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Digital–sustainable co-transformation: Introducing the triple bottom line of sustainability to digital transformation research

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Abstract. Organisations face two transformation challenges. They embark on their digital transformation (DT), while they also have to accomplish their sustainability transformation (ST). However, on an organisational level, existing information systems (IS) research has thus far treated both transformations separately. While we can observe calls for IS research that investigates the design and use of IT artefacts for ST, existing studies into DT emphasise economic sustainability. In fact, DT scholars hinge the success of DT on economic sustainability. We argue that this emphasis on economic sustainability is an opportunity missed; that DT can contribute to accomplishing the triple bottom line of sustainability (i.e., economic, social and environmental sustainability). We rest our argument on DT and ST’s linchpin: innovation. Existing studies outline that both transformations stem from a sequence of innovations. Drawing on a typology of innovation for ST, we posit that sustainable digital innovations can contribute to both DT and ST. We conceptualise this proposition as a digital–sustainable co-transformation. We argue that this concept can sensitise both IS researchers and practitioners to introduce the triple bottom line of sustainability to DT and to conceive of DT and ST not as two transformations running in parallel but as one co-transformation.

Keywords: Digital Transformation, Digital Innovation, Sustainability, Sustainability Transformation, Digital–Sustainable Co-Transformation

1 Introduction

Digital transformation (DT) receives grappling attention in both information systems (IS) practice and research [31, 36]. Existing work into this organisational transformation challenge suggests that DT alters organisations’ value proposition and identity [33]. Defining DT, Vial outlines it as “a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies” cess’ underlying logic is: organisations trigger significant changes, through infusing their value proposition with digital, to maintain their economic sustainability. In this vein, IS scholars have studied

changes to organisations' value proposition [31, 33], organisations' DT strategies [9, 40], and how digital innovations drive DT. However, organisations face not one but at least two transformation challenges.

Besides DT, they also face a sustainability transformation (ST) [13, 27, 28]. While they engage in the former in response to digital disruptions [31], they seek the latter in reaction to new laws and regulations that governments issue to accomplish the United Nations' (UN) Sustainability Development Goals (SDGs). These goals involve significant changes on an international, societal, organisational and individual level [7]. In practice, we can observe that organisations publish sustainability reports and announce sustainability strategies. Existing studies have termed this as ST [28], i.e., "organisational change efforts that are multi-layered, complex, and that relate to environmental societal, governmental, organisational, regulatory, and individual factors at the same time." The core notion of ST is that organisations improve their operations in accordance with the triple bottom line of sustainability. This triple bottom line comprises an economic, social and environmental dimension and conceptualises operations as sustainable, if they satisfy all three dimensions [30]. Thus, the ST captures organisational changes aimed at improving organisations' triple bottom line.

The SDGs and sustainability theme have also entered the field of IS research. For example, the Special Interest Group GREEN and International Conference on Information Systems 2021 requested manuscripts that investigate IS and sustainability [15]. Moreover, journals announced special issues on IS and sustainability [18]. These calls for research indicate IS scholars increasing interest in studying IS and sustainability. However, first, this research focuses on environmental sustainability [14, 27] and second, we find little research that introduces sustainability to the research theme of organisational DT. Indeed, existing DT studies have focused on economic sustainability [2, 31]. We argue that this is an opportunity missed; that DT can contribute to ST, if we introduce the triple bottom line of sustainability to DT and tackle both transformations as one co-transformation. Hence, we ask the research question of *how can we conceptualise the digital- and sustainability transformation as one co-transformation?*

To answer this question, the remainder of this article first outlines the key premises of existing DT and ST literature as well as their linchpin: sustainable digital innovations. Afterwards, we present an empirical example illustrating a sustainable digital innovation presenting a digital-sustainable co-transformation initiative. The subsequent discussion closes this article presenting two contributions. First, we propose the concept of a digital-sustainable co-transformation that rests on digital sustainable innovations. We argue that this concept can sensitise both researchers and practitioners to understand DT and ST not as two transformations running in parallel but as one co-transformation. Second, we argue that it introduces the triple bottom line of sustainability to DT research.

