use of the e-mail application to open newsletter), he/ she interprets the material properties of the IS artifact and perceives the possibility for action (i.e., affordance). We identify the combination of *data access* (i.e., receiving newsletter information), *data presentation* (i.e., design of newsletter), and *data automation* (i.e., automatic mailing) as relevant material properties to provide the belief formation affordance. Thus, in the following we investigate the affordance-forming constructs *IS artifact* and *user* to identify possible root causes linked to their case-dependent instantiation.

We identify all three material properties to be potential hosts of root causes. *Data access* properties can lead to eco-inefficiencies due to information overload and exceeding information complexity. These two root causes are closely linked to *data presentation*, which, in case of a poor instantiation, can exacerbate them even further. A flawed presentation of information in the newsletter increases time and effort of the user to consume it and thereby causes eco-inefficiencies. The last identified material property, *data automation*, relates to the frequency of the automated mailing. Finding the right balance is key. While too high frequencies of mailings can result in eco-inefficiencies, too low frequencies fail to achieve the

Scenario name	Green IS affordance	Conflicting outcome	Root cause construct	Root cause description
Weekly 'green' newsletter	*Belief formation*: Create attitude for environmentally sustainable work practices	Increased environmental awareness *vs.* Reduced productivity	Data access and data presentation	Information overload and complexity
			Data automation	Too high mailing frequency
			User abilities	Low information processing abilities
Workflow engine for digital time and effort tracking	*Action formation*: Perform environmentally sustainable work practices	Reduced paper consumption *vs.* Reduced productivity	Data collection	Missing data entry fields
			Data automation	Inefficient and too complex process
			User abilities	Insufficient computer literacy
'Green' dashboard	*Outcome assessment*: Review environmental sustainability decisions	Increased environmental awareness *vs.* Reduced economic awareness	Data access	Only access to environmental performance data
			Data exchange	Missing interface to database with economic KPIs

Table 8: Overview of *eco-inefficiency* scenarios

newsletter's intention due to missing environmental impact on the belief formation level.

Root causes do not only emerge from a flawed IS artifacts but also lurk in user characteristics. In this scenario, we identify *user abilities* to (1) handle the e-mail application and (2) consume a certain amount of information with a certain level of complexity as key for an eco-efficient realisation of the newsletter affordance. If these abilities are not given, the realisation can easily result in eco-inefficiency due to excessive time required by the user to read the newsletter.

b) Eco-inefficient workflow engine

This scenario is set within a company that implemented a workflow system to transform its controlling department towards a paperless office in order to decrease the carbon footprint and increase the operational performance of the department. While the implementation is considered successful in the controlling department, employees from other business units, who are using the online forms

to track their time and effort, are complaining about the inefficient underlying workflow and inappropriate online forms. In comparison to the previously paper-based process, the new process seems cumbersome requiring more time and effort. Thus, obviously the transformation achieved the aspired environmental goals at the expense of economic performance of other business units, rendering the new workflow engine eco-inefficient.

Based on our conceptual framework, we identify the workflow engine to act on the *action formation* level enabling the user to perform environmentally sustainable work practices (i.e., paperless office). In this case, we are facing two role incumbent types of actors (i.e., employees in the controlling department and employees in the remaining business units). This implies two different realisation journeys through our framework. As controlling employees perceive the offered artifact properties of the new system as supportive allowing them to conduct their daily business routines in an economically and environmentally more efficient manner (i.e., eco-efficient), we will focus our investigation on the other group of employees. Based on their different organisational role (i.e., different *goals*, *attitudes*, and *abilities*), they possess a different intention to use the system (i.e., for time and effort tracking purposes) and thus perceive and realise the material properties differently. In this case, we understand *data collection* (i.e., tracking of time and effort), *data manipulation* (i.e., correcting potential errors), *data exchange* (i.e., persisting work performance), and *data automation* (i.e., underlying automated workflow process) as most relevant material properties, which, in combination, can be perceived as affordances by the user groups.

In our imaginary scenario, we identify one root cause lurking within the *data collection* property, as the employees complain about missing data fields in the online forms. Initial user confusion and subsequent unofficial workarounds result in an increased amount of time and therefore in eco-inefficiencies. In combination with a time-inefficient and complex automated process (i.e., *data automation*), which cannot be easily adapted ad-hoc by the user, the whole workflow engine fails to produce eco-efficient results for the employees outside the controlling department. An additional possible root cause, outside the IS artifact, is the limited *user ability* to appropriate the new system, commonly denoted as ‘insufficient computer literacy’. This inhibits the user to execute the paperless time and effort tracking process as fast as the former paper-based one.

c) Eco-inefficient dashboard

The last eco-inefficient scenario is depicting a case, in which a manager is consulting a management dashboard supporting him/ her in tracking current environmental performance indicators. Initially, the Green IS implementation is considered to be a success, as the dashboard provides the manager with the previously requested and defined environmental indicators. No issues concerning a time-consuming and inefficient realisation process are raised and it seems that the provided information is presented in an appropriate manner as well. After a while, the manager utters concerns that the 'green' dashboard is not providing him/ her with a sufficiently holistic perspective on the company. He/ she is missing integrated information based on economic and environmental indicators simultaneously. As the realisation of the outcome assessment affordance results in an environmentally well-informed user but inhibits the integrated reflection of economic performance, we call this dashboard eco-inefficient.

The dashboard offers an *outcome assessment* affordance. Based on the managerial role and associated *goals* and responsibilities, he/ she perceives the material properties offered by the IS artifact (i.e., dashboard) as affordance to keep track of organisational developments in the field of environmental sustainability. In this case, we identify *data access* (i.e., retrieving dashboard information), *data manipulation* (i.e., data analysis operations, as for instance, roll-up or pivot), *data presentation* (i.e., visualisation of information), and *data automation* (i.e., underlying calculations based on business rules) as relevant material properties to provide the dashboard artifact in a concerted effort.

Despite the fact that the dashboard is initially perceived as a successful implementation by the manager, we have identified a deficient *data access* and missing *data exchange* property to be the central root causes, which render the IS artifact eco-inefficient. The dashboard only provides environmental data and inhibits the user to gain a holistic perspective on the company.

When evaluating our eco-inefficient scenarios, it becomes prevalent that the root causes to these conflicting outcomes either lurk within (1) the *IS artifact* or (2) the involved *user*. The *IS artifact* and its involved material properties reveal two possible types of root causes: Either, a relevant Green IS material property is *missing* (cf., the missing *data exchange* property to economic performance database) or an existing material property is *deficient* (cf., the inefficient data automation property leading to the flawed time and effort tracking workflow). Both types result in a system feature that is either *inhibiting economically favoured realisations* required to achieve comprehensive sustainability

outcomes or *facilitating economically unfavoured realisations* that is causing eco-inefficient outcomes. Therefore, we state:

> *H1a: Missing or deficient IS artifact material properties are positively associated with eco-inefficient sustainability outcomes.*

The second host of potential root causes is the *user*. Based on our definition, a user possesses *goals*, *abilities*, and *attitudes* that either constrain or enable him/ her to perceive and utilise material properties of an IS artifact (Markus and Silver 2008; Strong et al. 2014). While *goals* and *attitudes* mainly influence whether a Green IS affordance is realised at all, we define inappropriate user *abilities* to cause conflicting sustainability results (cf., missing *abilities* to consume complex newsletter information).

> *H1b: Missing user abilities are positively associated with eco-inefficient sustainability outcomes.*

We furthermore understand *user goals* as moderating variable that can exacerbate the conflicting sustainability result (cf., time and effort tracking that must be carried out due to legal restrictions despite an eco-inefficient workflow engine):

> *H1c: The effects of missing or deficient IS artifact material properties and missing user abilities on eco-inefficient sustainability outcomes will be positively moderated by user goals that enforce the utilisation of the IS artifact.*

3.3.1.2 Eco-Inequitable Outcomes

Eco-inequity scenarios depict cases, in which the results can be considered environmentally sustainable but either inhibit the improvement of social sustainability or even harm existing social sustainability standards. These scenarios are less frequently discussed than eco-inefficient scenarios. This is mainly due to three reasons: Firstly, among the three sustainability pillars, social sustainability is the least defined and well-understood concept. Secondly, due to the historic development of the sustainability concept, social sustainability is perceived to be the least important sustainability pillar. And thirdly, social sustainability is the most challenging sustainability pillar in terms of measurement and management.

Transferring the eco-inequity concept to the domain of Green IS, we describe three different affordances, which eventually lead to eco-inequitable scenarios. Again, we

select one *belief formation*, one *action formation*, and one *outcome assessment* affordance and rely on system example discussed by Recker (2016b).

a) *Eco-inequitable social networking*

Imagine a company introducing an internal social networking system to "democratize sustainability information as well as critical environmental decisions amongst employees" (Recker 2016b, p. 4476). It allows environmental sustainability information to disseminate quickly throughout the organisation and provides employees the opportunity to actively participate in the discussion and opinion-forming process. Initially, the social networking platform seems to be a success. Employee participation in the forum picks up and the online discussions and polls result in fruitful resolutions. After a while, employees raise concerns about the corporate spirit, which suffered from heated discussions on topics like waste separation or replacing parts of the car park with bicycle stands. It turns out that the new unregulated social networking system provides a platform for the two opposing parties (i.e., the 'tree-huggers' and the 'global warming conspirators') to openly fight for their position, which sometimes ends in personal allegations. As a result, through the social networking system user feel well-informed and empowered about environmental issues going on within the organisation. Simultaneously, they face growing aversion of opposing colleagues resulting in mistrust and discomfort within the organisational context. We call this case inequitable.

Based on our conceptual framework, we classify this case to act on the *belief formation* level. The new social networking system offers possibilities for sensemaking and attitude creation of environmental sustainability decisions and work practices. Furthermore, we define the social networking platform to combine *data collection* (i.e., commenting), *data access* (i.e., reading), *data manipulation* (i.e., voting), *data presentation* (i.e., comment editing), and *data exchange* (i.e., online forum) material properties in order to provide the information democratisation affordance to the user. Whether the affordance is realised or not, is, in this case, heavily dependent on the user's *attitudes* and communication *abilities*. As this fictitious case shows, in the long-term mainly users with the two radically opposing opinions (i.e., *attitudes*) continued to actively engage on this platform.

We identified two root causes, leading to this eco-inequitable result. Firstly, the hostile situation mainly unfolds in an uncontrolled manner, as no anonymous reporting functionality (i.e., *data collection*) exist, where users could report

Scenario name	Green IS affordance	Conflicting outcome	Root cause construct	Root cause description
'Green' social networking	*Belief formation*: Sensemaking of environmental sustainability decisions	Increased environmental awareness and participation *vs.* Personal allegations and offenses	Data collection	No anonymous reporting functionality
			User goals	No user with dedicated goals to moderate and administrate the forum
Video conferencing	*Action formation*: Perform environmentally sustainable work practices	Reduced carbon emissions *vs.* Reduced face-to-face interaction and social isolation	Data collection	Limited media richness of video and audio capturing
			Data exchange	Time lags inhibit immediate feedback
			User goals	Misguiding policies for video conferencing usage
'Green' appraisal system	*Outcome assessment*: Assess environmental sustainability work practices	Increased environmental awareness and participation *vs.* Data privacy concerns	Data collection	Data privacy infringements due to monitoring practices
			Data access	Data privacy infringements due to disclosure practices

Table 9: Overview of *eco-inequitable* scenarios

unethical or abusive online behaviour. Secondly, despite affordances for moderating and administrating the discussion forums, no user possesses these dedicated *goals* (e.g., ensure social and ethical user behaviour on the social networking platform) to realise these affordances.

b) Eco-inequitable video conferencing

This case is about a large multi-national corporation who introduces video conferencing as substitution for face-to-face conference meetings. The implementation of the conferencing system is accompanied by policies enforcing the utilisation for internal meetings in order to reduce the carbon emission footprint of the corporation. Within this fictitious setting, the introduction of the video conferencing IS is reasonable, as many employees were previously travelling by plane or car to company subsidiaries. The initial results in terms of CO_2 savings (i.e., *environmental* goal) and cost reductions (i.e., *economic* goal) are impressive and also employees express their gratitude, as the new conferencing system relieved them from stressful business travels (i.e., *social*

goal). After a while, the positive employee feedback vanishes and critical statements occur instead. The concerns mainly focus on declining social integration and organisational community feeling. Employees feel isolated and miss social interaction. Thus, the video conferencing system results in reduced carbon emissions but also stimulates social bonds between employees to loosen. This situation can thus be classified as eco-inequitable.

We classify the system features involved in this case to act on the *action formation* level. The video conferencing system allows the user to perform his/ her daily business (i.e., meetings) in an environmentally sustainable manner. We understand a video conferencing system to largely rely on *data collection* (i.e., capturing video and audio data), *data access* (i.e., retrieving video and audio data), and *data exchange* (i.e., transmitting video and audio data between conference participants) material properties. Furthermore, the user is guided by new *goals* (i.e., in terms of policies) enforcing the utilisation of the new Green IS.

Based on this case decomposition in its main constituents, we identify two possible root causes that provoke the situation to turn out eco-inequitable. Firstly, we are dealing with the seminal media richness theory by Daft and Lengel (1986) claiming that "communication media vary in the capacity to process rich information" (Daft and Lengel 1986, p. 560). Even though video conferencing is considered to be the second richest medium, it cannot fully compensate face-to-face communication regarding possibilities for immediate feedback, cues and communication channels, and personalisation. Here, the material properties *data collection* and *data exchange* represent the limiting factor and thus classify as first root cause. While video and audio recording functionality (i.e., *data collection*) can never fully capture reality in terms of fidelity of gestures, facial expressions, intonations, and – most importantly – physical presence, transmission functionality (i.e., *data exchange*) imposes limitations in terms of immediate feedback due to slight time lags. Secondly, we identify inappropriate user *goals* as second root cause for the emergence of an eco-inequitable result. It seems, that the implemented policies on organisational level lead to an excessive use of work virtualisation throwing the social interaction between employees out of balance.

c) Eco-inequitable appraisal system

Imagine a company, which introduces a new appraisal system to champion the 'green' employee of the month. Therefore, it calculates the carbon footprint of each employee by automatically capturing, for instance, paper and power consumption per workstation, means of transportation, and ordered lunch meals

at the company canteen. The detailed footprint and employee ranking are always visible online on the internal sustainability platform in real-time. What initially was considered as smart idea by top management to boost the new digital sustainability initiative, quickly turns out to cause turmoil among a large share of employees. Even though some of the complaining employees feel supported by the tracking system in acting more environmentally sustainable, the automated individual monitoring as well as the new level of transparency caused by the real-time employee ranking eventually results in a declining overall customer satisfaction due to emerging data privacy concerns. In short, an eco-inequitable result.

