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Designing for Digital Transformation in a Society of Smartness: Conceptual Cornerstones, Design Implications, and a Road Ahead

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Contents

Designing for Digital Transformation in a Society of Smartness: Conceptual Cornerstones, Design Implications, and a Road Ahead

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ABSTRACT

Information system (IS) researchers can be seen as key change agents in occasioning positive societal change and playing a role in responding to "grand challenges". In this monograph, we work with and advance literature about digital transformation (DT) towards how IS research can conceptualize and grapple with the design of IS artifacts for responding to such complex issues. We conceptualize DT as transformations of smart service systems (SSSs) due to the widespread use of smart technologies by individuals. We then further develop this literature toward a more sociological understanding of the practices within which individuals interact with smart technologies in their everyday lives. Based on providing these cornerstones, we move toward

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deriving specific suggestions for IS design of DT at a societal scale and, in doing so, contribute to research about DT, SSS, and IS design, respectively.

1

Introduction

Few, if any, scholars in the field of IS would disagree that our field is in a very good position to help practitioners responding to some key challenges that are associated with digital transformation (Davidson *et al.*, 2023; Faik *et al.*, 2020; Gegenhuber *et al.*, 2022; Majchrzak *et al.*, 2016; Seckler *et al.*, 2021). Information technologies (IT) are no longer just tools that support corporate strategies (Wessel *et al.*, 2021; Yoo, 2010, 2012), they have become artifacts that shape our daily lives far beyond organizational boundaries (Baskerville *et al.*, 2020; Yoo, 2010). It is with these changes that new questions arise that are diverse yet connected through one key question: *How to design artifacts conducive to responding to societal challenges?*

While broad and general, this question cuts across considerations related to recent developments in artificial intelligence (AI) and other technologies that can be used to improve health-related behaviors (Brohman *et al.*, 2020; Dadgar and Joshi, 2018; Wessel *et al.*, 2024) but also to drive fake news (Wang *et al.*, 2022b), influence elections (Blum *et al.*, 2024; Keller and Klinger, 2019), and attempts to destabilize entire countries. These examples are diverse and non-exhaustive, yet they showcase how societies around the globe have entered into an age where

various outcomes of technological developments have become tangible due to our everyday lives playing out in the digital sphere (Baskerville *et al.*, 2020). The digital sphere is seen to purposefully produce the "real world" (Baskerville *et al.*, 2020). Against this backdrop, addressing societal challenges through conducive artifacts becomes not only of technical but also increasingly managerial relevance: ensuring responsible use of technology implies to create solutions beyond "business value" but encompassing "social value" when approaching societies in digital transformation (Pappas *et al.*, 2023). Likewise, inclusion-driven social-value-first solutions would need a business model too (Bon *et al.*, 2020). Yet, literature informs us of lingering challenges in the digital realm. Algorithms and data may contain biases in technical systems (Friedman and Nissenbaum, 1996; Pappas *et al.*, 2023), and access to digital systems may be impaired (Fox and Connolly, 2018; Hustad *et al.*, 2019; Vassilakopoulou and Hustad, 2023), with the effect of excluding entire groups participating in societies from the merits of the digital sphere that is now "the real world" (Baskerville *et al.*, 2020; Fox and Connolly, 2018; Hustad *et al.*, 2019; Pappas *et al.*, 2023; Ziosi *et al.*, 2024). Hence, responsible and inclusive, that is, human-first, management and use of technology become an increasingly relevant but complex endeavor in the digital transformation of societies which invites us to expand knowledge beyond established perspectives on IT artifacts inside organizations (Pappas *et al.*, 2023; Winter, 2024; Winter *et al.*, 2014).

The purpose of our monograph is to take seriously the abovementioned developments and to probe the extent to which some extant literature helps us with developing answers. We double down particularly on the literatures about digital transformation (DT) and smart service systems (SSS) (Baskerville *et al.*, 2020; Beverungen *et al.*, 2019a,b; Davidson *et al.*, 2023; Yoo, 2010). The reason for doing so is that AI-based smart services are key to "de-centering organizations" (Alaimo and Kallinikos, 2022) in the key technological phenomena of our times and foregrounding production, use, and consumption of data in our everyday lives instead. While the importance of these phenomena is obvious, IS is a field centered around intra-organizational phenomena so that we lack design knowledge related to artifacts operating outside