2 Conceptual background: Digital transformation, sustainability transformation and their linchpin

In this section, we present the conceptual background for answering our research question. We first present existing studies on DT with its focus on economic sustainability. Afterwards, we outline the concept of ST. Subsuming that both DT and ST stem from innovation, we draw on a typology of innovation for ST to conceptualise sustainable digital innovations as the linchpin between the two transformations.

2.1 Digital transformation

DT receives significant attention in practice and research. DT is “a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies.” [31] Scholars and practitioners have engaged in understanding and mastering DT [9, 16]. They found that when embarking on their DT, organisations seek economic sustainability [2, 16, 31]. They transform their value proposition and internal structures to accomplish future-oriented economically sustainable modes of organising [9, 33]. To accomplish this goal, they formulate DT strategies [19, 22].

DT strategies serve as blueprints for organisations’ transformation activities. They sketch a path from organisations’ established business models to digital business models [22, 26]. In these strategies, organisations build on grass-root level digital innovations [4, 9, 40]. They organise innovation events to which they invite employees who then suggest and afterwards implement digital innovations. These realised digital innovations then constitute organisations’ realised DT strategy. Thus, organisations’ intended DT strategy serves as a blueprint but the realised DT takes an emergent form that unfolds from a sequence of digital innovations [9, 39, 40]. Indeed, Hinings et al. define DT as a sequence of digital innovations that accumulates to organisation-wide changes [20]. While the presented existing work on DT provides answers to “what it is” and “how it unfolds”, it remains silent on when we can deem organisations’ DT successful.

Reviewing IS studies on DT success, Barthel identifies a set of four clusters that reflect different notions of DT success [2]. The first, *company value and performance*, comprises studies that measure the impact of DT at the macro level (e.g., stock market price, company reputation, cost reductions, employee or customer satisfaction). The second, *digital business performance*, rests DT success on external performance measures of the new digital business that organisations create for their DT (e.g., revenue or profitability of the digital business models). The third, *realised external transformation*, suggests to measure DT success in the progress of the realised external changes (e.g., transformation of value proposition, customer interaction etc.). The fourth, *realised internal transformation*, discusses maturity models that capture the progress of the internal transformation of processes, structures, etc. Thus, while the first and second cluster present a notion of DT success that hinges on achieving organisational objectives, the third and fourth rest on accomplishing the DT process [2]. According to

Barthel, DT success criteria are thus contribution to organisational objectives and degree of completion, which can feature an internal or external orientation (see Figure 1).

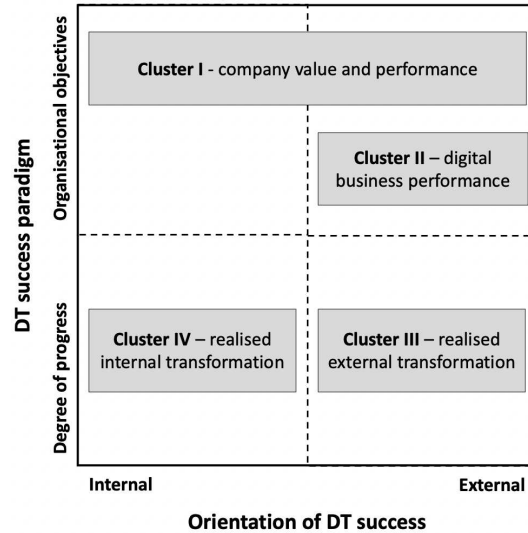


Figure 1. Overview of DT success factors (adapted from [2])

All DT success clusters pin DT's success to economic sustainability. The DT success criteria indicate an emphasis on accomplishing sustained competitiveness and profitability. However, with sustainability entering the field of IS research, we must ask whether economic sustainability should be or can be the sole dimension for assessing DT success? In the triple bottom line of sustainability, economic sustainability presents one of three dimensions. This suggests that DT could support organisations' ST and that the triple bottom line of sustainability offers an alternative to assessing DT success. Thus, we next consult existing work on ST to identify a conceptual linchpin between DT and ST.