We classify the appraisal system to act on both *outcome assessment* level and *belief formation* level. In this case, we focus on the outcome assessment affordances as we understand the resulting eco-inequity conflict to emerge on this level. To be able to provide the affordance, the system combines features of *data collection* (i.e., automated tracking of employee behaviour), *data automation* (i.e., automated calculation of carbon emission footprint), *data access* (i.e., retrieving current rankings), and *data manipulation* (i.e., drilling down into own or colleagues' activity streams). Depending on his/ her *goals*, *abilities*, and *attitudes*, a user interacts with the system in different ways. While some users are only interested in their own environmental performance, others try to improve their current performance by learning from colleagues.

Analysing this scenario, we identify two possible root causes to this eco-inequity. Firstly, the standards of *data collection* seem to interfere with the employees' value system in terms of data privacy. Employees feel monitored and screened by the organisation. For instance, recording data like paper and power consumption can be possibly used to backtrack employee activity and performance. Secondly, displaying the activity stream and the associated carbon footprint online, where it can be accessed by any other employee of the organisation, is further adding to data privacy concerns in terms of private data disclosure. We therefore identify *data access* properties of the appraisal system as second root cause.

Similar to the eco-inefficient scenarios (cf., chapter 3.3.1.1), the root causes lurk within either (1) the *IS artifact* or (2) the involved *user*. Again, we are talking about *missing* (cf., missing anonymous reporting functionality to report abusive or unethical online behaviour) or *deficient* (cf., slow data transmission causes time lags in video conferencing) Green IS material properties, causing a flawed artifact. These flawed

system features are either *inhibiting socially favoured* or *facilitating socially unfavoured realisations* causing eco-inequitable outcomes. Therefore:

> *H1d: Missing or deficient IS artifact material properties are positively associated with eco-inequitable sustainability outcomes.*

Compared with eco-inefficient scenarios, we cannot identify any root cause located in the *user abilities* that might lead to eco-inequitable results. We thus do not propose any connection between these two constructs. Instead, we account for *user goals* as externally moderating variable again (cf., policies for video conferencing system):

> *H1e: The effects of missing or deficient IS artifact material properties on eco-inequitable sustainability outcomes will be positively moderated by user goals that enforce the realisation of the IS artifact.*

3.3.2 How Conflicting Sustainability Outcomes Affect the User and the IS Artifact

So far, we understand the immediate concrete result as the end product of an affordance realisation process. This signifies one iteration of our conceptual framework from left to right (i.e., *IS artifact + user → Green IS affordance → Realisation → Immediate concrete result*) (cf., Figure 4). While it allows us to hypothesise conflicting sustainability results as an outside observer, the isolated existence of a conflicting result does not exert any impact on the individual or IS artifact yet. As we are also interested in the impact of conflicting sustainability results, we draw upon our feedback relationships introduced in chapter 3.2.2 to suggest short and long-term effects. Insights of this chapter will be used to inform research question 2:

RQ 2: How do Green IS induced conflicting sustainability outcomes affect the user and the IS artifact in the short and long-term?

3.3.2.1 Short-Term Impact

Similarly to Strong et al. (2014), we use the short-term feedback loop to account for individual reflective mechanisms as, for instance, changing user abilities (i.e., individual learning) or changing user attitudes. These reflective mechanisms resonate well with the concept of *experience*, which is an extensively discussed variable in seminal TAM

literature (Ajzen 1991; Davis 1993; Venkatesh and Morris 2000; Venkatesh et al. 2003). When a user realises a functional affordance he/ she – consciously or subconsciously – reflects on the *immediate concrete result* by comparing it with the *initially expected result* (i.e., intention formed by goals, attitudes, and abilities). This comparison considers the actual outcome as well as the underlying realisation process (e.g., required time, effort, or complexity) (Strong et al. 2014). We understand reflective mechanisms as short-term feedback (i.e., within seconds up to a week) as they occur in the direct aftermath of the affordance realisation.

The actual feedback can take different shapes in terms of form and magnitude. On the one hand, it is formed by *realisation enabling mechanisms* leading to the learning of habitual routines. We understand them as reinforcing mechanisms that foster the individual's affordance-actualisation journey. On the other hand, *realisation restricting mechanisms* are feedback forms that either lead to (1) adjustments of the realisation process (e.g., trial and error) or to (2) the future rejection of the realised system affordance (Strong et al. 2014). The actual form and magnitude of the feedback mechanism is significantly depending on the user's goals, attitudes, and abilities. With these contingency factors in mind, we discuss possible short-term mechanisms for each of the conflicting sustainability results introduced in chapter 3.3.1. An overview can be found in Table 10.

a) Eco-inefficient results

Eco-inefficient results often lead to the rejection of the afforded Green IS features in the short-term, if no external factor exist which enforces the Green IS utilisation (e.g., policies). For instance, the eco-inefficient *newsletter* is too frequently overloading the user with complex information, causing inefficiencies in information consumption. Depending on the user, the very first reflection on the affordance realisation will either lead to the immediate rejection of the affordance (e.g., the user has strong conflicting *goals* or a general low environmental *attitude*) or result in a more moderate (i.e., decreasing) change of attitude without an immediate rejection. The rejection itself is expressed as immediate deletion of future newsletters without prior reading. Projecting this adjusted behaviour onto the three dimensional sustainability perspective shows a potential return to the status-quo of the economic performance prior to the introduction of the newsletter. Simultaneously, the environmental impact of the belief formation affordance decreases again as the adapted user behaviour (i.e., deletion of the newsletter) prevents any further creation of environmental awareness.

In the *'green' dashboard* scenario, the user, who is relying on the dashboard to review environmental sustainability decisions, does not fully reject the affordance. Due to the priority of his/ her goals, he/ she rather spends time on consulting the economic performance dashboard instead. Here, the affordance realisation process illustrates well the underlying resource (i.e., time) problem that is leading to the partial rejection of the new dashboard: When reflecting on the immediate concrete result, the user is not fully satisfied with the system as integrative information on economic and environmental performance indicators is missing. As the incumbent organisational role (e.g., manager) expects him/ her to make decisions that ultimately ensure the economic sustainability of the organisation, the benefits of the 'green' dashboard seem to be limited to him/ her. These insights are then reflected in the adapted user behaviour favouring the utilisation of the economic dashboard. From a bottom line perspective, the adapted user behaviour has no major impact on economic and social performance but negatively impacts the environmental sensemaking of organisational behaviour.

The case of the eco-inefficient *workflow engine* is different due to the mandatory duty to track time and effort. As the new system completely replaces the previous paper-based process and other alternatives do not exist, users cannot simply reject the inefficient workflow system. Consequently, as users are compelled to utilise the system, they develop a declining attitude towards its usage and towards environmental issues in general. The result of the unadapted user behaviour can again be depicted from a bottom line perspective: While the economic performance of the employee continues to be impaired by the new system, the paper consumption is further reduced. Social performance is not noticeably affected.

Analysing the eco-inefficient scenarios, we observe a recurring scheme in the short-term feedback mechanism. When considering all three first-order constructs of the user, eco-inefficient immediate concrete outcomes (1) do not directly affect individual user *goals*, (2) affect individual *abilities* in terms of learning, and (3) affect individual *attitudes* in the short-term. The impact on user *attitudes* is heavily depending on the initial user's intention and the immediate concrete result. If the immediate concrete outcome (i.e., considering all three sustainability dimensions) is fully in favour with the user's initial intention (i.e., expectations), the feedback increases the attitude towards reusing the affordance. In case, negative side effects (i.e., economic impairments) occur, the user's attitude towards the reutilisation of the Green IS extenuates in the short-term. We propose:

Conflicting outcome		Expected changes in user attitude		Expected short-term user behaviour	Short-term impact on sustainability		
Conflict type	**Scenario**	**Tendency**	**Description**	**Description**	**Economic**	**Social**	**Environ-mental**
Eco-Inefficiency	Weekly 'green' newsletter	▼	Information overload, complexity, and high frequency of newsletter lead to rejecting user attitude	User rejects affordance by deleting newsletter without prior reading	▲	►	▼
	Workflow engine	▼	Inefficient workflow process and flawed input forms lead to decreasing user attitude	User continues usage due to mandatory time and effort tracking and absence of feasible alternatives	▼	►	▲
	'Green' dashboard	▼	Missing integration of environmental and economic data lead to decreasing user attitude	Priority of organisational goals causes user to focus on economic dashboard	►	►	▼
Eco-Inequity	'Green' social networking	▼	Personal allegations and offenses lead to rejecting user attitude	User rejects affordance by refraining from further participation in online democratisation process	►	▼	▼
	Video conferencing	▼	Reduced face-to-face interaction and social isolation lead to decreasing user attitude	User continues usage due to organisational policies; quality and effectiveness of video conferences decreases (e.g., impaired decision-making process)	▼	▼	▲
	'Green' appraisal system	▼	Data privacy concerns lead to rejecting user attitude towards overall 'green' sustainability initiative	User rejects appraisal system and complains about data privacy infringements; overall employee satisfaction decreases	►	▼	▼

Table 10: Overview of *short-term impact* of conflicting sustainability outcomes (▲: increasing; ▼: decreasing; ►: constant)

H2a: In the short-term, eco-inefficient sustainability outcomes are positively associated with a decreasing user attitude towards the utilisation of the IS artifact.

b) Eco-inequitable results

Similar to eco-inefficient results, also eco-inequitable results do usually lead to the full rejection of the new affordance, if no external factor is enforcing its realisation. Especially realisations accompanied by side effects that negatively impact the user on a physical or mental level should immediately result in user rejection. This can be observed in the eco-inequitable 'green' social network and 'green' appraisal system scenarios (cf., chapter 3.3.1.2).

After a successful period in the beginning, the *'green' social network* transformed towards an unregulated platform allowing for personal allegations and offenses. Consequently, user participating in the online discussions might perceive an increased environmental awareness and individual empowerment. However, they also feel personally offended by colleagues. Depending on their individual characteristics, in the short-term users will either (1) fight back with personal allegations (i.e., exacerbating the negative social impact of the system), (2) immediately refrain from future system usage (i.e., reducing the environmental impact of the system), or (3) realise the affordance a couple of more times before finally rejecting it (i.e., reducing the environmental impact of the system). We expect the second and third case to predominate the reflective mechanism and thus expect the short-term user behaviour to mainly decrease the environmental impact of the 'green' social network. Major changes in economic impacts are neglectable in this case.

The *'green' appraisal system* seems to be a promising digital innovation to promote environmental behaviour throughout the organisation. Unfortunately, most of the employees perceive the underlying monitoring features to transgress data privacy boundaries. Thus, even though the actual affordance of tracking one's own environmental performance might be considered as a helpful and technically sophisticated feature, users still understand the necessary prerequisites as personal infringements. In this case, the end does not justify the means. Consequently, this reflective mechanism leads to the rejection of the monitoring feature in the short term. Even further, employees actively seek to end the collection of data on individual level. Overall, the employee satisfaction decreases.

The case of the in-equitable *video conferencing* system is special due the existing organisational policies imposing the substitution of physical work practices with

the help of work virtualisation affordances. Furthermore, the actual negative social impacts of the system are comparably subtle, as the involved mental side effects are hardly attributable on individual but rather on group (i.e., interpersonal) level. Such effects comprise mainly a decreasing social and interpersonal quality level of video conferencing. They are, for instance, expressed in unnecessary delays of decision-making processes and emerging trust issues. In this case, we understand the reflective mechanism as sub-conscious process. Therefore, an ongoing *undifferentiated* utilisation of video conferencing affordances exerts negative impacts on the social and potentially also on the economic bottom line, as important decisions might be deferred. We deliberately use the adjective '*undifferentiated'* as we claim that a *differentiated* application of work virtualisation affordances (e.g., consideration of pre-existing interpersonal relationships) must not result in socially or economically harmful work practices.

Similar to eco-inefficient outcomes, we see that eco-inequitable immediate concrete outcomes (1) do not directly affect individual user *goals*, (2) affect individual *abilities* in terms of learning, and (3) affect individual *attitudes*. In the short-term, negative social side effects (c.f., reduced face-to-face interaction and social isolation in the video conferencing case) affect the user's attitude towards the reutilisation of the Green IS in a negative way. On average, we expect a weaker short-term impact of eco-inequitable sustainability outcomes on the user's attitude than of eco-inefficient sustainability outcomes (cf., previous paragraph). However, we state:

H2b: In the short-term, eco-inequitable sustainability outcomes are positively associated with a decreasing user attitude towards the utilisation of the IS artifact.

3.3.2.2 Long-Term Impact

In the previous chapter, we identify possible short-term impacts on users' attitudes via individual reflective mechanisms. However, theoretical contributions (cf., Molla (2008), Molla and Abareshi (2011), Schmidt and Kolbe (2011), Cooper and Molla (2014), or Recker (2016a)) as well as longitudinal case studies (cf., Seidel et al. (2014) and Hedman and Henningsson (2016)) in the Green IS domain identify organisational context factors (e.g., size, industry, and environmental strategies) as important long-term moderators when explaining the adoption and appropriation of Green IS

We assume organisational goals to reflect relevant organisational context factors (e.g., a mid-sized company is expected to develop different economic and environmental goals

than a multinational corporation). Furthermore, we conceptualise them as facilitating construct in our framework to describe organisational reflective mechanisms allowing us to investigate long-term impacts of conflicting sustainability outcomes. The organisational reflective mechanism can be understood as organisational counterpart to the individual reflective mechanism introduced in the previous chapter. While users compare the immediate concrete result with their initial intention, companies (i.e., represented by managers) do so by comparing organisational level outcomes with organisational goals. We refer to insights from the collective constructs literature (cf., Burton-Jones and Gallivan (2007), or Bloomfield et al. (2010)) and understand organisational outcomes as a collection of multiple individual immediate concrete results.

Strong et al. (2014) use *consistency* (i.e., quality factor assessing the additive power of multiple individual affordance realisations), *extent* (i.e., quality factor assessing similarity of scope of multiple individual affordance realisations), and *alignment* (i.e., quality factor assessing the organisational expedience of multiple individual affordance realisations) to investigate and classify the emergence of organisational level outcomes. We do not rely on such a granular classification as this would require even more hypothesising of fictitious case information. Instead, we proffer to theorise possible long-term developments by evaluating the level of direct observability of organisational level outcomes emerging from the adapted short-term user behaviour defined in chapter 3.3.2.1. This rationale is based on the assumption that (1) the success of the Green IS implementation is monitored by responsible project management and (2) the employee performance is continuously monitored by responsible middle management. Only if the organisational level outcomes are observable, they can be measured against organisational goals and only then the reflective mechanism might trigger organisational countermeasures aiming to change either the IS artifact or user.