of "organizational containers" (Winter *et al.*, 2014). Based on ideas of "problematizing" (Alvesson and Sandberg, 2011, 2020), we critically review the literatures about DT and SSS highlighting both commonalities and differences in terms of their *root metaphors* and *paradigms*. Returning to a few classical articles in IS (Markus and Robey, 1988) and organization theory (Van de Ven and Poole, 1995, 2005), we work toward showing that these literatures develop understandings of transformation based on different "imperatives" (Markus and Robey, 1988) akin to – though oftentimes not explicating – deterministic thinking. Based on our analysis, we depart from these understandings by suggesting an "emergent process" (Markus and Robey, 1988) as a new paradigm for designing for DT in the society of proclaimed smartness that we live in. We build on sociological practice theory to suggest a set of new root metaphors consistent with emergent processes. Our concrete methodologies to gather and analyze literatures are a "review of reviews" of the DT literature and a conceptual replication of one seminal review by Lim and Maglio (2018) of the literature about SSS.

Our work contributes to IS research in three important ways. The DT literature has spoken about the digital transformation of society for many years (Majchrzak *et al.*, 2016). Recent technological developments have introduced new levels of complexity through machine learning (ML), self-learning algorithms and other artifacts that have agency to create various data in partially uncontrollable ways. For one instance, data and algorithms are used in combination in technical systems where potentially present algorithmic biases are going to play out during interactions (Beverungen, 2014; Friedman and Nissenbaum, 1996; Ziosi *et al.*, 2024). As concrete interactions are needed for the bias, it may only come to the fore through emergence over time. Thus, algorithmic and other forms of biases increase complexity with regards to responsible management of technology (Ebrahimi *et al.*, 2024; Pappas *et al.*, 2023; Ziosi *et al.*, 2024) and are possibly additional sources of emergence in processes of DT. Hence, as scholars of management and design, we need to find ways to appreciate such additional sources of emergence in DT and adjust our baseline assumptions accordingly. As our review shows, much of the literature reiterates views that do not allow for capturing such emergence and we overcome this issue. Secondly, our

work is consistent with recent developments in DSR that foreground more open and inductive approaches (Seckler *et al.*, 2021). We offer to theoretically ground such work in consistent assumptions for those instances when the according solutions target artifacts addressed to speak to societal concerns. Finally, we advance recent developments in sociological practice theory that have been devoted to increase its impact through designing IS artifacts. We unpack a set of assumptions that shine through in these works but have not been fully explicated.

We structure the following considerations into four parts. First, we briefly unpack some key terms that we use throughout our work and that we selectively draw from seminal works in IS and organization theory. Second, we perform our analyses of different literatures including a depiction of the according methodologies. Third, we delve into the introduction of new paradigmatic considerations and the development of alternative root metaphors before we, fourth, discuss our work in a broader context.

Appendices

A

Literature on Digital Transformation

As detailed in Table A.1, Veldhoven and Vanthienen (2022) is cited 51 times: 12x "Business", 10x "Management", 9x "Environmental Sciences", 9x "Green Sustainable Science Technology", 7x "Environmental Studies"; 17x "09 Industry", 6x "12 Responsible Consumption", 4x "No Poverty", 4x "03 Good Health and Well Being", 4x "04 Quality Education".

Vial (2019) is cited 1471 times[1]: 472x "Management", 340x "Business", 186x "Information Science Library Science", 174x "Environmental Science", 173x "Computer Science Information Systems"; 621x "09 Industry Innovation And Infrastructure", 131x "12 Responsible

Table A.1: Overview of reviewed reviews on DT

	Journal	Citation Count
Veldhoven and Vanthienen (2022)	EM	215GS; 58 WoS
Vial (2019)	JSIS	GS x, 1621 WoS
Hanelt *et al.* (2021)	JMS	GS x, 491 WoS
Kraus *et al.* (2022)	IJIM	478, 143 WoS
Verhoef *et al.* (2021)	JBR	GS x; 1026 WoS

[1] WoS reported that 533 records out of 1,471, so 36.234%, have no data for the SDG assignment.

Consumption And Production", 130x "No Poverty", 119x "04 Quality Education", 67x "03 Good Health and Well Being".

Hanelt *et al.* (2021) is reported as 472x times cited: 200x "Management", 129x "Business", 55x "Information Science Library Science", 45x "Environmental Sciences", 44x "Engineering Industrial".[2]

Kraus *et al.* (2022) is marked as a "Hot Paper" and "Highly Cited Paper" albeit with 143 citations in the WoS: 47x "Management", 35x "Business", 20x "Ìnformation Science Libary Science", 10x "Environmental Sciences", 13x "Green Sustainable Science Technology"; SDGs: 56x "09 Industry", 24x "01 No Poverty", 18x "12 Responsible Consumption", 9x "04 Quality Education", 5x "03 Good Health and Well Being".