2.2 Sustainability transformation

Sustainability development refers to taking decisions that “[meet] the needs of the present without compromising the ability of future generations to meet their own needs” [35]. In an act of global governance, the UN has defined the SDGs. The most pressing issues that the SDGs address: social and environmental sustainability [24, 30]. Setting the SDGs, the UN ask national governments to take action toward social and environmental sustainability [1, 7, 24]. However, besides governments, organisations take a central role in sustainability development [1, 14, 24]. They source, process, and re-use environmental resources. They employ workers, act in local and global communities and most importantly, they drive innovation and thus change [24, 30]. They are central actors in our societal processes and mechanisms requiring sustainability development.

The definition of sustainability evolved from a focus on environmental sustainability to a triple bottom line of sustainability [11, 14, 30]. The triple bottom line defines actions as sustainable, if they satisfy the three dimensions of economic, environmental

and social sustainability [11, 12]. This renders sustainability a complex challenge because it demands actors to consider multiple parameters and their interdependencies when taking decisions for ST. In this vein, Seidel et al. define organisational STs as “a special case of organisational change efforts that are multilayered, complex, and that relate to environmental societal, governmental, organisational, regulatory, and individual factors at the same time.” [28] Thus, ST, next to DT, presents a major transformation challenge for organisations [14, 24].

Interested in the convergence of these two transformation challenges, sustainability scholars have studied their interrelation [8, 14, 24]. They found four interrelations. Researchers and practitioners conceive of digital and sustainability as (1) standalone challenges, (2) neutrally interrelated, (3) positively interrelated or (4) negatively interrelated [8]. Despite these insights into the interrelation between DT and ST, their nexus remains subject to scrutiny [8, 14]. Noteworthy, DT can also have deteriorating effects on sustainability [14]. Moreover, existing work focuses on the contribution of digital to economic and environmental sustainability [8, 14, 24].

Existing IS studies reflect these observations. IS researchers postulate two perspectives on IS and ST. IS can either support organisations’ ST or offer direct solutions to sustainability challenges [17, 27, 28]. At the core of both perspectives, organisations’ innovation capabilities drive their ST [3, 25]. However, similar to sustainability research, prior work focuses on environmental sustainability. For example, Seidel et al. report design principles and affordances that can support environmental ST [27]. Similarly, Hanelt et al. show how IS can support the effectiveness of eco-innovations (namely, electric vehicles) [17]. Also, Seidler et al. propose an eco-sustainability logic to support pro-environmental behaviour [29]. While this indicates that the phenomenon of ST is a subject of interest in IS research, existing work (in IS and other research fields) focuses on environmental sustainability.

Concluding, we define ST as an organisational change process that aims at significant changes to improve organisations’ triple bottom line – economic, social, and environmental – sustainability. We further highlight three observations. First, existing studies in IS on the research theme of DT and into ST emphasise the economic and environmental dimensions. This suggests that we require research that takes a holistic view at sustainability. Second, the interrelation between digitalisation and sustainability remains unclear. Scholars argue for neutral, positive and negative interrelations. In any case, they argue for sustainability being a strategic imperative for DT since organisations’ ST is critical for sustainability development [24].

2.3 Sustainable digital innovations: The linchpin of a digital- and sustainable transformation

DT and ST both present organisations with transformation challenges. While the first requires organisations to infuse their value proposition and identity with digital [31, 33], the second involves organisational changes for contributing to the SDGs [12]. Both require significant changes [7, 33] that entail qualitatively different organisations [5]. Thus, we can subsume that DT and ST alter the inner workings – the deep structure – of organisations. Further, both transformations rest on innovation [3, 20, 25, 30, 31].