Based on our conceptual model, we identify four possible types of *artifact change* and three types of *user change* induced from organisational level. While completely new material properties or symbolic expressions can be (1) *added* to the IS artifact, existing properties and expressions can either be (2) *edited*, (3) *deleted*, or (4) *recombined*. These changes provide either adjusted system features or completely new features that can then be perceived as new possibilities for action (i.e., affordances) by the user. An organisationally induced change of the user can be achieved through altering (1) *user goals* (e.g., adjusted or new governance policies), (2) *user abilities* (e.g., user training), or (3) *user attitudes* (e.g., key users or champions promoting the utilisation of the new Green IS). With these ‘organisational adjusting screws’ in mind, we discuss potential long-term developments for each of the conflicting sustainability results introduced in

chapter 3.3.1. We explicitly consider short-term changes in user behaviour theorised in chapter 3.3.2.1. An overview can be found in Table 11.

a) Eco-inefficient results

Organisational level outcomes of eco-inefficient Green IS implementations (cf., chapter 3.3.1.1) and associated short-term user reactions expressed in adapted behaviour (cf., chapter 3.3.2.1) will be eventually perceived by the responsible Green IS project manager or other middle management in the long-term. Depending on their level of observability, this happens sooner or later.

In the case of the *weekly 'green' newsletter*, the average user rejects the affordance by deleting the newsletter without prior reading. This behaviour is not immediately observable by management. Only with the help of qualitative follow-up surveys, project manager can assess the actual impact of the newsletter. Doing so, they find out that the newsletter is actually failing in terms of environmental impact. The subsequent root cause analysis most probably unveils economic reasons that led to the rejection of the newsletter. Consequently, the project manager revises the newsletter and edit *data access* (i.e., reduction of information volume), *data presentation* (i.e., improvement of information presentation), and *data automation* (i.e., reduction of mailing frequency) material properties. This will eventually result in a state, where the decrease in economic performance is justified by the increase in environmental awareness. Besides the IS artifact, the company revises organisational policies and other organisational instruments (e.g., management communications) to influence user behaviour by increasing the user's attitude towards reading the 'green' newsletter.

Compared to the newsletter, organisational impacts of the *workflow engine* are better observable. In this case, all users continue to utilise the inefficient system due to the absence of feasible alternatives and the obligation to track time and effort. Comparably quick, the aggregating economic inefficiencies can be observed by management and reflected against organisational goals. After the identification of the root causes, mitigating actions are initiated. They either comprise (1) changes to the *IS artifact*, as for instance, adding *data collection* (i.e., inclusion of missing data fields) and editing *data automation* (i.e., improvement of underlying workflow process) material properties, or (2) *user* targeted measures, as for instance, the provision of user training to increase user abilities.

Conflicting outcome		Short-term user behaviour	Short-term sustainability			Expected long-term changes	
Conflict type	**Scenario**	**Description**	**Economic**	**Social**	**Environ-mental**	**IS artifact**	**User**
Eco-inefficiency	Weekly 'green' newsletter	User rejects affordance by deleting newsletter without prior reading	▲	►	▼	*Edit data access, data presentation, and data automation*: Reduction of information and mailing frequency and improvement of presentation	*Goals and attitudes:* Communication of organisational expectations via soft policies
	Workflow engine	User continues usage due to mandatory time and effort tracking and absence of feasible alternatives	▼	►	▲	*Add data collection and edit data automation:* Inclusion of missing data fields and improvement of workflow process	*Abilities:* Provision of user training on correct usage of workflow engine for digital time and effort tracking
	'Green' dashboard	Priority of organisational goals causes user to focus on economic dashboard	▲	►	▼	*Add data exchange and edit data manipulation:* Provide environmental-economic data interface and cross-sectional data analytics	*Abilities:* Provision of user training on correct usage of cross-sectional dashboard
Eco-inequity	'Green' social networking	User rejects affordance by refraining from further participation in online democratisation process	►	▼	▼	*Add data collection:* Implement anonymous functionality to report unethical and offensive online behaviour of colleagues	*Goals, attitudes, and abilities:* Sanctioning of unethical online behaviour and promotion of social network via champions and management commitment
	Video conferencing	User continues usage due to organisational policies; quality and effectiveness of video conferences decreases	▼	▼	▲	*Edit data exchange:* Improvement of broadband connection quality	*Goals:* Provision of meeting guidelines that discriminate meetings by gravity and pre-existing level of interpersonal relationships of meeting participants
	'Green' appraisal system	User rejects appraisal system and complains about data privacy infringements; overall employee satisfaction decreases	►	▼	▼	*Edit data access or delete data collection*: Limiting access to private data or abolishment of appraisal system	*Attitudes:* Promotion of 'green' appraisal system through champions and management commitment (only in case of continued maintenance of the appraisal system)

Table 11: Overview of *long-term impact* of conflicting sustainability outcomes (▲: increasing; ▼: decreasing; ►: constant)

The *'green' dashboard* case is again less transparent for project managers. Users create a negative attitude towards the Green IS and focus on other systems (i.e., dashboard with economic indicators) to satisfy their intentions, which are in turn influenced by their individual goals. Only through an active follow-up measuring the benefits of the newly implemented system, project managers might find out about the problem. Subsequently, the company decides to change the existing artifact by adding *data exchange* and *data access* and editing *data manipulation* material properties. The change provides a data interface between the 'green' dashboard frontend application and an existing database that stores economic performance indicators. The edited *data manipulation* property further allows to interrelate economic data with environmental data resulting in an integrate view on both sustainability pillars. An additional user training ensures that managers posit the right *abilities* to use the new integrative business intelligence system.

Our offered long-term feedback mechanism theorises how the organisation is reflecting on the aggregated immediate concrete outcomes. It builds upon the assumption that companies aspire to achieve their long-term organisational goals. They use organisational goals as strategic guiding principles and measurement instruments to continuously assess the actual organisational performance emerging from aggregated individual immediate concrete results. Within the boundaries of our conceptual framework, we theorise two possibilities how an organisation can react to eco-inefficiencies induced by a Green IS. Depending on the identified root causes, management either (1) introduces organisational actions to influence the *user behaviour* or (2) initiates technical changes to the *IS artifact*. Intended changes to the *user behaviour* are usually implemented via official policies (cf., updated meeting guidelines for video conferencing meetings) or trainings (cf., user training on the correct usage of the workflow engine), aiming to change user goals or abilities. Additionally, intended changes can also be induced by soft measures, which permeate rather unofficially throughout the organisation (cf., organisational promotion of carpooling system through key users) changing the user attitudes. Therefore, we propose:

H2c: In the long-term, eco-inefficient sustainability outcomes are positively associated with organisationally induced user adjustments (i.e., goals, abilities, or attitudes).

In case the organisation presumes the root cause to be located within the technology itself, we expect organisationally induced changes (i.e., official change requests) targeting the IS artifact in terms of adjusted material properties as discussed in the scenarios. Consequently, we state:

H2d: In the long-term, eco-inefficient sustainability outcomes are positively associated with organisationally induced IS artifact adjustments (i.e., add, delete, edit, recombine material properties).

b) Eco-inequitable results

The situation with eco-inequitable results (cf., chapter 3.3.1.2) is similar to eco-inefficient ones. Monitoring the quality of the implemented Green IS, project managers and middle management are responsible to take mitigating actions in case of emerging conflicting goals.

In case of the *'green' social networking*, the short-term user behaviour, expressed through non-participation in the network, can be easily observed by responsible project managers. Two different solution approaches are identified: The first approach involves changes to the IS artifact in terms of an added *data collection* material property. This new property allows users to anonymously report unethical or offensive online behaviour of other users. In addition to the artifact change, this approach also introduces new user *goals*, which do not target regular social network participants but endows selected users with a new administrative role to follow-up on the anonymous reports mentioned before. Thus, a new organisational role with completely new goals is created. The second approach includes updated organisational policies, reflecting the condemnation of unethical and offensive online behaviour, as well as organisational communications that promote the right utilisation of the social network. Such changes are used to influence the user *attitudes* and *abilities*.

The eco-inequitable *video conferencing* scenario is probably the most challenging case in terms of direct observability of conflicting sustainability results. This is due to the fact that users are compelled by policies to utilise video conferencing as primary mean to facilitate meetings even though they might be aware of disadvantageous side effects. For external observers though – and sometimes even for the actual user –, the negative social and economic impacts are only indirectly and very subtly attributable to the new work virtualisation affordance. Only a dedicated check might uncover this slow and detrimental process and its underlying root causes. While the imposed limitation of media richness cannot be resolved with existing video conferencing solutions, efforts are undertaken to change the *data exchange* material property aiming at the improvement of the broadband connection quality in order to avoid future connection problems. Furthermore, *user goals* are affected by updated meeting policies reflecting a more differentiated application of work virtualisation affordances. The new

meeting policies consider the pre-existing level of interpersonal relationships of the meeting participants as well as the gravity of the planned meeting.

Short-term impacts of the *'green' appraisal system* can be easily observed due to actively opposing employees. When hypothesising long-term changes in this case, we identify two main scenarios: In the first scenario, the company does not change the *data collection* properties of the system but restricts the *data access* property in such a way that users can only review their own activity stream. Simultaneously, an organisational promotion initiative aims at changing the users' *attitudes* to utilise the system in the future. In the second scenario, the opposing mass is too strong and causes deletion of the data *collection material* property. The abolishment of this central material property would imply the ultimate failure of the 'green' appraisal system.

Based on the collective construct theory, organisational performance (i.e., aggregation of multiple individual immediate concrete results) requires time to emerge and to be observed by an agent who is monitoring the outcomes on behalf of the organisation. While Strong et al. (2014) rely on specific antecedent indicators (i.e., consistency, extent, and alignment) to classify the *aggregation of multiple individual immediate concrete results*, we use a reduced assessment method and investigate only the form (i.e., open vs. latent) and speed (i.e., slow vs. quick) of emerging organisational outcomes to derive possible long-term developments of our scenarios. Compared to the eco-inefficiency cases, we expect eco-inequitable outcomes to be less observable on average, as the emergence of social impairments on an organisational level oftentimes latent and slower (e.g., social isolation due to increased video conferencing).

Yet, once uncovered, the organisation cannot ignore this development threatening a decreasing employee satisfaction. Depending on the identified root causes, management therefore either (1) introduces organisational actions to influence the *user behaviour* or (2) initiates technical changes to the *IS artifact*.

H2e: In the long-term, eco-inequitable sustainability outcomes are positively associated with organisationally induced user adjustments (i.e., goals, abilities, or attitudes).

H2f: In the long-term, eco-inefficient sustainability outcomes are positively associated with organisationally induced IS artifact adjustments (i.e., add, delete, edit, recombine material properties).

With these hypotheses, we finish our theory development. So far, we have theorised two types of conflicting sustainability outcomes (i.e., eco-inefficiency and eco-inequity) and how they might emerge from Green IS implementations (cf., chapter 3.3.1). We then used these conflicting outcomes and theorised their short and long-term impact on the user and the IS artifact (cf., chapter 3.3.2). In the next chapter, we propose two appropriate research models, which provide thorough empirical instruments to test the stated hypotheses.

4 Theory Operationalisation

To address the proclaimed absence of empirical publications in the field of Green IS (Malhotra et al. 2013), this chapter contains two enactment possibilities describing how to empirically test the so far conceptually derived hypotheses. We provide two empirical instruments whose enactments produce insights that directly add to the current Green IS body of research (cf., chapter 5.1 for a detailed discussion of our contributions). Our ambition is to reduce the entry barriers for future researchers that consider to embark on our theory of unsustainable Green IS with an empirical approach.

Firstly, we introduce a research model that supports the empirical test of the five hypotheses addressing the first research question (cf., chapter 4.1). Our second research model allows for an empirical validation of the six hypotheses addressing the second research question (cf., chapter 4.2). The constructs of each research model are operationalised (cf., chapters 4.1.1 and 4.2.1) – reusing the construct definitions from our conceptual framework (cf., chapter 3.2.1) – and supplemented with a first collection of measurement items. Additionally, for both research models we provide measurement strategies that comprise recommendations for survey design and data collection procedures (cf., chapters 4.1.2 and 4.2.2).

4.1 Measuring the Emergence of Conflicting Sustainability Outcomes

During the course of this work, we have derived five hypotheses from our conceptual framework explaining the emergence of conflicting sustainability outcomes in the aftermath of a Green IS implementation (cf., Table 17 in the Appendix). User and IS artifact have been identified as possible hosts for root causes leading to eco-inefficient or eco-inequitable immediate concrete results. Based on these hypotheses, we have present our first research model depicted in Figure 6.

4.1.1 Research Model

As our framework (cf., chapter 3.2.1) explains how a Green IS impacts an organisation and its collective individuals in the short and long-term, it is comprised of generic as well as neutral constructs and conceptualises a value neutral evolvement of outcomes. However, we are specifically interested in conflicting outcomes. To be able to empirically test for these particular events we use the already defined neutral constructs from our conceptual framework (e.g., user goals) and attribute certain conditions (e.g., *misaligned* user goals).