Verhoef *et al.* (2021) is cited 983 times when using the WoS-function to analyze results. Here, we are using this to gather an overview on forward-looking research areas that are citing this article: according to the WoS, this article has been cited 302 times in the field of "Business", 293 times in "Management", 128 "Environmental Sciences", 105 "Environmental Studies", 109 "Green Sustainable Science Technology".[3] Another possible quick overview is generated by another feature of the WoS, that is to group the citing articles in relation[4] to the UN-SDG: 422x "09 Industry Innovation And Infrastructure", 94x "01 No Poverty", 45x "Quality Education", 90x "12 Responsible Consumption And Production", 38x "03 Good Health and Well Being".

Grouping forward citations by journals: Kraus *et al.* (2022): 11x IJIM, 7x RMS, 6x SUS, 5x TFSC, 5x JIK. Verhoef *et al.* (2021): 93x SUS, 54x JBR, 33x TFSC, 21x IETEM, 15x TIS, 14x JKE, 13x IJInM. Hanelt *et al.* (2021): 31x SUS, 18x TFSC, 13x JBR, 12x TI, 11x JKM, 10x IETEM, 8x JMS, 5x EJIS.

[2] 39x "Environmental Studies", 36x "Computer Science Information Systems", 36x "Economics", 38x "Green Sustainable Science Technology", 27x "Operations Research Management Science".

[3] The categories are created by the WoS.

[4] WoS reported that 409 records, 41.607% out of 983 possible records did not contain data for the relevant field to establish an SDG-relation. The WoS feature relating articles with the UN's SDGs is generally relevant while a miss rate of 42% does not yet render this feature useful enough.

B

Literature Review SSS

Table B.1: Articles in the derived review basket basically range across all smart + x categories as previously established in Lim and Maglio (2018)

		Problem	Solution
Fischer *et al.* (2020)	Living	The discourse on smart services is multidisciplinary and thus, a knowledge gap exists to create common ground for central concepts regarding the transformative potential and evidence-based design knowledge.	A conceptual taxonomy on smart services is designed comprising 8 dimensions with 20 characteristics across 100 smart services from the smart living sector.

Continued.

Table B.1: Continued

		Problem	Solution
Lukić *et al.* (2017)	Grid	Smart grid technologies are affecting all parts of the electricity supply chain, market structure, business models and services.	We develop a model of business intelligence to provide electricity markets with necessary data flows and information for the decision-making process to leverage new capabilities of smart grids and thus enable new business value creation.
Schulz *et al.* (2020)	Mobility	Technical progress disrupts mobility sector, new integrators promise to offer smart mobility through service integration ranging from car-sharing to public transport. Mobility providers rarely entered value co-creation relationships which is why mobility is not considered smart from a citizen's perspective.	Grounded in an empirical qualitative study we identify several inhibitors of value co-creation from the viewpoint of mobility providers and show how these inhibitors trigger eventual value co-creation relationships.

Table B.2: Prevalent levels of analysis in articles on SSS in articles of premier basket journals

	Smart	Nano	Micro	Meso	Macro
	+	7	11	8	1
Kahlen *et al.* (2023)	Market		X	X	

Continued.

Table B.2: Continued

	Smart	Nano	Micro	Meso	Macro
Herterich *et al.* (2022)	Srv Eco-System	X	X		
Wang *et al.* (2022a)	Transportation		X	X	
Cichy *et al.* (2021)	Product		X		
Knote *et al.* (2021)	Pers.Ass.	X	X		
Tarafdar and Bose (2021)	Watch	(x)	X		
Bartelt *et al.* (2020)	City			X	
Kang *et al.* (2020)	Ride-Hailing		X		
Xie *et al.* (2020)	Driving	X	X		
Bürger *et al.* (2019)	Factory			X?	
Huber *et al.* (2019)	Srv.Sys.	X	X		
Wessel *et al.* (2019)	Watch / SSS	X	(x)	X	
Oberländer *et al.* (2018)	'things'	(x)	X	X	
McGrath (2016)	Card			X	X
Murillo-Sánchez *et al.* (2013)	Grid			X	
$\sum$: 15		7	11	8	1

Table B.3: Prevalent levels of analysis in articles on SSS in articles of Lowry35

	Smart	Nano	Micro	Meso
Becker *et al.* (2023)	City			X
Graf-Drasch *et al.* (2023)	City	x	x	x
Bastidas *et al.* (2022)	City		X	X
Dickhaut *et al.* (2022)	Pers. ass.		X	
Huang *et al.* (2022)	Police-ing	x	x	
Oschinsky *et al.* (2022)	City		X	
Tang *et al.* (2022)	Health	x	X	
Anthony *et al.* (2021)	Urban transport	X	x	X
Li *et al.* (2021)	Transport	x	x	
Klinker *et al.* (2020)	Device/glasses	x	x	
Miah and Vu (2020)	City/health		X	
Anke (2019)	Service		X	X
Singh *et al.* (2020)	Monitoring (citizen)	x	x	X
Turetken *et al.* (2019)	Mobility		X	X

Continued.

