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Inductive Empiricism, Theory Specialization and Scientific Idealization in IS Theory Building

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Abstract:

This paper distinguishes and discusses three strategies for theory building in Information Systems (IS) - inductive empiricism, theory specialization and scientific idealization - and contrasts them in terms of three desiderata of theories - realism, generality and precision - and tradeoffs between them. Inductive empiricism, emphasizing realism and generality, represents the received view with the classic Grounded Theory Methodology as a prime example. The paper argues for openness to theory specialization in practical disciplines such as IS. Theory specialization implies sacrificing generality of theories for their realism and precision. The distinctive attention of the paper lies in scientific idealization, sacrificing realism of theories for their precision and generality. It has been almost completely omitted in in the literature on IS theory building. The special focus of the paper lies in IT applications as a category of IT artifacts and in design-oriented theories which provide knowledge of how to design "better" IT applications. The paper illustrates its points using TAM/UTAUT research as an example.

Keywords: Theory building, Inductive empiricism, Theory specialization, Scientific idealization, Grounded Theory Methodology, Technology Acceptance Model.

[Department statements, if appropriate, will be added by the editors. Teaching cases and panel reports will have a statement, which is also added by the editors.]

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This manuscript underwent [editorial/peer] review. It was received xx/xx/20xx and was with the authors for XX months for XX revisions. [firstname lastname] served as Associate Editor.] **or** The Associate Editor chose to remain anonymous.]

1 Introduction

Native IS theories, i.e. IS/IT-specific theories developed within the IS discipline, have been called for years (e.g. Walls et al. 1992, Orlikowski and Iacono 2001, Benbasat and Zmud 2003, Markus and Saunders 2007, Grover et al. 2008, Straub 2012, Grover and Lyytinen 2015, Tate et al. 2015). They are needed, since theories borrowed from reference disciplines - outside the disciplines of computing (Computer Science, Software Engineering, Information Systems) - tend to be void of any IS/IT-specific content. Therefore, they are weak in providing knowledge of how to design "better" IT artefacts to improve human conditions at the levels of individuals, groups, organizations, industries, markets, societies by (Grover and Lyytinen 2015).

The calls for native theories in IS has led to increased attention to theory building in the IS literature (e.g. Weber 2012, Burton-Jones et al. 2015, Grover and Lyytinen 2015, Markus and Rowe 2018, Hassan et al. 2019, Rivard 2021, Burton-Jones et al. 2021, Hassan et al. 2022, Mithas et al. 2022). However, this body of literature omits two biases of IS research: firstly, the preference for high generality of IS theories as a contrast to technology-specific and context-specific theories (Lee 1989, Lee and Baskerville 2003, Cheng et al. 2016, Davison and Martinsons 2016, Siponen and Klaavuniemi 2019); and secondly, almost the total omission of scientific idealization in IS theory building.

The purpose of this paper is to complement the extant IS literature by identifying and contrasting three strategies for theory building in IS: 1) inductive empiricism, 2) theory specialization, and 3) scientific idealization.

Inductive empiricism is introduced in this paper as a kind of "received view" that has gained wide attention in the IS literature. When following it, a researcher attempts to find a general principle or law (≈ theory) based on a finite number of empirical observations (Vickers 2009)[1]. The classic Grounded Theory Methodology (Glaser and Strauss 1967) is a prime example of inductive empiricism in IS theory building (e.g. Swanson and Swanson 1990, Urquhart 2001, Fernandez and Lehmann 2005, Urquhart et al. 2010, Birks et al. 2013, Urquhart and Fernandez 2013, Urquhart 2016).

In the case of theory specialization, instead of the ambition to achieve wide generality of theories, it is accepted that theories may be very technology-specific and/or context-specific. Theory specialization has been practiced for decades in IS when scholars have borrowed theories from reference disciplines and adapted them explain phenomena related to IT artifacts. The focus of this paper is, however, in theory specialization at the level of different IT artifacts rather than at the level of IT artifacts, in general.

Scientific idealization refers to the intentional introduction of untrue assumptions, or assumptions that are true only in extreme conditions, into scientific theories (Cartwright 1983, McMullin 1985, Mäki 2020). It has effectively been applied in physics and economics (e.g. the classical mechanics and microeconomics) as well as in social sciences ("ideal types"), including organization studies, but has largely been omitted as an explicit strategy of theory building in the IS literature.