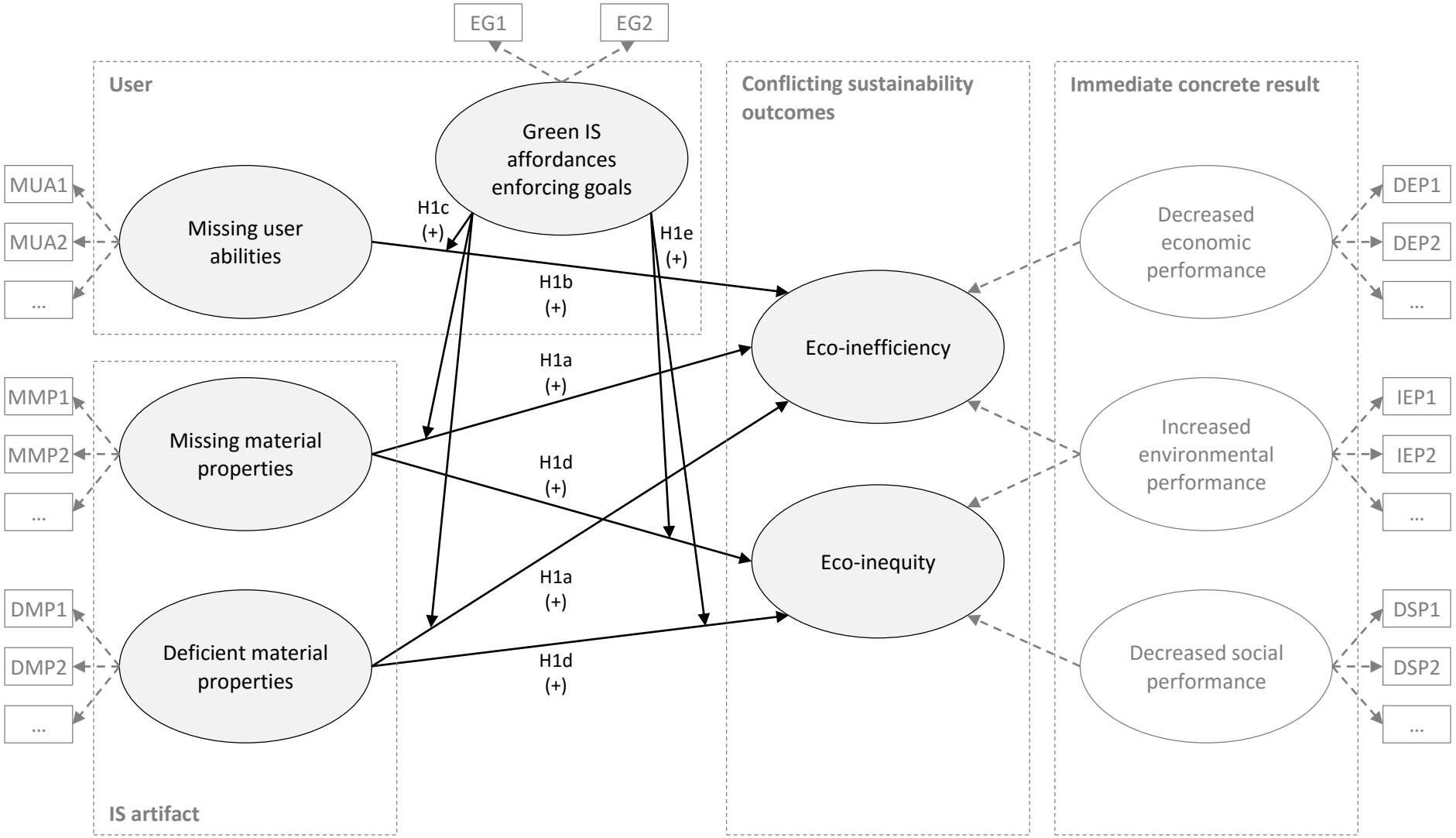

Figure 6: Research model for research question 1 (main constructs, as used in hypotheses, are shaded)

For our first research model, we need to operationalise the two conflicting sustainability outcomes (i.e., eco-inefficiency and eco-inequity), and their antecedents originating from the IS artifact (i.e., missing and deficient material properties) and the user (i.e., misaligned goals and missing abilities). Please note, that to date no commonly agreed understanding of the majority of these constructs (e.g., what exactly is environmentally supportive or economically and socially impairing?) exists. Consequently, the survey and especially the measurement items contain a researcher's bias as they are based on our conceptualisation of these constructs. For a first proposal of measurement items, see Table 19 in the Appendix.

a) Eco-inefficiency and eco-inequity

We understand the conflicting sustainability outcomes as instantiated immediate concrete results as defined in our conceptual framework in chapter 3.2.1.5. There, we define an *immediate concrete result* as an economic, environmental, or social positive or negative consequence arising from the user's purposeful manifestation of any Green IS affordance. Subsequently, in chapter 3.3.1 we classify *eco-inefficiency* as the state characterised by multiple combined immediate concrete results that serve environmental goals but simultaneously inhibit the achievement of economic goals (i.e., mainly due to inefficiency losses). Similarly, we classify *eco-inequity* as the state characterised by multiple combined immediate concrete results that serve environmental goals but simultaneously inhibit the achievement of social goals. Therefore, we understand both conflicting sustainability outcomes as higher-order formative constructs (MacKenzie et al. 2011) that are either characterised by positive environmental and negative economic (i.e., eco-inefficiency) or positive environmental and negative social (i.e., eco-inequity) immediate concrete results.

b) Missing or deficient material properties

In our conceptualisation of possible conflicting scenarios, we have identified missing or deficient material properties as IS artifact-related root causes. Material properties are properties of the IS artifact that can be – depending on the use context – perceived and interpreted by a user. To date, no exact and comprehensively exhaustive collection of material properties exist, which ultimately define the functional (i.e., material) requirements for Green IS. Therefore, we understand *missing* or *deficient material properties* as a retrospective and user-specific evaluation of the IS artifact. *Missing material properties* are absent properties of the IS artifact that a user would expect to be supportive in the achievement of user goals. *Deficient material properties* are existing properties of the IS artifact that a user believes to be inhibiting in the

Conceptual construct	Operationalised construct	Definition
Conflicting sustainability outcomes	Eco-inefficiency	State characterised by multiple combined immediate concrete results that serve environmental goals but simultaneously inhibit the achievement of economic goals
	Eco-inequity	State characterised by multiple combined immediate concrete results that serve environmental goals but simultaneously inhibit the achievement of social goals
IS artifact	Missing material properties	Absent properties of the IS artifact that a user would expect to be supportive in the achievement of user goals
	Deficient material properties	Existing properties of the IS artifact that a user believes to be inhibiting in the achievement of user goals
User	Missing abilities	Absent physical or mental power or skill that a user would expect to be supportive in the achievement of user goals
	Green IS affordances enforcing goals	Role-incumbent goals enforcing the realisation of Green IS affordances

Table 12: Construct operationalisation for research question 1

achievement of user goals. Please note that missing and deficient material properties could be used as formative first-order constructs constituting, for instance, a *flawed IS artifact*. However, we refrained from such higher-order constructs, as our stated hypotheses do not require these complex measurements.

c) Missing user abilities and Green IS affordances enforcing goals

In chapter 3.2.1.2, we define *abilities* as physical or mental power or skill to perceive and utilise the functional affordance. In our research model, we operationalise *missing abilities* as absent physical or mental power or skill that a user or manager would expect to be supportive in the achievement of user goals (i.e., the evaluation happens retrospectively). In this case, the current set of abilities is not sufficient to perceive and utilise the Green IS affordance. It is therefore constraining the affordance-actualisation process. *Goals*, as defined in our framework (cf., chapter 3.2.1.2), are end results or reference points towards which effort (i.e., behaviour) is directed. We operationalise *Green IS affordances enforcing goals* as role-incumbent goals, which extrinsically enforce the

realisation of Green IS affordances even though the user's post-realisation reflection identifies conflicting sustainability outcomes. Without any Green IS affordances enforcing goals, the first reflection on the conflicting sustainability outcome would most probably lead to an immediate rejection by the user. Similar to missing and deficient material properties, missing abilities and Green IS affordances enforcing goals could be defined as first-order constructs composing a second-order construct as, for instance, *user related root causes*. Again, to test our hypotheses no complex higher-order constructs are necessary.

4.1.2 Measurement Strategy

For the empirical test of the hypotheses, we recommend to conduct a global, cross-sectional survey questionnaire targeting medium and large companies that run a Green IS in their organisation.

a) Sampling

For sampling purposes, we suggest to apply a multistage sampling process as proposed by Fowler (2009). In a *first step*, eligible and interested survey companies (i.e., those with an implemented Green IS) are identified and included in the sample cluster (Fowler 2009, p. 28). Researchers can draw on commercial data providers maintaining directories of IT executives to acquire contact records (e.g., 'Directory of Top Computer Executives' maintained by the *Applied Computer Research, Inc.*). The dataset of contact records (i.e., the sample frame) can then be used to initially address CIOs and senior-level IT executives in a standardised letter sent via e-mail. In a *second step*, the actual sample of respondents (i.e., Green IS users) is then randomly selected from the identified cluster of companies.

The content of the letter should at least cover (1) the research matter (i.e., investigating antecedents of unsustainable Green IS) and objectives (i.e., increasing the long-term probability of success of Green IS implementations), (2) benefits for research participants (e.g., insights into research findings, in form of management summaries, and possible long-term research collaboration on Green IS), (3) expected effort required for participation (i.e., completion of one survey questionnaire by the sample of Green IS users), and (4) the eligibility criteria for survey companies (i.e., must run a Green IS). Please note, that we deliberately advise against the inclusion of the questionnaire at this initiating stage. Instead, the letter should be solely used to identify the sample cluster and serve as

ID	Condition	Question	Answer
Q1		Do you run a Green IS in your organisation?	yes/ no
Q2	If *Q1* = yes	Are you interested to participate in our survey?	yes/ no
Q3	If *Q2* = no	Please provide a reason why you are not interested to participate in our survey!	Text
Q4	If *Q2* = yes	Which type of Green IS do you run?	Text
Q5	If *Q2* = yes	When did you introduce the Green IS?	Date
Q6	If *Q2* = yes	How many users approximately utilise the Green IS?	Integer

Table 13: Proposed stage 1 sampling questionnaire for research question 1

informative and preparatory mean, while preventing an intrusive initial demeanour of the research institution in the eyes of the contacted IT executives. To keep the response efforts at a minimum level, we suggest to include a reply functionality gathering the most relevant information as depicted in Table 13.

The results of the first stage of the sampling procedure should yield three overlapping subsets of the initial *sample frame* (i.e., database with contact records). Respondents that qualify as eligible and express their interest to participate in the survey are grouped in the *sample cluster* (cf., Figure 7). Please note that using this type of sampling might involve a selection bias towards a certain subset of the population of eligible companies. Therefore, the calculation of the sample error must appropriately account for the cluster sampling procedure.

In the second step of the sampling procedure, the sample cluster serves as basis to derive the final survey sample by randomly selecting respondents (i.e., Green IS users) that will receive the actual questionnaire.

b) Data collection

We recommend a self-administered survey in form of an online questionnaire, whose access link is distributed via e-mail addressed to the survey respondents (i.e., Green IS users). This recommendation is mainly based on the survey method's advantages as, for instance, lower costs, spatial independence, and quicker response times (Klassen and Jacobs 2001). We are optimistic that the fairly complex two-step sampling procedure pays off at this stage and partially mitigates the common problem of low response rates associated with self-administered approaches. When sending out the questionnaire to lower-level

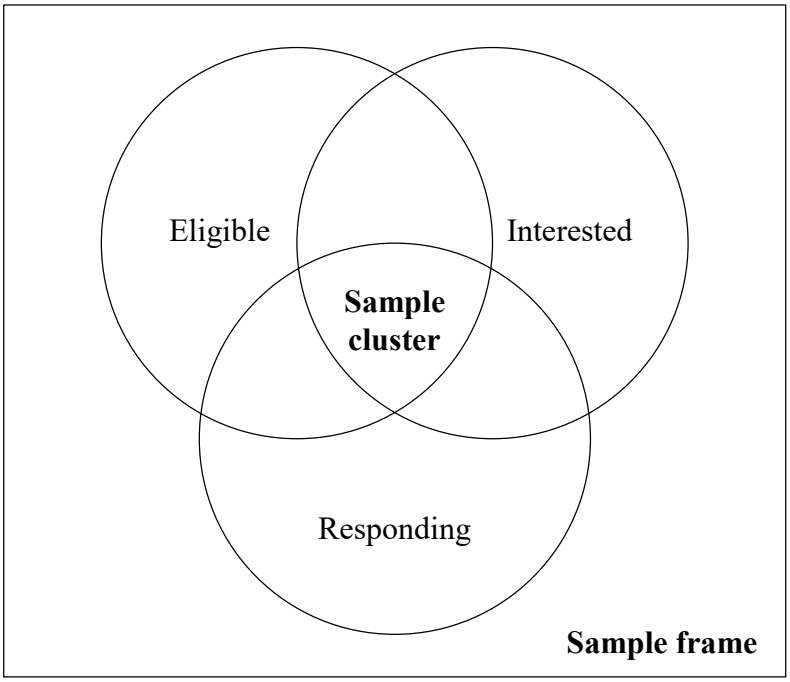

Figure 7: First stage of sampling procedure

Green IS users, the initial clearance of the IT executive signals top-management commitment and conceivably yields a higher response rate. This is why we recommend to refer to the IT executive in the survey e-mail. A personal announcement of the executive in advance might increase the response rate even further. However, it should be ensured that no coercive pressure the survey participation is exerted.

Following a self-administered method, special attention must be payed to the actual item design. It is important to provide closed questions with a set of predefined answers of which the respondent can select from. Self-administered open questions do oftentimes lead to incomparable and hardly codeable answers (Fowler 2009). Furthermore, as the absent interviewer cannot exert any quality control during the completion of the survey, a comprehensible and self-explanatory questionnaire is of particular importance. Hence, survey complexity and duration are important parameters that should be determined in prior pilot studies. These considerations have been taken into account as far as possible during the design of the proposed measurement items in Appendix D.

We recommend to split the questionnaire into three parts: (1) questions to capture meta-information about the respondent's usage of the Green IS, (2) questions to measure the model constructs, and (3) questions to capture organisational background and demographic information about the respondent. The first set of

questions collects information about, for instance, the first contact with, frequency of use of, or the last contact with the Green IS. The second set of questions aims to measure our construct items using a 7-point Likert scale, ranging from ‘strongly disagree’ to ‘strongly agree’. And the third set of questions closes the survey with questions about, for instance, the respondent’s gender, age range, organisational position, and organisational seniority.

Depending on the final sample size (i.e., number of companies and total number of respondents), we suggest to plan a data collection period of at least six to eight weeks (Fowler 2009). The respondents should be granted enough time to complete the online survey (e.g., two weeks). After the first phase, we recommend one or two reminders – in the best case, sent by the IT executive – kindly asking for participation. In the unlikely case of still low response rates, a targeted follow-up in form of a telephone survey can be considered.

4.2 Measuring the Impact of Conflicting Sustainability Outcomes

While our first research model allows us to test IS artifact and user characteristics as possible antecedents of conflicting sustainability outcomes, we present a second research model in this chapter, which supports the empirical validation of our six hypotheses (cf., Table 18 in the Appendix) about the impact of conflicting sustainability outcomes on IS artifact and the user. In particular, we are interested in any short-term adjustments of user behaviour, which we mainly ascribe to changing user attitudes, and organisationally induced changes in the long-term targeting the IS artifact and the user.

4.2.1 Research Model

Our second research model is heavily depending on the investigated companies and their state of the Green IS implementation. In case we are investigating companies that are *planning to introduce a Green IS in the near future*, our second study would be best supported by a longitudinal survey approach, measuring IS artifact and user characteristics at several points in time (i.e., pre and post-implementation). However, we expect the search for a company, with intentions to implement a Green IS in the near future, to be quite cumbersome. Additionally, there is always a certain level of risk involved that the Green IS implementation does not result in conflicting sustainability outcomes, which would render our research endeavours ineffective.