Table B.3: Continued

	Smart	Nano	Micro	Meso
Lukić *et al.* (2017)	Grid		X	X
Chung *et al.* (2016)	Health	X	x	X
$\sum$: 16		8	15	9

Table B.4: Smart AND Health in title, abstract, keyword — levels of analysis

	Smart	Nano	Micro	Meso	Macro
Abdeen *et al.* (2022)	Health	x	X		
Alabdulatif *et al.* (2022)	Healthcare		X	X	
Ebrahimi *et al.* (2022)	Health		X	X	
Thapliyal *et al.* (2022)	Healthcare	x	X		
Chen *et al.* (2022)	Healthcare			X	X
Almas *et al.* (2023)	Healthcare	x	X		
Akhtar *et al.* (2023)	Healthcare	x	X		

Table B.5: "Smart" service systems per journal groups: HCI

	Jour.	Smart + X	Levels covered	Perspective	Def.?
Kashef *et al.* (2021)	CHB	City, surveillance	Micro, meso, (macro)	Inter- action in socio-technical view of SSS	Y
Mora *et al.* (2021)	CHB	City	Micro, meso, macro	Smart city as ecosystem	(y)
Mikusz *et al.* (2021)	ATHCI	'Environment'	Nano, micro	Tech.	N
Hung and Lin (2020)	IJHCS	Monitoring	Nano, micro	Tech.	N
Barbosa *et al.* (2018)	IJHCS	Wheel-chair	Nano, micro	(Still) technical	(y)

Table B.6: Prevalent levels of analysis in articles on SSS in articles of premier basket journals

	Jour.	Smart + X	Nano	Micro	Meso	Macro	Perspective	Def.
Bürger *et al.* (2019)	DSS	Factory			X?			tech. /IoT
Tarafdar and Bose (2021)	DSS	Watch	(x)	X			Tech.?	impl.
Kahlen *et al.* (2023)	ISR	Market		X	X		Inter-action of software agents	C / impl.
Wang *et al.* (2022a)	ISR	Transportation		X	X			N
Herterich *et al.* (2022)	ISJ	Srv Eco-System	X	X			Eco- system	
Huber *et al.* (2019)	ISJ	Srv.Sys.	X	X			SSS	Y
Bartelt *et al.* (2020)	EJIS	City			X		System(s)	Y
Oberländer *et al.* (2018)	EJIS	'things'	(x)	X	X		Inter-acting actor(s)	Y
Wessel *et al.* (2019)	JAIS	Watch / SSS	X	(x)	X		SSS	Y
Kang *et al.* (2020)	JAIS	Ride-Hailing		X			Tech. sys	y
Xie *et al.* (2020)	JAIS	Driving	X	X			Tech. sys/srv	C
Knote *et al.* (2021)	JAIS	Pers. Ass.	X	X			Tech. obj.	Y
Cichy *et al.* (2021)	MISQ	Product		X				N
$\sum$: 15								

Table B.7: Prevalent on SSS in coded evaluations – Approach as in Van De Ven and Poole (2005) (T: = technology-centric; MM: = mixed methods; S: = Survey)

		Evaluation				
	"smart" + x	**Arti-ficial**	**Natural-Istic**	***Artifact-Centric***	**"Second" Data**	**Approach**
Umer *et al.* (2022)	Healthcare	X		X	X	I
Ejaz *et al.* (2021)	Healthcare	X				I
Jamil *et al.* (2021)	Fitness	X		T		I∼
Javed *et al.* (2020)	Health activity		X	T		I, IV∼
Hung and Lin (2020)	Health monitoring		X	T + S		II∼
Lin *et al.* (2018)	Health clothing		X	T + S		I, (II, IV)∼
Young and Kitchin (2020)	City		X	X; MM		I, II
Mikusz *et al.* (2021)	Environment		X	x + MM		I, II, III∼

Note: Statements like

> "We then conducted a 5-month field trial to collect porters' traces. Finally, a series of quantitative analyses were performed to assess the efficiency of porter operations, such as the movement distribution of porters in different time periods and areas, workload distribution among porters, and possible bottlenecks of delivering services." (Lee *et al.*, 2023, p. 1)

were coded as matching towards "approach I" (Van De Ven and Poole, 2005, p. 1387) since it seems as if the "traces" and "quantitative" analyses were at least formulated towards approach I since a clear effect is presented as result (here: "improve efficiency of the porter team"; Lee *et al.*, 2023, p. 1).