Scholars have argued that DT emerges from a sequence of digital innovations [20]. Digital innovations are combinations of innovative digital business concepts and digital technological solutions [34]. Indeed, prior studies present cases of realised DT strategy emerging from a grass-root level process of generating and implementing digital innovations [4, 9, 40]. Thus, we can understand digital innovations to be at the core of organisations' DT.

Similarly, innovations are at the core of ST [25, 30]. In ST, we can observe practitioners and scholars seeking innovations that satisfy the triple bottom line of sustainability. Silvestre and Tirca suggest a typology of innovation for ST [30]. They differentiate between four types of innovation: traditional, social, green and sustainable innovations (see Figure 2).

Social emphasis	High	Social innovations	Sustainable innovations
		<ul style="list-style-type: none"> • <i>Emphasise social sustainability</i> • <i>maximize social dimension; other dimensions are subservient</i> 	<ul style="list-style-type: none"> • <i>Strike a balance on the tripple bottom line of sustainability</i> • <i>no maximisation; strive to satisfy all dimensions</i>
	Low	Traditional innovations	Green innovations
		<ul style="list-style-type: none"> • <i>Emphasise economic sustainability</i> • <i>maximize economic dimension; other dimensions are subservient</i> 	<ul style="list-style-type: none"> • <i>Emphasise environmental sustainability</i> • <i>maximize environmental dimension; other dimensions are subservient</i>
		Low	High
		Environmental emphasis	

Figure 2. Typology of innovations for ST (adapted from [30])

Traditional innovations present the basic type of innovation that offers economic gains, e.g., an increase in market share, returns or earnings. Social innovations address societal differences, e.g., poverty, hunger, health issues and inequality. Green innovations contribute to the preservation of our planet, e.g., clean production, circular economy, etc. Since sustainability presents a triple bottom line, innovations often require trade-offs. For example, emphasising an innovation's social sustainability may drop its economic sustainability. However, sustainable innovations strike a balance on the triple bottom line of sustainability [30]. Silvestre and Tirca note that sustainable innovations must not be new to the world but account for an organisations' ST, if they are new to that organisation [30]. Hence, sustainable innovations play a significant role for organisations' ST.

Building on scholars studying DT and ST, we can understand both transformations as stemming from a sequence of innovations [20, 30, 31]. This makes innovation the linchpin of the two transformations. In this vein, we suggest the concept of sustainable digital innovations as a type of innovation that contributes to accomplishing both DT and ST. We define sustainable digital innovations as digital innovations that satisfy the

triple bottom line of sustainability. Sustainable digital innovations transform organisations into digital but also sustainable organisations. Next, we illustrate the concept of sustainable digital innovations presenting the exemplary case of Bext360.

3 Exemplary case Bext360: Sustainable digital innovation for digital–sustainable co-transformation

Bext360 is an example of a sustainable digital innovation. Bext360 is a service platform that combines digital technological solutions (i.e., blockchain, machine vision and software) to improve the supply chain transparency of coffee [10]. Most of the world's coffee is produced by small farms, who receive only a fraction of the consumer prices for coffee but carry climate risks (e.g., flooding or draughts) or suffer from middlemen manipulation [21, 41]. The bext360 machine, as a sustainable digital innovation, tackles these sustainability issues. It evaluates the coffee cherries' quality using machine vision, presents real-time offers to the farmers based on their coffee cherrie's quality and stores the respective coffee batch's information to a blockchain that is later amended with new records on the batch's processing and shipping [24, 37].

Positioning bext360 in Silvestre and Tirca's framework [30], we conceive of it as a social innovation. For the owners of the small farms, bext360's independent evaluation and real-time payment create trust in the process [21]. Indeed, the farmers trust the machine over humans [38]. The roastery can select high-quality coffee cherries and verify the journey of a certain batch to the roastery based on the blockchain [23]. This information can be presented to consumers and wholesale customers, but also to any other stakeholder of the process, which creates supply chain transparency [21, 43]. This transparency alters the power distribution between farmers and purchasers (often large multinational corporations) making exploitation of farmers more difficult [21].