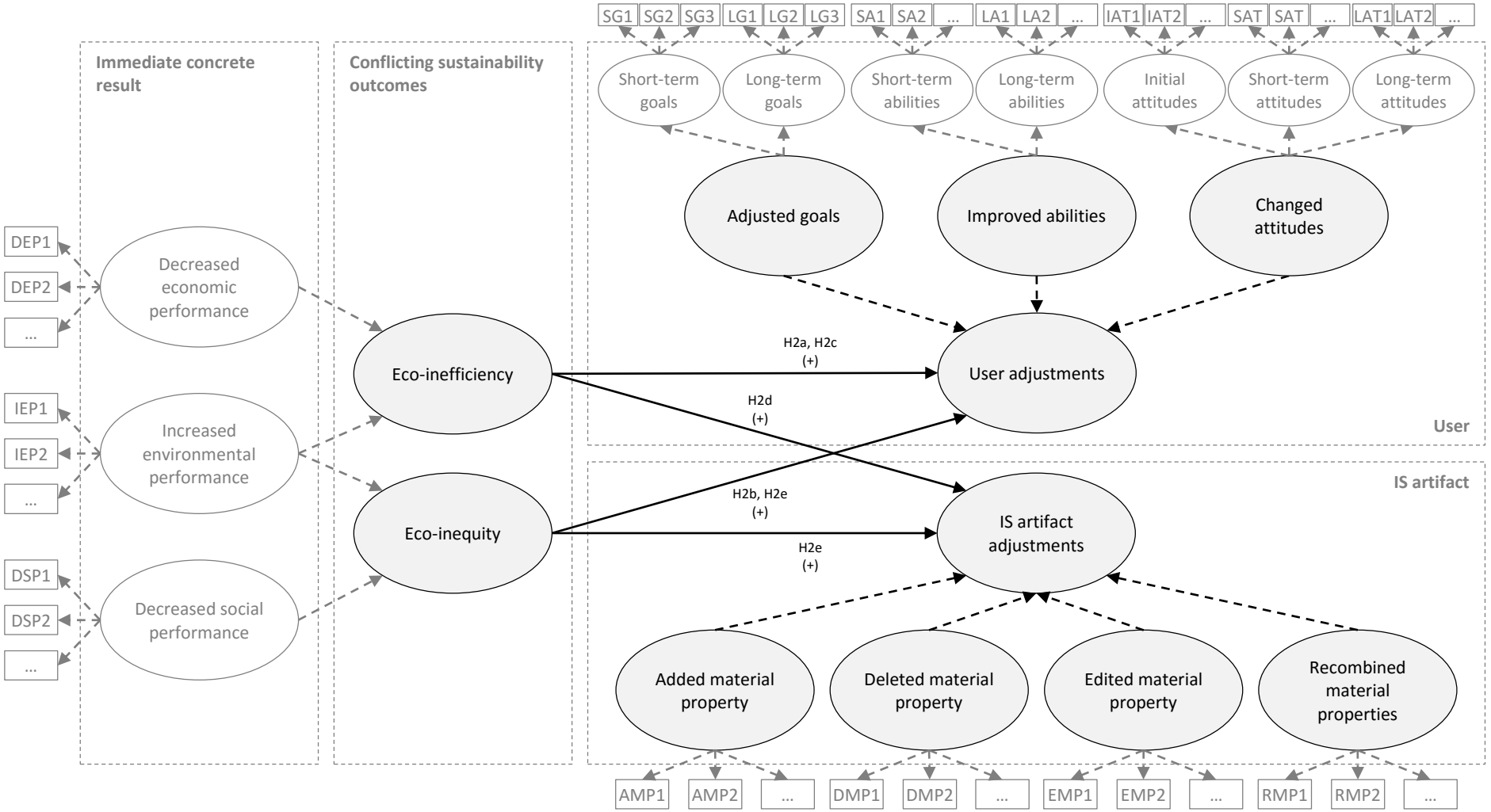

Figure 8: Research model for research question 2 (main constructs, as used in hypotheses, are shaded)

Consequently, in the next paragraphs, we assume a cross-sectional research setting, in which we investigate companies that *have implemented a Green IS already* and – post-implementation of a Green IS – *face problems that are attributable to conflicting sustainability outcomes*. This assumption is also appropriately reflected in our measurement strategy (cf., chapter 4.2.2).

For our second research model (cf., Figure 8), we can rely on the two conflicting sustainability outcomes (i.e., eco-inefficiency and eco-inequity) already operationalised in chapter 4.1.1. We therefore have to define the two remaining higher-order constructs (1) *IS artifact adjustments* (i.e., added, deleted, edited, and recombined material properties) and (2) *user adjustments* (i.e., adjusted goals, improved abilities, and adjusted attitudes) only. Again, we try to reuse as much conceptual knowledge from our framework construct definitions (cf., chapter 3.2.1). Additionally, the operationalised constructs are supplemented by a first draft of measurement items, which can be found in Table 20 (i.e., user respondents) and Table 21 (i.e., manager respondents) in the Appendix.

a) IS artifact adjustments

In chapter 3.2.1.1, we use our understanding of material properties as building blocks of any IS artifact to derive a domain-specific definition of the IS artifact. Through the inclusion and parametrisation of one material property as well as through the combination of multiple material properties, an IS features emerge as Green IS affordances in the moment the material properties are perceived and interpreted by a user. We therefore define *IS artifact adjustments* as material properties of Green IS features that have been altered (i.e., added, deleted, edited, or recombined) post-go-live of the IS artifact.

Deducing from our depicted scenarios from chapter 3.3.2.2, we can specify four formative first-order constructs: (1) *Added* material properties are newly included building blocks that so far did not exist in the first version of the IS artifact. (2) *Deleted* material properties are removed building blocks that so far did exist in the first version. (3) *Edited* material properties represent tweaked building blocks that so far did exist in the first version of the IS artifact in an altered manner. And (4) *recombined* material properties are combinations of multiple building blocks that so far did not exist in the first version of the IS artifact. In conclusion, we understand *IS artifact adjustments* as a formative higher-order construct comprised of the four adjustment types discussed before (MacKenzie et al. 2011).

Second-order construct	First-order construct	Definition
IS artifact adjustments	Added material property	New material properties that did not exist in the first version of the IS artifact
	Deleted material property	Removed material properties that did exist in the first version of the IS artifact
	Edited material property	Tweaked material properties that did exist in the first version of the IS artifact in an altered manner
	Recombined material properties	New combinations of multiple material properties that did not exist in the first version of the IS artifact
User adjustments	Adjusted goals	Organisationally induced changes of aspired end results towards user effort is directed
	Improved abilities	Organisationally induced enhancements of the user's skillset to effectively and efficiently utilise the IS artifact
	Changed attitudes	Alterations (i.e., increase or decrease) in the degree to which a user evaluates the utilisation of the IS artifact as favourable or unfavourable

Table 14: Construct operationalisation for research question 2

b) User adjustments

When operationalising *user adjustments,* we have to consider three types of changes: (1) *Adjusted goals* are organisationally induced changes of aspired end results to which user effort is directed (e.g., updated or new official governance policies). (2) I*mproved abilities* are organisationally induced enhancements of the user's skillset to effectively and efficiently utilise the IS artifact (e.g., new employee trainings). And (3) *changed attitudes* are alterations (i.e., increase or decrease) in the degree to which a user evaluates the utilisation of the IS artifact as favourable or unfavourable. For the last construct, we pick up Ajzen's (1991) definition of attitude and tweak its focus towards the utilisation of a Green IS (i.e., the behaviour in question). Please note, that we refrain from understanding it as an incremental two-point scale (i.e., favourable vs. unfavourable) and rather understand favourable and unfavourable as the extremes on a floating spectrum.

This implies that not all occasions, in which the degree decreases, automatically change a user's attitude from favourable to unfavourable.

When testing our hypotheses for research question 2 (cf., Table 18 in the Appendix) in a cross-sectional study, we have to consider short and long-term user changes. In particular, we have identified short-term user adjustments in form of changed *user attitudes* (cf., hypotheses *H2a* and *H2b*). Therefore, this first-order construct is collecting information from two different points in time from the past. We suggest to include some measurement items targeting the time after the initial contact with the Green IS and others targeting the time after an endured utilisation of the Green IS. Further considerations are accordingly reflected in the measurement strategy presented in the next chapter.

4.2.2 Measurement Strategy

Initially, we set out with the idea to propose a fully-fledged strategy for a quantitative study tackling both research questions simultaneously. We expect more valuable research findings, if both research models can be tested with the same sample. For instance, this would allow researchers to explore relationships between identified root-causes of conflicting sustainability outcomes (i.e., research question 1) and short and long-term organisational impacts (i.e., research question 2), which have not been considered so far in any of our theoretical hypotheses.

However, we sense that the extended size and complexity of a comprehensive research study might deter scholars from conducting and companies from participating in the survey. Thus, to increase positive response rates as well as to improve the research flexibility and approachability for future scholars, we deliberately break it down into two separate research endeavours. This implies that for our second survey we have to anticipate another *(a) sampling* and *(b) data collection process*; this time slightly adapted.

a) Sampling

Again, we suggest a multistage sampling process with the goal of globally identifying eligible and interested companies for the survey first and then selecting actual survey participants (cf., Figure 7). For stage one (i.e., identification of potential companies), we recommend to contact IT executives in a non-intrusive manner relying on a similar letter as introduced in chapter 4.1.2. Due to a different research focus, the eligibility criteria for companies must be adapted to capture additional information on potential utilisation problems of Green IS users (cf., Table 15).

ID	Condition	Question	Answer
Q1		Do you run a Green IS in your organisation?	yes/ no
Q2	If *Q1* = no	Do you consider to introduce a Green IS in your organisation within the current or next fiscal year?	yes/ no
Q3	If *Q1* or *Q2* = yes	Are you interested to participate in our survey?	yes/ no
Q4	If *Q3* = no	Please provide a reason why you are not interested to participate in our survey!	Text
Q5	If *Q1* and *Q3* = yes	Have users encountered any problem(s) with the utilisation of the Green IS so far?	yes/ no/ unsure
Q6	If *Q5* = yes	Please shortly specify the problem(s)!	Text
Q7	If *Q5* = unsure	Would you like us to investigate possible Green IS utilisation problems in your company?	yes/ no
Q8	If *Q1* and *Q3* = yes	Which type of Green IS do you run?	Text
Q9	If *Q1* and *Q3* = yes	When did you introduce the Green IS?	Date
Q10	If *Q1* and *Q3* = yes	How many users approximately utilise the Green IS?	Integer
Q11	If *Q2* and *Q3* = yes	Which type of Green IS do you plan to introduce?	Text
Q12	If *Q2* and *Q3* = yes	When do you plan to introduce the Green IS?	Date
Q13	If *Q2* and *Q3* = yes	How many users approximately will utilise the Green IS in the future?	Integer

Table 15: Proposed stage 1 sampling questionnaire for research question 2

We still advise to keep the initial stage 1 letter and its integrated survey as short and easy as possible for the IT executive. Please note, this time we understand eligible companies as entities that are already running a Green IS and are willing to participate retrospectively in our survey (cf., *Q1* and *Q3* to *Q10*). Organisations that are planning a Green IS implementation and are willing to participate in an "*in vivo* real-time" (Malhotra et al. 2013, p. 1266) study (cf., *Q1* to *Q4*, and *Q11* to *Q13*) can be recorded as 'potential survey partners'. However, due to increased complexity and study failure risk, we recommend to first focus on companies, that already have implemented a Green IS (cf., 4.2.1). Keeping the response rate high at this stage is critical in order to establish a pool of eligible survey partners large enough for an appropriate selection of the final survey sample, which, in turn, is key to reliable and robust survey results.

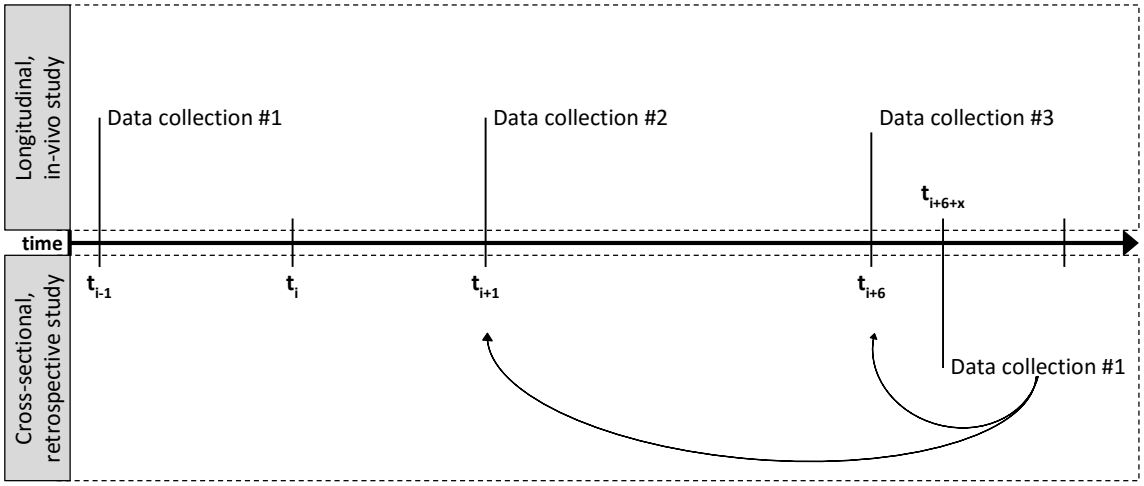

Figure 9: Data collection procedures for research question 2

For stage two, we need to consider an adjusted selection profile for survey participants. Besides system users, we are also interested in data from senior managers measuring organisationally induced changes of the IS artifact or the user, which we stated in hypotheses *H2c* to *H2f* (cf., Table 18 in the Appendix). We expect data from middle managers, which might only be available to them, to contain important auxiliary information, as data collected from Green IS users would only rely on officially announced organisational changes. Please be aware, that the increased complexity of multiple cohorts comes along with the risk that less companies will be interested in a survey participation (Bhattacherjee and Premkumar 2004).

b) Data collection

Please remember, that we are presenting a research model as well as a sampling and data collection processes for a *cross-sectional study*, as we are asking survey participants retrospectively about short and long-term impacts of their Green IS (cf., Figure 9). We suggest to ask users and managers once at t_{i+6+x} retrospectively about Green IS impacts at t_{i+1} (i.e., short-term, approximately one month after implementation) and t_{i+6} (i.e., long-term, approximately six months after implementation), where t_i is the point of implementation of the Green IS. If we conducted an *in-vivo longitudinal study*, the research model as well as the sampling and data collection processes would look different. For instance, the data collection process would – in the best case – comprise three data collection points (cf., Venkatesh et al. (2003)): At time t_{i-1}, data were collected prior to the Green IS implementation; at t_{i+1}, data were collected after approximately one month after implementation; and t_{i+6} marked the moment of the third data collection, approximately six months after the implementation.