Table B.8: Early coded statements on possible tech dominance

Technology Dominance	**Not**	**....**	**Yes**
Abdeen *et al.* (2022)		...	X
Alabdulatif *et al.* (2022)		...	X
Ebrahimi *et al.* (2022)		...	X
Thapliyal *et al.* (2022)		X	
Kaur *et al.* (2023)			X
Akhtar *et al.* (2023)			X
Abdel-Basset *et al.* (2021)			X
Ahanger *et al.* (2022)	X		
Ahmad *et al.* (2022)	X		
Almas *et al.* (2023)			X
Alquthami and Meliopoulos (2018)			X
Anke (2019)			X
Anthony *et al.* (2021)			X
Barbosa *et al.* (2018)			X
Bartelt *et al.* (2020)			X
Bastidas *et al.* (2022)			X
Bertacchini *et al.* (2017)			X
Bhatia and Sood (2016)			X
Bürger *et al.* (2019)			X
Catarinucci *et al.* (2015)			X
Chiang and Liang (2015)			X
Chung *et al.* (2016)			X
Chung *et al.* (2017)			X
Cichy *et al.* (2021)			X
D'Amico *et al.* (2020)			X
Deng and Fei (2023)			?!
Dickhaut *et al.* (2022)			X
Ejaz *et al.* (2021)			X
Heilig and Voß (2017)			X
Hossain and Muhammad (2018)		X	
Huang *et al.* (2022)			X
Huber *et al.* (2019)			X
Hung and Lin (2020)			X
Islam *et al.* (2023)			X
Kahlen *et al.* (2023)	X		
Kang *et al.* (2020)	X		
	4	2	30

Continued.

Table B.8: Continued

Technology Dominance	Not	....	Yes
Kashef *et al.* (2021)			X
Khan *et al.* (2019)		X	
Klinker *et al.* (2020)	X		
Knote *et al.* (2021)			X
Lee *et al.* (2023)		X	
Li *et al.* (2021)		X	
Lin *et al.* (2018)			X
Lukić *et al.* (2017)			X
Maleki *et al.* (2018)		x	X
Meng *et al.* (2021)			X
Mamonov and Benbunan-Fich (2020)			X
Mikusz *et al.* (2021)			X
Mora *et al.* (2021)			X
Natgunanathan *et al.* (2019)			X
Oberländer *et al.* (2018)			X
Qi and Guo (2019)	X!		X!
Rana and Mishra (2020)			X
Ray (2017)		X	x
Razaque *et al.* (2022)			X
Santofimia *et al.* (2018)		X!	x
Siddiqui *et al.* (2014)			X
Simonofski *et al.* (2021)			X
Singh *et al.* (2018)	X		x!
Singh *et al.* (2020)	X		x
Singh *et al.* (2019)	X		
Tang *et al.* (2022)	X		x
Tarafdar and Bose (2021)			X
Turetken *et al.* (2019)			X
Verma and Sood (2018)			X
Visvizi (2023)	X		
Wen and Guo (2014)	X		
Yang *et al.* (2023)	X		
Yang and Lee (2017)	X		

Continued.

Table B.8: Continued

Technology Dominance	**Not**	**....**	**Yes**
Xie *et al.* (2020)			X
	10	6	25
	4	2	30
(Sum:77; Docnt:71)	14	8	55

Note: Statements like:

> "Smart health is a relatively new paradigm where information and communication technology is utilized to improve health care and medical services" (Abdeen *et al.*, 2022, p. 1)

or

> "Advances in information technology have steered several nations' aspirations toward a health-oriented society. Conspicuously, a new concept known as smart healthcare (SHC) has been coined." (Kaur *et al.*, 2023, p. 1)

were assessed as technology-dominant in Table B.8, while statements like

> "Healthcare is the most pivotal domain of every nation. With the sudden upraise of the COVID-19 pandemic, there has been a major concern for the healthcare industry to provide quality medical services to the common people." (Ahanger *et al.*, 2022, p. 1)

lead to a not-technology-dominant assessment.

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