Bext360 is also a green innovation since the blockchain also monitors the environmental footprint of a coffee batch [42]. For instance, based on the location of origin, shipping steps and details on the used transportation stored to the blockchain, it is possible to calculate the emissions for transportation and to evaluate the transportation method [44]. Further possibilities involve measuring herbicides or pesticides in the coffee cherries. Moreover, based on the farm locations (if known), comparison of satellite images can reveal whether farmers fire-cleared forests to grow coffee, how often the crop has been irrigated artificially or the farms' waste management.

Coda Coffee, a US coffee roastery, uses the bext360 platform to increase transparency of its supply chain [14]. Previously, the Coda Coffee owners travelled around the world and worked closely with coffee farmers and cooperatives to ensure both the quality of coffee cherries, but also ethical work conditions and environmental sustainability [38]. Bext360 allows Coda Coffee to achieve the same organisational goals but sustainably. Thus, introducing bext360 as a sustainable digital innovation to its supply chain, Coda Coffee accomplished a digital–sustainable co-transformation initiative.

4 Discussion

In this article, we cast the research question of *how can we conceptualise the digital- and sustainability transformation as one co-transformation?* Building on the tenets of both DT and ST, we have argued that innovations are the linchpin between the two. In this vein, we suggested the concept of sustainable digital innovations. We then illustrated this concept using an exemplary case: Coda Coffee introducing bext360 to its supply chain. We next extend the concept of sustainable digital innovations to the concept of digital-sustainable co-transformation. Afterwards we present implications to research and practice.

4.1 The concept of digital-sustainable co-transformation

Drawing on the presented conceptual background, we propose the concept of digital-sustainable co-transformation. The digital-sustainable co-transformation is a process that involves significant changes to an organisation based on a sequence of sustainable digital innovations. Prior studies suggest that both DT and ST rest on a sequence of innovations [20, 30, 31]. Building on Silvestre and Tirca’s typology of innovations, we conceptualised sustainable digital innovations as digital innovations (innovative combinations of digital business concepts and digital technological solutions [34]) that satisfy the triple bottom line of sustainability. With the concept of digital-sustainable co-transformation, we adapt this typology to DT. That is, DT can provide grounds for organisations to accomplish their ST through sustainable digital innovations. We stress the plural in “innovations” since a single innovation makes no transformation but a sequence of innovations does. As a strategic imperative, ST subsumes the strategic objective of DT, i.e., economic sustainability. Therefore, we present this as a typology of DT for ST (see Figure 3).

Social emphasis	High	Social-digital transformation <ul style="list-style-type: none"> • Digital transformation emphasises social sustainability • Digital innovations that contribute to organisations’ social sustainability; other dimensions are subservient 	Digital-sustainable co-transformation <ul style="list-style-type: none"> • Digital- and sustainability transformation as one strategic imperative • Sustainable digital innovations that strike a balance on the triple bottom-line of sustainability
	Low	Digital transformation <ul style="list-style-type: none"> • Digital transformation emphasises economic sustainability • Digital innovations that contribute to organisations’ economic sustainability; other dimensions are subservient 	Green-digital transformation <ul style="list-style-type: none"> • Digital transformation emphasise environmental sustainability • Digital innovations that contribute to organisations’ environmental sustainability; other dimensions are subservient
		Low	High
		Environmental emphasis	

Figure 3. Typology of DT for sustainability

The typology differentiates between four types of DT for sustainability. First, DT as studied in prior work with an emphasis on organisations' economic sustainability. Second, social-DT as capturing a transformation process that rests on digital innovations that emphasise the social dimensions of sustainability. Third, green-DT that emphasises digital innovations that contribute to environmental sustainability. Last, the digital–sustainable co-transformation that understands both DT and ST as one strategic imperative and introduces the triple bottom line of sustainability to DT. This last type of DT for sustainability strikes a balance on the triple bottom line without seeking maximisation of any of the dimensions.