Consequently, for our cross-sectional study, we do not require different questionnaires dispensed at multiple points in time. However, as we are focusing on two cohorts (i.e., users and managers), we have to provide two different questionnaires. While the *user questionnaire* (cf., Table 20 for proposed measurement items) gathers data on (1) perceived conflicting sustainability outcomes on *individual level* and (2) *individually perceived* changes of goals, abilities, and attitudes over time, the *manager questionnaire* (cf., Table 21 for proposed measurement items) focuses on (1) perceived conflicting sustainability outcomes on *organisational level*, (2) *organisationally induced* changes of users' goals, abilities, and attitudes over time, and (3) *organisationally induced* changes of the IS artifact over time.

Regarding the type of questions, we fully rely on 7-point Likert scale questions in the user questionnaire. For managers, we also include questions covering time-related (e.g., asking for the amount of time invested for user training or the point in time of organisationally induced changes) and quantity-related (e.g., asking for the number of employees that attended user training) aspects. The rationale is to acquire richer but still standardised and comparable information in areas, that we consider particularly important for the validation of a subset of our hypotheses.

5 Discussion

In this paper, we investigate conflicting sustainability outcomes occurring in the aftermath of Green IS implementations. Our claim is, current research and practice in the Green IS domain are overly driven by environmental benefits, while trade-offs with economic and social aspects are not actively considered during the design and implementation of Green IS. In order to support our claim, our affordance-based framework (cf., chapter 3.2) helps us explaining the socio-technical interaction between a human actor and an IS artifact. The subsequent instantiation of the framework has demonstrated possible conflicting sustainability outcomes and their potential short and long-term impacts on the IS artifact and the user.

In the following, we discuss our contributions and implications for the Green IS research and practice (cf., chapter 5.1). Furthermore, we critically assess identified limitations of our work (cf., chapter 5.2) and highlight potential areas for future research (cf., chapter 5.3).

5.1 Contributions and Implications

We distinguish our contributions and implications into findings *relevant for research* (cf., chapters 5.1.1 and 5.1.2) and findings *relevant for practice* (cf., chapter 5.1.3). While the former insights expand the current body of research by capitalising on our integrated findings originating from the comprehensive sustainability perspective, the latter insights address Green IS management related issues.

5.1.1 Challenging the Status Quo of Existing Green IS Research

One main contribution of this paper is that we challenge the status quo of the existing direction of Green IS research. Our literature review revealed an increasing gap between Green IS research and a comprehensive sustainability view. As mentioned in the beginning, our aim is not to disparage existing work in this field but present a reasoned motivation why scholars should consider a more comprehensive sustainability perspective when investigating IS that ought to support organisations and individuals in becoming more environmentally sustainable. For instance, it does not suffice to solely consider design principles that are targeting environmental benefits (cf., Recker (2016b)). We should extend our understanding of sustainability and address this challenge from a holistic perspective.

We have demonstrated in our – avowedly worst case – scenarios how an excessive environmental focus during the design and implementation phase of a Green IS artifact can result in rejecting user behaviours in the short-term. In case of collectively converging behaviours and in absence of any organisational corrective actions, we expect the adoption of the Green IS to fail. Therefore, three years after Malhotra et al.'s (2013) endeavour to galvanise IS scholars in order to invest more effort in impactful Green IS research, we today attempt to initiate a minor but eventually fundamental course correction.

We consider this course correction to be minor with regard to research methodologies. However, we expect fundamental implications for the overall impact of Green IS research: Contemplating all three sustainability dimensions and their conflicting nexuses simultaneously, should improve the practical applicability of Green IS research. To frame it different: A comprehensive sustainability perspective provides a far more realistic setting in which a Green IS is applied. We must admit that environmental goals are rarely – if ever – the leading maxim for companies in today's capitalistic market system. From a stakeholder perspective, we identify three interest groups (i.e., also addressed by the triple bottom line): Investors (i.e., profit), employees (i.e., people), and the environment (i.e., planet). Without doubt, no silver bullet exists which fully satisfies all three stakeholders simultaneously. These trade-offs are even considered to be an unsolved issue in the original sustainability research domain. However, a raised awareness of the conflict zones and a proactive examination of these (e.g., reflected in adjusted design and implementation principles) should at least alleviate the potential negative symptoms to a considerable extent (e.g., Green IS rejection or unnecessary organisational follow-up investments required for reactive measures).

We expect the implications of the suggested course of action to impact the complete range of the "value space of research" (Malhotra et al. 2013, p. 1266):

a) *Conceptualisation of Green IS*
   Green IS scholars should reconsider their underlying assumptions and point of views, when *conceptualising* the body (i.e., what), purposes (i.e., why), and boundaries (i.e., in which context) of Green IS research. It is inexpedient to narrowly consider Green IS benefits being the most important objectives in an organisational context. Instead, the purpose of Green IS should be understood as instilling an additional layer of normative but unintrusive principles on top of economic and in the wider context of social maxims. This will inevitably create friction and trade-off situations, which can be solved best by the inclusion of human beings, who are able to reflect and discuss the trade-offs in a democratic

manner. Therefore, Green IS artifacts should not be seen as foreign objects that deterministically indoctrinate a new belief and behaviour, but rather as an external impulse that necessarily will create friction, with which the individuals and the organisation must actively intermingle. The affordance-based conceptualisation of the socio-technical interaction provides a reasonable toolset that supports the investigation of this friction.

This implies, the question of intrinsic conviction (e.g., environmental belief) becomes eminently important. Resonating with this line of thought, we proffer: A statement and position is particularly strong and persistent when it provably adopts a self-critical and differentiated point of view but still convinces its opponents of its importance and right of existence. This humble but persuasive perception should be reflected in the underlying conceptualisation of Green IS.

b) Analysis of Green IS

Research that is *analysing* Green IS (e.g., development, adoption, or appropriation) with the help of case studies or quantitative surveys obtains a different normative lens when considering the full sustainability spectrum. So far, scholars analyse Green IS implementations with a notable environmental and economic bias (cf., chapter 2.2). Such predispositions form framing benchmarks against which the observations are measured. Consequently, a bias towards environmental and economic indicators might result in a selective perception of the researcher when collecting survey data. Latent but potentially important variables, such as social and emotional necessities on individual level or business model and cultural structures on organisational level might be overlooked resulting in incomplete explanations of the case that lack relevant information. With the inclusion of the economic and social dimensions and the explicit consideration of the conflicting nexuses, we hope to lay the foundation for a richer understanding of Green IS applications in organisations.

c) Design of Green IS

Implications for *design* research in Green IS are essential. Providing design principles for the development of IS that support organisations in becoming more environmental friendly is important (cf., Recker (2016b)). Yet, increasing the probability of a sustained success of the implementation by including design principles that consider economic and social implications is equally important. We predict a notable increase in user acceptance if the Green IS is less restrictive for employees in their daily business (i.e., not economically or socially inhibiting). Furthermore, we particularly recall the trade-offs that might arise from the

implementation of a Green IS artifact. Such trade-off situations should be explicitly considered in the development of Green IS design principles. For instance, they can comprise specific material properties or combinations of material properties that particularly offer more flexible and multiple alternative realisation paths of Green IS affordances. These implications are partially reflected in the concept of "artifact mutability" by Recker (2016b, p. 4479). We concede that these principles create additional complexity in the design process, but we emphatically recommend to treat them at least as supplementary quality criteria during the development phase.

d) Impact of Green IS

Finally, our extension of the underlying sustainability principles contains implications for *impact* related research as well. By nature of the research field, researchers have an extraordinary interest in the environmental impact of the Green IS as they try to find convincing arguments for the development and implementation of such systems. If positive ancillary effects in the economic or social dimension exist, this coinciding win-win-win situation makes a good case, which is benignly perceived by organisations. However, we support the position that researchers should as well pay attention to potential negative economic and social impacts associated with Green IS solutions. If such drawbacks are disclosed and openly discussed, the current body of research in Green IS can enhance and progress towards a more nuanced community expressed in a stronger convincing position than ever before. If the community continues to deliberately avoid these verily uncomfortable discussions, it might probably have an easy time selling its findings to already convinced practitioners. Yet, in order to convince undecided or even refusing parties, an inclusive and open debate on Green IS impact is imperative.

5.1.2 Providing an Affordance-Based Theory on Green IS Usage

To date, our conceptual framework is the first application of the affordance-actualisation theory by Strong et al. (2014) in order to explain the socio-technical interaction between an actor and a Green IS. We have identified four publications from the Green IS domain that draw upon affordance theory for different purposes: (1) Seidel and Recker (2012) theorise how functional affordances of IS facilitate the creation of green business processes; (2) Seidel et al. (2013) identify four functional affordances of IS providing green transformative power to organisations; (3) Reuter et al. (2014) identify five functional affordances of IS that assist organisations in reducing energy consumption;

and (4) Recker (2016b) uses the concept of functional affordances to detail the building blocks of his Green IS design theory in form and function.

Strong et al.'s (2014) generic affordance-actualisation theory provides the necessary framework to explain how IS and actors interact with each other. Insights from Recker's (2016b) Green IS design theory furnish the components of an abstract-level, idealistic Green IS, which we use to specify the constructs *IS artifact* (hitherto: *IT artifact*) and *Green IS affordance* (hitherto: *affordance*). While the specified Green IS affordances (cf., chapter 3.2.1.3) assist us in the development of reasonable scenarios depicting how Green IS can environmentally support individuals and organisations, the detailed definition of the IS artifact, using the six generic data-driven material properties (cf., chapter 3.2.1.1), demonstrates how any IS artifact can eventually be perceived as environmentally supportive based on the user's intentions.

The four principles of affordance theory, introduced in chapter 2.3, are reflecting the main implications of our affordance-based theory for Green IS research. The first and second principle (cf., first principle: Affordances are functional/ relational; second principle: Affordances are opportunities for action) suggest that scholars – when *conceptualising* Green IS – should cater for two types: Intentionally implemented Green IS versus Green IS that unintentionally emerged and became environmentally supportive. Available research oftentimes understand Green IS as systems that are the product of a purposeful design and implementation process (cf., Watson et al. (2008) or Chen et al. (2009), or Seidel et al. (2013)). However, when understanding the socio-technical IS as an affordance-driven concept emerging from the relational interaction between IS artifact and actor, we must also account for Green IS affordances that may unexpectedly emerge from IS without any initial environmental intention. This tweaked conceptualisation can be helpful when analysing the emergence, adoption, and appropriation of Green IS initiatives in organisations.

Furthermore, our affordance-based Green IS framework expands existing analytical and explanatory capabilities when *analysing* Green IS implementations. An underlying advantage of the affordance-actualisation theory is its wide applicability across industries and business models, which is the case for the Green IS domain as well. We identify two main features that increase the explanatory power of our framework: Firstly, the deliberate distinction between *affordance perception* and *affordance realisation* (cf., second principle: Affordances are opportunities for action) provides the researcher with a more granular analysis instrument, allowing for a separate investigation of both sub-processes. This extension becomes particularly interesting when conducting a variance analysis between Green IS affordances from different scopes of operation (i.e., *belief*

formation, *action formation*, or *outcome assessment*). Questions concerning differing perception-realisation-journeys between affordances from different scopes of operations can be investigated. Secondly, the feedback relationships (cf., fourth principle: Affordances are learnable) offer an analytical instrument to explain short and long-term organisational developments induced by the Green IS. Furthermore, our current analytical instrument can be extended and enriched by a stronger focus on the collective realisation of affordances (cf., Strong et al. (2014)). This will further increase the framework's explanatory power as interdependencies between individual affordance realisations can be investigated in more detail.

Additionally, our affordance-based framework includes characteristics of *process* and *systems theory* (cf., Webster and Watson (2002)), as it combines the scientific understanding of probabilistic and sequential relationships between events (i.e., *Realisation* → *Immediate concrete result*) with emerging and reciprocal relationships between system-comprising parts (i.e., *IS artifact + User* → *Green IS affordance*; *Immediate concrete result* → U*ser*). This hybridised theoretical approach extends the researcher's toolset for three reasons: Firstly, balancing the theory's focus between technology (i.e., IS artifact) and actor (i.e., user) endows researchers with a separate and transparent understanding of both while their interweaving (i.e., emerging interrelationship) is acknowledged simultaneously (cf., first principle: Affordances are functional/ relational). Secondly, the sequential process approach allows us to break down the socio-technical construct into its atomic instantiations. Meaning, every single interaction between an actor and the IS artifact (i.e., affordance perception and – if actualised – realisation) can be evaluated in terms of its impact (cf., fourth principle: Affordances are learnable). Thirdly, reciprocal feedback relationships (cf., chapter 3.2.2) – characteristic for the system approach (cf., Garud and Kumaraswamy (2005) or Clark et al. (2007)) – enable us to evaluate and explain different impact intensities at different points in time (cf., third principle: Affordance realisation is actor and goal dependent; fourth principle: Affordances are learnable).

The extensions are particularly important for multilevel research that pursues the objective to explain organisational impact over time: Oftentimes, "researchers […] assume that the effect of independent variables on dependent variables is instantaneous, [which] may not be the case; especially in collectives, the relationship between predictor and outcome variables may take time (e.g., days, months or years) to emerge" (Burton-Jones and Gallivan 2007, p. 671). Our conceptual framework supports this opinion and provides good reasons why we should not assume that instantaneous effect.

5.1.3 Creating a new Perspective for Green IS Management

With our research we also call out to practitioners, who are responsible for the management of Green IS. Even though the current state of our work is still in its conceptual infancy and requires an empirical validation, we are convinced to contribute relevant findings in form of 'theorised lessons learned' to the common knowledge of Green IS practitioners. These lessons learned do mainly imply an adjustment of the management mindset, when (1) planning, (2) building or sourcing, or (3) running a Green IS. While implications for (1) planning and (2) building or sourcing convey mindset adjustments to *proactively mitigate the future emergence of conflicting sustainability outcomes*, the implications for (3) running a Green IS mainly concern *reactive management practices*.

When it comes to a *proactive mitigation of possible conflicting sustainability outcomes*, managers should explicitly consider the comprehensive sustainability perspective and examine potential trade-offs that might emerge from the introduction of an additional environmental layer. Before even collecting any specific requirements for the Green IS, management should revise the company's current strategy and vision and assess its compatibility with environmental initiatives asking questions as, for instance: Is there an actual environmental belief and honest conviction existent on management level or is the idea of a Green IS rather an attempt to greenwash the company's image? How far is the company willing to trade-off economic efficiency and effectiveness for environmental sustainable operations?

This explicit examination of sustainability conflicts should also then reflect onto the actual implementation process (i.e., internal development or external sourcing) of the Green IS. When evaluating possible system solutions, companies should pay more attention to *how well* it actually *embeds* into the current practices and culture of the organisation and which trade-offs are still within an acceptable range. Especially for Green IS, the '*how*' plays an increasingly important role, as we are dealing with systems that usually are perceived as additional overhead in already complex day-to-day core business tasks. System benefits are rarely immediately perceivable and tangible for the executing user. Therefore, sensemaking and reflection affordances, as demonstrated in the B-A-O framework (Recker 2016b), play an important role in the initial user acceptance phase.