The discussion of the three strategies makes two contribution to the IS literature addressing theory building. Firstly, and most importantly, it pays attention to scientific idealization in IS theory building. Secondly, it advocates openness to technology-specific and context-specific theories especially in practical disciplines (such as IS), which aim at supporting some extra-scientific action (Strasser 1985), since different technologies (e.g. different IT artifacts) differ in their effectiveness and efficiency in addressing specific practical problems (e.g. improving human or organizational performance by adopting IT artifacts). Theory specialization has been addressed in the context of theory contextualization (Hong et al. 2014) but the latter does not refer only to technology-specific or context-specific theories: it also covers general theories expanded by technological and/or contextual moderating factors that cover alternative technologies and contexts.

The structure of this paper is the following. The next section introduces the conceptual background of this paper. Sections 3-5 introduce the three strategies – inductive empiricism, theory specialization and scientific idealizations´ – separately. The section following these introductions use TAM/UTAUT research as an illustration. The final section makes some conclusions**.**

[1] Since "induction" is used as a proof technique in mathematics, I will use the phrase "inductive empiricism" to denote the empirical research strategy, in question.

2 Theory and its Quality

This section introduces first the interpretation of theory adopted in this paper. Thereafter it proceeds to three desiderata of theories - realism, precision and generality - and trade-offs between them (Levins 1966), claiming that inductive empiricism puts emphasis on realism and generality at the cost of precision, theory specialization on realism and precision at the cost of generality, and scientific idealization on generality and precision at the cost of realism.

2.1 Theory

It is well-known that the concept “theory” is not easy to define (Sutton and Staw 1989). I will focus in this paper on empirical theories only, i.e. on theories that attempt to describe and/or explain some external reality[2]. For that purpose, I adopt the interpretation of “theory” from Gregor (2006). She characterizes theories as “abstract entities that aim to describe, explain, and enhance understanding of the world and, in some cases, to provide predictions of what will happen in the future and to give a basis for intervention and action” (p. 616). As the major contribution, she introduces a taxonomy of five types of theory: (1) theory for analyzing, (2) theory for explaining, (3) theory for predicting, (4) theory for explaining and predicting, and (5) theory for design and action. The special focus of this paper lies in theories for explaining and/or predicting.

I do not make a sharp distinction between “models” and “theories” (see Niederman (2021) for some difficulties of separating), especially when models – just as theories – are intended to cover a class of instances rather than a single instance or event (but nothing is without exceptions: to my understanding the big bang theory in cosmology concerns a single actual event but in principle could cover several instances). A part of theory formulation is its expected scope of applicability (Tsang and Williams 2012), i.e. the boundaries within which the theory is expected to hold (Dubin 1978).

By “theory building” I refer to creating a new theory, excluding the ”strong” empirical testing of the proposed theory. If the theory in question is ”derived” from empirical data set, the ”strong” test should be based on data obtained from different units - within theory’s scope of applicability - than those in the initial data set and preferably be conducted by researchers different from the orginators of the theory in question. The above interpretation of ”theory building” does not exclude preliminary or “weak” testing or contrasting the theory under development with the reality to be modelled (Schickore 2022, Siponen and Klaavuniemi 2020).

This paper addresses theory building in the context of IS research. Therefore, I presume that theory building, whether following any of the three strategies, entail “IT artifacts” in a form or another in the theory under construction. The special focus of this paper lies in theory building in the case of “IT applications”, which are systems with human beings as users and have functionality/capability to provide direct services or affordances to their users (Iivari 2017)[3]. IT applications form a subset of “IT artifacts” (Orlikowski and Iacono 2000), which in my terminology cover all sort of computer hardware and software, related data communication technologies, digital content artifacts, and their system combinations. Despite this special focus, most of the time this paper refers to ”IT artifacts” in general, since they cover various base technologies (Lyytinen and Rose 2003), which may also be of interest in IS theory building.

My special interest is in design-oriented explanatory/predictive theories. They provide knowledge of how to design “better” IT artifacts by comprising design features (“design parameters” in Lee et al. 2021) of IT artifacts. However, I exclude “theories for design and action” or “design theories” from the scope of this paper. They are discussed in Walls et al. (1992), Gregor and Jones (2007), Kuechler and Vaishnavi (2012), and Iivari (2020), for example[4].

Explanatory/predictive (design-oriented) theories contain causal relationships (Gregor 2006). There is a huge body of literature on different conceptions of causation and causal modelling in the philosophy of

[2] As a consequence, I exclude “axiomatic theories” in the sense of pure axiomatic systems as used especially in mathematics without any attempt to describe/explain real world phenomena. An axiomatic system consists of a set of axioms from which one can logically derive a set of theorems. If an axiomatic system describes a real world phenomenon, it is not excluded. Note that this meaning of “axiomatic theory” differs from that in Lee et al. (2021).

[3] The word “direct” attempts to exclude so-called systems software from the category of IT applications. The services provided by systems software are indirect in the sense that they are required for providing the services of IT applications.