We argue that this typology, and particularly the concept of digital–sustainable co-transformation, introduce the triple bottom line of sustainability to organisational DT research. Moreover, it asks scholars and practitioners to conceive of DT and ST not as separate, but as one transformation challenge. Scholars pose that DT and ST require significant changes [8, 30, 33]. DT alters organisations' value proposition and identity [31, 33] and ST has significant impact on value creation and society. If DT research retains its prevalent focus on economic sustainability, scholars and practitioners miss the opportunity to leverage DT for ST. The concept of digital–sustainable co-transformation puts forth this argument and calls for research that considers DT and ST as one co-transformation. It suggests that when altering their value proposition and identity to digital, organisations could simultaneously alter both to digital–sustainable.

4.2 Research implications

We outline four research implications. First, the concept of digital–sustainable co-transformation acts as a sensitising device [32] that introduces the triple bottom line to DT research. This adds to existing DT studies' considerations of how and whether DT contributes to organisations' economic sustainability [2, 9, 22]. We thus argue that the digital–sustainable co-transformation invites IS scholars to take a critical approach to studying DT and organisational change that ventures beyond economic values; to take a critical-turn in studying DT and question whether the economic dimension should be the major dimension or whether – and how – organisations can accomplish a digital–sustainable co-transformation. In this vein, the concept calls for future research that investigates how the digital–sustainable co-transformation manifests in organising empirically. For example, how this perspective alters internal organising and strategic alignment between digital and business? Specifically, how can organisations utilise distinct metrics to evaluate the co-transformation's success in accomplishing sustainability? These are exemplary questions for potential critical research into the digital–sustainable co-transformation.

Second, besides these empirical questions, the concept requires scholars to critically reflect their research approaches. At times, our research approaches run risk of reproducing the values inscribed in the real-world phenomenon without questioning these values against what is at stake – here sustainability. Hence, considering that existing DT studies tilt toward economic sustainability, we argue that the digital–sustainable co-transformation suggests employing critical research approaches to DT research that,

opposed to reproducing the field values, scrutinises the field values against a pre-defined set of values (e.g., sustainability), if we strive for our research to facilitate accomplishment of the SDGs.

Third, the triple bottom line is not only absent in DT research but also in IS research on sustainability. IS scholars studying ST have thus far focused on how IS can support ST (IT enabled ST) with a focus on environmental sustainability [17, 27, 29]. Since the digital–sustainable co-transformation stresses the triple bottom line, we argue that future research should take a holistic view on IS and ST. That is, to extend the existing emphasis on economic and environmental sustainability to investigate how IS can support (or offer solutions for) social and environmental sustainability. If we consider existing literature on digital, however, the focus should be on “offering solutions”. With digital, we can observe the fusion of business and IT to one digital business strategy and an organising logic of digital [6, 37]. The digital–sustainable co-transformation sets digital and sustainable on par. Thus, we argue that scholars should study them (digital and sustainable) as integral – inseparable – parts of business.

Lastly, existing sustainability research deals with DT and ST as two separate phenomena that – occasionally – converge [8, 14]. The concept of digital–sustainable co-transformation shifts this view. Opposed to speaking of convergence and interrelation, the concept suggests to conceive of both as one co-transformation that emphasises a balance on the triple bottom line. This alters questions of how DT disrupts – positively or negatively – sustainability to how DT and ST can synergically accomplish sustainability development.

4.3 Practical implications

The proposed concept of a digital–sustainable co-transformation holds practical implications. In public discourse, DT and ST appear as two separate concerns. Introducing the digital–sustainable co-transformation sensitises public discourse – involving practitioners – to think of and address these two transformations as one. That is, to generate not digital innovations for DT and then sustainable innovations for ST but to craft, articulate and execute digital–sustainable co-transformation strategies that foster sustainable digital innovations that strike a balance on the triple bottom line. This suggests the consideration of how practitioners can merge their DT and ST strategies into one strategy. This merger offers the prospect of hitting two birds with one shot, i.e., to save resources on both transformations while accomplishing them jointly.

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