For companies that are already managing a running Green IS, our findings imply that Green IS friction cannot be completely avoided. The triple bottom line and their conflicting nexuses show, balancing all three pillars simultaneously will inevitably produce trade-off situations, which require dedicated management attention and

guidance. As sustainability outcomes are not always easily observable, management should therefore pay special attention to latent developments. Users that face conflicting sustainability outcomes will most probably search for guidance in their official organisational goals. If they cannot find direction there, management should be prepared to quickly cater for organisational guidance in terms of updated policies and employee goals.

Many practical implications revolve around organisational and managerial practices. This is due to our firm opinion that many problems are actually rooted in an essentially misaligned mindset of responsible executives, far before any Green IS implementation. Greening a company by simply implementing an IS will most likely never lead to a fundamental organisational change of beliefs and convictions. Instead, a genuine management endeavour orchestrating multiple change actants (e.g., user policies, user training, or promotional activities) around an eco-efficient and eco-inequitable system design drastically increases the chances for a truly sustained Green IS success.

5.2 Limitations

Our work contains several limitations, which can be grouped into *framework-related*, *theory-related* and *measurement-related* limitations. We present all three groups in more detail in the following.

5.2.1 Conceptual Framework

When interpreting our theory of unsustainable Green IS, the reader should be mindful of how we arrived at the hypotheses. Central to our line of argumentation is our conceptual framework, which we generated from different underlying theories and concepts. In order to have them integrated and make them fit our research context, we slightly tweaked them here and there. We therefore investigate the formative components *(a) affordance-actualisation theory* and *(b) Green IS design theory* in more detail and highlight associated limitations.

a) *Affordance-actualisation theory*

   We heavily rely on Strong et al.'s (2014) affordance-actualisation theory to explain Green IS-associated organisational change. The affordance concept allows us to break down the socio-technical interaction between user and IS artifact into its atomic parts. However, in our application of Strong et al.'s (2014) framework, we have a tendency to focus on the individual interaction with the

artifact. We do not conceptualise organisational outcomes as independent self-contained entities in our framework but rather understand them as collective constructs emerging from individual actions and self-reflection. Even though we consider this organisational level to play an important role in our theorised Green IS-associated organisational change, we widely disregard other organisational structures and solely rely on our *organisational goals* construct.

Furthermore, we mentioned that the actual Green IS affordance emerges from the relation between IT artifact and user. This implies the support of our model for IT artifacts that have not been intended to create environmental affordances. On the one hand, this can be considered as strength of our model. However, on the other hand, the model does not explain well, when and how (i.e., under which preconditions) a deviance in user behaviour leads to an unintended but sustained Green IS use.

b) Green IS design theory

In order to define our IS artifact, which is a central construct in the affordance-actualisation framework, we rely on Seidel et al. (2013) and Recker (2016b) to inform which affordances an idealistic Green IS should provide. Following the affordance theory postulate, Recker (2016b) specifies a Green IS in form and function. Because of complexity reasons and the focus of our research purpose, we adopt the concepts of functional affordances (i.e., principle of function) and material properties (i.e., principle of form) but exclude the concept of symbolic expressions (i.e., principle of form). For the moment, this exclusion serves our purposes more than it restricts us in providing a powerful explanatory framework. However, recent research in affordance theory has demonstrated the importance of symbolic expressions in forming object-based beliefs (Grgecic et al. 2015). This issue is of particular importance for Green IS research, in which belief formation affordances play a pivotal role in user acceptance and continuous system usage.

5.2.2 Theory Development

We restricted our theory development to eco-inefficient and eco-inequitable outcomes only. Eco-ineffectiveness and eco-insufficiency have been excluded from our research as they represent cases of environmentally impairing outcomes. As our investigation centres around unsustainable Green IS (i.e., environmentally supportive initiatives with economic

or social negative side effects), we decided to ignore these conflicting sustainability outcomes. Anyway, we do not expect them to manifest too often in real cases.

As mentioned several times throughout our paper already, we did not rely on any case or survey data when deriving eco-inefficient and eco-inequitable scenarios, which form the basis for the deduction of our theory of unsustainable Green IS. Thus, all discussed scenarios are fictitious. This circumstance inherently implies a certain researcher's bias when hypothesising possible conflicting sustainability outcomes. Especially, due to our particular focus on conflicting outcomes, we deliberately take an opposing position to what we call "Green IS researchers focussing on *environmental and economic benefits*". Instead, our position can be understood as "Green IS researchers focussing on *economic and social drawbacks*". Together, both positions are expected to create the differentiated and comprehensive viewpoint on Green IS that we particularly support in the introductory chapter of this paper.

Despite the researcher's bias, we feel confident that the deductive process is sufficiently supported by applied reasoning and grounded in seminal literature (e.g., our definition of conflicting sustainability outcomes by negating Dyllick and Hockerts' (2002) criteria of corporate sustainability). Furthermore, reflective discussions with colleagues were used to additionally cater for the bias and keep the scenarios as realistic as possible. Beyond doubt, the identified root causes of the conflicting sustainability outcomes are only one possible explanation in a million other explanations. However, we are confident that the recurring patterns among all discussed scenarios provide a sufficient basis to deduce our general hypotheses. Notwithstanding, our proffered theory remains a conceptual venture, which requires a thorough empirical validation in the next step. Being aware of this issue, we explicitly invested effort to provide potential leverage points for future scholars in form of two research models (cf., chapters 4.1.1 and 4.2.1).

5.2.3 Theory Operationalisation

Talking about the two research models, our theory operationalisation contains limitations as well that deserve to be mentioned here. We would like to highlight two types: Limitations concerning the *(a) measurement items* and *(b) measurement strategies*.

a) *Measurement items*

   We have proposed a first draft of measurement items (cf., Table 19, Table 20, and Table 21 in the Appendix) for both research models presented in chapters 4.1 and 4.2. We followed MacKenzie et al.'s (2011) suggestions and reviewed literature as well as oriented by our operationalised constructs of the research model in order

to identify items. However, we have stopped at this point of the scale development procedure. Consequently, our proposed measurement items are by no means ready to be immediately included in a final questionnaire. Next steps in the item development procedure would comprise an assessment of the content validity of the items as well as an update of the measurement models (cf., Figure 6 and Figure 8) in case of any changes to the measurement items (e.g., changed relationship between indicator and latent construct from reflective to formative).

b) Measurement strategies

Our proposed measurement strategies (i.e., especially the data collection procedures) are based on certain assumptions concerning the survey context. We have purposefully decided to split both research models and treat them as separate survey occasions. Thereby, we hope to increase the probability of future application of at least one of the research models. Furthermore, despite its long-term research characteristics, we have deliberately proposed a cross-sectional instead of a longitudinal approach for research question 2. We justify this recommendation by an expected reduced research complexity and an expected increase in the response rate of interested companies. However, the cross-sectional measurement strategy for research question 2 comes with a trade-off regarding the expected quality of the collected data. This data quality impairment is caused by the inherent onetime data collection, in which survey participants are asked to reflect on system use and other model constructs for points in time that date back more than six months before data collection. A longitudinal research approach would prevent this problem but it would also come with the previously mentioned increased level of research complexity and increased risk of research ineffectiveness (cf., chapter 4.2.2). Eventually, both proposed measurement strategies shall only be considered as initial suggestions and must be re-evaluated in the actual survey context, in which the theory will be tested.

5.3 Areas for Further Research

The previous chapter on limitations of our work indicates several open issues that should be addressed in future research. We group our recommendations into three main topics: *(a) empirical validation of our theory of unsustainable Green IS, (b) refinement and enactment of our affordance-based Green IS framework,* and (*c) the integration of the comprehensive sustainability view in Green IS research.*

a) *Validating our theory of unsustainable Green IS*

Our theory of unsustainable Green IS remains to be a conceptual venture and provocative claim, which requires a thorough empirical validation. Therefore, future research should seize upon our proposed research models and drive the next steps in the construct measurement and validation process as suggested by MacKenzie et al. (2011). These steps include the (1) *validation of our proposed measurement items* and (2) *identification and selection of the survey sample*. For the validation of the measurement items, we recommend to evaluate two aspects: the *qualitative adequacy* and *content adequacy* of the items. While the first evaluation's objective is to ensure adequate syntax and semantics of the measurement items (e.g., simplicity, preciseness, and unambiguity), the second aspect assesses whether individual items actually represent aspects of the construct's content domain and whether the set of all items collectively represents the complete construct's domain. Both evaluation procedures can be supported by expert panels consisting of researchers that have either extensive knowledge of quantitative studies or a background in the key subject area (Recker 2016a).

For the selection of a survey sample, we suggest to follow our recommendations as depicted in chapter 4. In our limitations (cf., chapter 5.2), we already highlighted the key assumptions underlying our recommendations to conduct two cross-sectional surveys. However, as survey contexts are hardly predictable, we suggest for future research to transfer our cross-sectional study for research question 2 into a longitudinal study, in order to make at also accessible for a different research setting. This transfer would require an adjustment of the research model, its items, and the data collection schedule.

b) *Refining and enacting our affordance-based framework*

Besides our actual theory of unsustainable Green IS, we recall our affordance-based framework of Green IS impact on organisations and individuals as helpful conceptualisation offering many opportunities for scholars to theorise, analyse, and design better Green IS. We see two possible streams of incorporating our framework in future research: Firstly, the *framework should be refined* by adding the concepts of symbolic expressions, which we so far deliberately excluded from our work. However, the substantial role of symbolic expressions has been recently demonstrated as "technical object, functional affordance, and symbolic expressions offer unique and important opportunities to investigate the relation between IT artifacts and users" (Grgecic et al. 2015, p. 583). Secondly, the *framework offers many possibilities for different research enactments* focusing on different aspects of the Green IS domain. For instance, future research could

investigate varying affordance perception and realisation processes depending on the B-A-O level of the investigated affordance. Another motivation could be to research the realisation process of organisational-level affordances and specifically pay attention to the sequential unfolding of and interdependencies between individual affordance realisations.

c) *Integrating the comprehensive sustainability view in Green IS research*
Despite ongoing criticism, we are strong supporters of the three dimensional sustainability perspective. Even though no silver bullet has been developed, yet, to harmonise all three pillars simultaneously, we at least recommend scholars and practitioners to mentally deal with their conflicting nexuses. We are convinced that this active examination will have its positive impact on Green IS research (cf., chapter 5.1.1) and management (cf., chapter 5.1.3). We are thus calling out to all actors involved in the Green IS domain to purposefully integrate the comprehensive sustainability view in their thoughts, ideas, and future research deeds.

6 Conclusion

Existing research in Green IS has made relevant contributions to its body of knowledge by investing effort in examining and demonstrating the valuable role of IS for environmental sustainability. However, we observe a growing research gap due to an isolated focus on environmental and economic benefits of Green IS. So far, Green IS scholars have largely neglected the more comprehensive and commonly practiced perspective of sustainability (i.e., triple bottom line), as our literature review shows (cf., chapter 2.2).

In this paper, we have argued why this comprehensive perspective on sustainability is important and should be applied in future Green IS research. We demonstrated on a theoretical level how Green IS initiatives can lead to conflicting sustainability outcomes (i.e., eco-inefficiency and eco-inequity). For a robust theoretical foundation, we adopted and merged Strong et al.'s (2014) affordance-actualisation theory (i.e., IS-driven organisational change → *how* does the socio-technical system interact) with Recker's (2016b) design theory of Green IS (i.e., design principles of form and function for Green IS → *what* affordances should an IS artifact provide to support organisations in environmental sustainability initiatives) and evaluated the projected outcomes from a comprehensive sustainability perspective applying Elkington's (1994) triple bottom line.

Our detailed investigation of eco-inefficient and eco-inequitable results led us to the hypotheses that either a flawed IS artifact (i.e., missing or deficient material properties) or a disallowed (i.e., goals), incapable (i.e., abilities), or unwilling (i.e., attitudes) user can be identified as root causes of conflicting sustainability outcomes. As a short-term result of these conflicting sustainability outcomes, we anticipate a decreasing user attitude towards the usage of the IS artifact and theorise organisationally induced changes of the IS artifact or user in the long-term. However, these anticipations and assumptions remain to be hypothetical statements. In order to stimulate the future empirical validation of our theory, we offer entry points for researchers in form of two research models and corresponding measurement items and strategies.

Our reflection on the theoretical research findings has revealed that a parallel satisfaction of all three sustainability pillars is almost impossible. Only in rarest occasions, a win-win-win situation, as defined by Elkington (1994), can be achieved in today's normative setting of our capitalistic market system. However, we believe that an awareness about and a dedicated examination of these conflicting nexuses in between the pillars (e.g., eco-efficiency, eco-equity), can create the right analytical lens and mindset for scholars and practitioners to further improve the quality of Green IS in the future.

With these findings, we hope to initiate a minor but eventually fundamental course correction of current Green IS research. Our ambition is not to render all previous Green IS literature void. Instead, placing the Green IS domain into the more comprehensive universe of sustainability rather reveals frictions and trade-off situations that should not be disregarded but instead understood as open issues waiting to be actively considered in future research. Eventually, our findings create a more integrated yet also more differentiated perspective on Green IS, which strengthens the position of Green IS research in arguing for sustainable IS solutions to support environmental sustainability initiatives.

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Winkler von Mohrenfels, Hannah; Klapper, Daniel (2012): The Influence of Mobile Product Information on Brand Perception and Willingness to Pay for Green and Sustainable Products. In *ICIS 2012 Proceedings*.

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Zhang, He; Liu, Lin; Li, Tong (2011): Designing IT Systems According to Environmental Settings: A Strategic Analysis Framework. In *Journal of Strategic Information Systems* 20 (1), pp. 80–95.

Ziemba, Ewa (2015): Examining Critical Success Factors for Sustainable Information Society - Lessons Learned from Poland. In *ECIS 2015 Proceedings*.

Appendix

A Depiction of Complete Search Strings

EXACTSRCTITLE(
"MIS Quarterly Management Information Systems" OR "European Journal of Information Systems" OR "Information Systems Journal" OR "Information Systems Research" OR "Journal of Information Technology" OR "Journal of Strategic Information Systems" OR "Journal of the Association of Information Systems" OR "Journal of Management Information Systems"
)

AND TITLE-ABS-KEY(
"sustainability" AND "IS" OR "IT" OR "information systems" OR "information technology"
)

AND PUBYEAR > 2012

B List of Identified IS Papers with Holistic Sustainability View

Author	Title	Source	Year
Journal papers (period: 2013-2016)			
Henfridsson and Lind	Information Systems Strategizing, Organizational Sub-Communities, and the Emergence of a Sustainability Strategy	JSIS	2014
Conference papers (period: 2010-2016)			
Abraham and Mohan	Sustainability Innovation Systems (SIS): IT Investments and Stages of Sustainability Maturity	AMCIS	2015
Chung et al.	Sustainable Social Shopping Systems: Concept and Implementation	AMCIS	2014
Granath and Axelsson	Stakeholders' View on ICT and Sustainable Development in an Urban Development Project	ECIS	2014
Heales et al.	Multi-Dimensional Views for Sustainability: Ontological Approach	AMCIS	2015
Katchuck and Port	Managing Green IS - Integrating the Triple Bottom Line into the IS Value Chain: A framework for sustainable IS solutions	AMCIS	2011
Krishnan and Teo	The Effect of Information Systems Capabilities on Sustainability: A Country-Level Analysis	PACIS	2011
Krishnan et al.	IT Readiness, ICT Usage, and National Sustainability Development: Testing the Source-Position-Performance Framework	ICIS	2011
Kurnia et al.	Understanding The Roles of IS/ IT in Sustainable Supply Chain Management	PACIS	2012
Winkler von Mohrenfels and Klapper	The Influence of Mobile Product Information on Brand Perception and Willingness to Pay for Green and Sustainable Products	ICIS	2012
Moeller et al.	How Sustainable is COBIT 5? Insights from Theoretical Analysis and Empirical Survey Data	AMCIS	2013
Nishant	Green IS and Organizational Performance: An Empirical Examination	PACIS	2012
Seidel et al.	Enablers and Barriers to the Organizational Adoption of Sustainable Business Practices	AMCIS	2010
Sutherland and Hovorka	Enterprise Architecture as a Contributor to Sustainability Objectives	ECIS	2014
Ziemba	Examining Critical Success Factors for Sustainable Information Society - Lessons Learned from Poland	ECIS	2015

Table 16: Identified IS papers with holistic sustainability view

C Overview of Hypotheses

Research question	Conflicting sustainability outcome	Hypothesis	
How do Green IS lead to conflicting sustainability outcomes?	Eco-Inefficiency	H1a	Missing or deficient IS artifact material properties are positively associated with eco-inefficient sustainability outcomes.
		H1b	Missing user abilities are positively associated with eco-inefficient sustainability outcomes.
		H1c	The effects of missing or deficient IS artifact material properties and missing user abilities on eco-inefficient sustainability outcomes will be positively moderated by user goals that enforce the utilisation of the IS artifact.
	Eco-Inequity	H1d	Missing or deficient IS artifact material properties are positively associated with eco-inequitable sustainability outcomes.
		H1e	The effects of missing or deficient IS artifact material properties on eco-inequitable sustainability outcomes will be positively moderated by user goals that enforce the realisation of the IS artifact.

Table 17: Overview of hypotheses for research question 1

Research question	Conflicting sustainability outcome	Time horizon	Hypothesis	
How do Green IS induced conflicting sustainability outcomes affect the user and the IS artifact in the short and long-term?	Eco-Inefficiency	Short-term	H2a	In the short-term, eco-inefficient sustainability outcomes are positively associated with a decreasing user attitude towards the utilisation of the IS artifact.
		Long-term	H2c	In the long-term, eco-inefficient sustainability outcomes are positively associated with organisationally induced user adjustments (i.e., goals, abilities, or attitudes).
			H2d	In the long-term, eco-inefficient sustainability outcomes are positively associated with organisationally induced IS artifact adjustments (i.e., add, delete, edit, recombine material properties).
	Eco-Inequity	Short-term	H2b	In the short-term, eco-inequitable sustainability outcomes are positively associated with a decreasing user attitude towards the utilisation of the IS artifact.
		Long-term	H2e	In the long-term, eco-inequitable sustainability outcomes are positively associated with organisationally induced user adjustments (i.e., goals, abilities, or attitudes).
			H2f	In the long-term, eco-inequitable sustainability outcomes are positively associated with organisationally induced IS artifact adjustments (i.e., add, delete, edit, recombine material properties).

Table 18: Overview of hypotheses for research question 2

D Proposed Measurement Items

Code	Item	Adapted from
Increased environmental performance: Since I am using our Green IS…		
IEP1	…I am more aware of environmental consequences resulting from my behaviour.	Seidel et al. (2013), Recker (2016b)
IEP2	…I feel more responsible for environmental consequences resulting from my behaviour.	
IEP3	…I decide more environmentally sustainable.	
IEP4	…I act more environmentally sustainable.	
IEP5	…I feel better informed about the environmental impact of environmental decisions I have made in the past.	
IEP6	…I feel better informed about the environmental impact of environmental work practices I have executed in the past.	
Decreased economic performance: Since I am using our Green IS…		
DEP1	…I accomplish my daily work less quickly.	Davis (1989), Moore and Benbasat (1991), Thompson and Higgins (1991), Compeau and Higgins (1995)
DEP2	…my job performance has decreased.	
DEP3	…my job became more challenging.	
DEP4	…my work productivity has decreased.	
Decreased social performance: Since I am using our Green IS…		
DSP1	…I feel less satisfied with my work.	Morris and Venkatesh (2010)
DSP2	…I feel more stressed at the end of a workday.	Sykes (2015)
DSP3	…I feel less connected with my colleagues.	Hackman and Oldham (1975)
DSP4	…I find my job less enjoyable.	Davis et al. (1992)
DSP5	…the number of conflicts with colleagues has increased.	new
DSP6	…my social well-being in my job has decreased.	
Missing material properties: I am missing Green IS functionality that would…		
MMP1	…allow me to use the system more efficiently.	Chang and King (2005), Petter et al. (2008)
MMP2	…give me more flexibility in using the system.	
MMP3	…increase my participation in decisions.	

MMP4	…increase the compatibility of the system with other aspects of my work.	
MMP6	…supports me in the coordination of multiple goals.	new
Deficient material properties: Our Green IS contains functionality that…		
DMP1	…inhibits me to use the system more efficiently.	Chang and King (2005), Petter et al. (2008)
DMP2	…reduces the flexibility in using the system.	
DMP3	…decreases my participation in decisions.	
DMP4	…decreases the compatibility of the system with other aspects of my work.	
DMP5	…only targets the achievement of environmental goals.	new
Missing abilities: I do not have…		
MA1	…control over using our Green IS.	Taylor and Todd (1995)
MA2	…the resources necessary to use our Green IS.	
MA3	…the knowledge necessary to use our Green IS.	
MA4	…access to specialised instruction concerning our Green IS.	Thompson and Higgins (1991)
MA5	…access to a specific person (or group) assisting in system difficulties.	
Green IS affordances enforcing goals: With the implementation of our Green IS…		
EG1	…new objectives or goals were introduced that rigidly define when to use the new system.	Seidel et al. (2013)
EG2	…new objectives or goals were introduced that rigidly define how to use the new system.	
EG3	…new objectives or goals were introduced that enforce the system utilisation.	

Table 19: Measurement items for research questions 1 (respondent: user)

Code	Item	Adapted from
Increased environmental performance: After the first contact with our Green IS…		
IEP1	…I was more aware of environmental consequences resulting from my behaviour.	Recker (2016b)
IEP2	…I felt more responsible for environmental consequences resulting from my behaviour.	
IEP3	…I decided more environmentally sustainable.	
IEP4	…I acted more environmentally sustainable.	
IEP5	…I felt better informed about the environmental impact of environmental decisions I have made in the past.	
IEP6	…I felt better informed about the environmental impact of environmental work practices I have executed in the past.	
Decreased economic performance: After the first contact with our Green IS…		
DEP1	…I accomplished my daily work less quickly.	Davis (1989), Moore and Benbasat (1991), Thompson and Higgins (1991), Compeau and Higgins (1995)
DEP2	…my job performance decreased.	
DEP3	…my job became more challenging.	
DEP4	…my work productivity decreased.	
Decreased social performance: After the first contact with our Green IS…		
DSP1	…I felt less satisfied with my work.	Morris and Venkatesh (2010)
DSP2	…I felt more stressed at the end of a workday.	Sykes (2015)
DSP3	…I felt less connected with my colleagues.	Hackman and Oldham (1975)
DSP4	…I found my job less enjoyable.	Davis et al. (1992)
DSP5	…the number of conflicts with colleagues increased.	new
DSP6	…my social well-being in my job decreased.	
Short-term goals: With the Green IS implementation, I received new goals that…		
SG1	*Adapt from Table 19 (Green IS enforcing goals)*	
Long-term goals: Today, the goals…		
LG1	…rigidly define when to use the new system.	Seidel et al. (2013)
LG2	…rigidly define how to use the new system.	
LG3	…enforce the system utilisation.	

Short-term abilities: When I used our Green IS the first time, I did not have…		
SA1	…control over using the system.	Taylor and Todd (1995)
SA2	…the resources necessary to use the system.	
SA3	…the knowledge necessary to use the system.	
SA4	…access to specialised instruction concerning the system.	Thompson and Higgins (1991)
SA5	…access to a specific person (or group) assisting in system difficulties.	
Long-term abilities: When I am using our Green IS today, I do not have…		
LA1	*Adapt from Table 19 (Missing abilities)*	
Initial attitudes: Before the first contact with our Green IS, I thought…		
IAT1	…using the new system will be a bad/ good idea.	Davis (1989)
IAT2	…the new system will make work more interesting.	Thompson and Higgins (1991)
IAT3	…working with our Green IS will be fun.	
IAT4	…I will like working with the system.	Compeau and Higgins (1995)
Short-term attitudes: After the first contact with our Green IS, I thought…		
SAT1	…using the new system is a bad/ good idea.	Davis (1989)
SAT2	…the new system makes work more interesting.	Thompson and Higgins (1991)
SAT3	…working with our Green IS is fun.	
SAT4	…I like working with the system.	Compeau and Higgins (1995)
Long-term attitudes: Today, I think…		
LAT1	…using the new system is a bad/ good idea.	Davis (1989)
LAT2	…the new system makes work more interesting.	Thompson and Higgins (1991)
LAT3	…working with our Green IS is fun.	
LAT4	…I like working with the system.	Compeau and Higgins (1995)

Table 20: Measurement items for research questions 2 (respondent: user)

Code	Item	Adapted from
Increased environmental performance: After the Green IS implementation…		
IEP7	…I was more aware of environmental consequences resulting from our company's actions.	Green, Jr. et al. (2012), Recker (2016b)
IEP8	…I felt more responsible for environmental consequences resulting from our company's actions.	
IEP9	…I took more environmentally sustainable management decisions.	
IEP10	…our company acted more environmentally sustainable (e.g., reduction of air emissions, energy use, or hazardous materials).	
IEP11	…I felt better informed about the environmental impact of managerial decisions I have made in the past.	
IEP12	…I felt better informed about the environmental impact of actions our company has produced in the past.	
Decreased economic performance: After the Green IS implementation…		
DEP5	…our monthly operating costs increased.	Hubbard (2009), Green, Jr. et al. (2012)
DEP6	…our monthly sales decreased.	
DEP7	…our monthly productivity decreased.	
Decreased social performance: After the Green IS implementation…		
DSP8	…our employee satisfaction score decreased.	Hubbard (2009)
DSP9	…our employee turnover rate increased.	Seidel et al. (2014)
DSP10	…the number of sick days increased.	
Short-term goals: With the new Green IS, management defined goals that…		
SG1	*Adapt from Table 19 (Green IS affordances enforcing goals)*	
Long-term goals: Over time [please specify]*, the goals have been adjusted to…		
LG4	…increase the flexibility of the Green IS use.	new
LG5	…increase compatibility of the Green IS use with business practices.	
LG6	…increase their compatibility with other goals (e.g., economic performance).	
Short-term abilities: Prior to the Green IS implementation, the company…		
SA6	…offered users training on the system.	Nelson and Cheney (1987)
SA7*	Please specify the number of employees devoted to the training before the release!	

SA8*	Please specify the devoted time of Green IS training per user before the system release!	
SA9	…has released specialised instructions concerning the system use.	Thompson and Higgins (1991)
SA10	…has assigned a specific person (or group) assisting in system difficulties.	
Long-term abilities: Over time [please specify]*, the company…		
LA6	…has increased the number of employees devoted to the Green IS training.	Nelson and Cheney (1987)
LA7*	Please specify the number of employees devoted to the Green IS training, now!	
LA8	…has increased the devoted time of Green IS training per user.	
LA9*	Please specify the devoted time of Green IS training per user, now!	
LA10	…has extended its offer for Green IS-related training.	
LA11	…has released specialised instructions concerning the system use.	Thompson and Higgins (1991)
LA12	…has assigned a specific person (or group) assisting in system difficulties.	
Initial attitudes: Prior to the Green IS implementation, the company…		
IAT5	…has officially promoted the new system internally through opinion leaders.	new
IAT6*	Please specify how often the Green IS has been promoted through opinion leaders before the system release!	
IAT7	…has officially promoted the new system internally through executive management.	
IAT8*	Please specify how often the Green IS has been promoted through executive management before the system release!	
Long-term attitudes: Over time [please specify]*, the company…		
LAT5	…has increased the number of system promotions through opinion leaders.	new
LAT6*	Please specify how often the Green IS has been promoted through opinion leaders until today!	
LAT7	…has increased the number of system promotions through executive management.	
LAT8*	Please specify how often the Green IS has been promoted through executive management until today!	

Added material property: Over time [please specify]*…		
AMP1	…the Green IS has received new functionality.	new
AMP2*	Please specify the number of change requests for new Green IS functionality executed until today!	
Deleted material property: Over time [please specify]*…		
DMP1	…existing Green IS functionality has been removed.	new
DMP2*	Please specify the number of change requests to remove existing Green IS functionality executed until today.	
Edited material property: Over time [please specify]*…		
EMP1	…existing Green IS functionality has been adjusted.	new
EMP2*	Please specify the number of change requests to adjust existing Green IS functionality executed until today.	
Recombined material property: Over time [please specify]*…		
RMP1	…existing Green IS functionalities have been recombined with each other to create new features.	new
RMP2*	Please specify the number of change requests to recombine existing Green IS functionalities executed until today.	

Table 21: Measurement items for research questions 2 (respondent: manager) [* no 7-point Likert scale]

Declaration of Authorship

I hereby declare that, to the best of my knowledge and belief, this Master's Thesis titled "Unsustainable Green Information Systems: An Affordance-Based Conceptualisation of Conflicting Short and Long-Term Sustainability Outcomes of Green Information Systems in Organisations" is my own work. I confirm that each significant contribution to and quotation in this thesis that originates from the work or works of others is indicated by proper use of citation and references.

Brisbane, 8 July 2016

Roman Zeiß