[4] I make a distinction between design-oriented explanatory/predictive theory and “design theory”. According to my interpretation the latter provides a theoretical justification for a heretofore innovative IT artifact (Hevner et al. 2004) in terms of kernel theories (Walls et al. 1992) or justificatory knowledge (Gregor and Jones 2007).

science and in special disciplines such as IS (Markus and Robey 1988, Lee et al. 1997, Gregor 2006, Gregor and Hovorka 2011, Avgerou 2013, Burton-Jones et al. 2015, Mingers and Standing 2017, Markus and Rowe 2018, Siponen et al. 2020, Mithas et al. 2022). In philosophy of science it is common to distinguish at least five accounts of causation: regularity, counterfactual, probabilistic, interventionist, and process theories of causation (Rohlfing and Zuber 2021). With Lee et al. (1997) as an exception, the IS papers mentioned above do not take a position to what account of causation is the most appropriate. Since such a position is not necessary for the argumentation of this paper, I will not discuss causation in more detail in this paper.

2.2 Desiderata of Theories

Levins (1966) distinguishes realism, precision and generality of models as their desiderata and the trade-off relationships between them[5]. He does not clearly define these concepts, but their meanings can be inferred from examples he uses and from the explanations of his work (Weisberg 2006). According to Weisberg (2006) *realism* describes how accurately a theory/model represents the phenomenon to be modelled[6]. Since highly fictive models, e.g. Schelling's (1978) model of population segregation (as introduced in Elliot-Graves and Weisberg (2014)), may allow fairly accurate predictions, I prefer to stick to Levins' terminology. I also wish to emphasize representational faithfulness, i.e. the correspondence between the representation and the part of reality to be represented, in addition to accuracy. Note, however, that the discussion below does not stipulate any "absolute" concept of the degree of realism, which could be used to compare realism of any theory/model of the phenomenon of interest (e.g. of IS use). Realism as used in this paper is a (transitive) relationship between theory/model versions under development: if theory/model M_2 is a refinement of theory/model M_1 it is more accurate than M_1, but not necessarily more faithful, if the refinement is incorrect.

In the case of *precision* I adopt Levins' (1966) original view rather than Weisberg's (2006) interpretation[7]. Levins describes sacrificing precision as resorting to qualitative models - "very flexible models, often graphical, which generally assume that functions are increasing or decreasing, convex or concave, greater or less than some value, instead of specifying the mathematical form of an equation" (p. 422). So, *precision* in this paper describes how unambiguously the theory is described. In order to increase their precision, scientific theories are usually described in a scientific language rather than in the ordinary language, using alternative and complementary representation techniques (e.g. mathematical-logical formalism, graphical representations, natural language descriptions).

In the case of *generality*, I adopt Weisberg's interpretation of generality as the number of actual or alternatively potential phenomena that a model can be applied to. Actual generality corresponds to the concept of scope of applicability, "which refers to how far a theory covers certain empirical phenomena" (Tsang and Williams 2012), whereas potential generality refers to all possible systems to which theory can be applied[8].

Levins (1966) point is that it is impossible to maximize realism, precision and generality at the same time. As the result he identifies three strategies:

- Sacrifice generality to realism and precision.

[5] Weick (1979) introduced quite a similar framework of trade-offs between accuracy (≈ realism), simplicity and generality. It is frequently referred in the IS literature (e.g. Weber 2012). This paper adopts Levins' framework, however, since it is more appropriate for the purpose of this paper to contrast the three strategies of theory building.

[6] Weisberg (2006) identifies two interpretations of realism in Levins (1966): how well the structure of the model represents the structure of the world or (…) how close the output of the model matches some aspect of the target phenomenon." (p. 635). Realism in this paper refers to the former interpretation, being analogous to "representational faithfulness" of IS models (Recker et al. 2019). The latter interpretation of realism is close to predictive accuracy/precision as noted by Weisberg.

[7] Weisberg (2006) interprets precision as "fineness of specification of the parameters, variables, and other parts of model descriptions" (p. 636), associating it with statistical properties such as measurement error.

[8] This paper is interested in generality of theories, not in their generalizability (Lee and Baskerville 2003), and it addresses "generalization" (Lee and Baskerville 2003, Tsang and Williams 2012) only tangentially: Inductive empiricism (Section 3) includes a two-stage "theoretical generalization" (Tsang and Williams 2011) from empirical data to "substantive theory" (ET generalization in Lee and Baskerville 2003) and further generalization from "substantive theory" to "formal theory").

- Sacrifice realism to generality and precision.
- Sacrifice precision to realism and generality.

Most scholars construe that the three strategies reflect a three-way trade-off between the three desiderata. Referring to Weinberg (2006), I interpret that the trade-offs are relevant when the qualities are at a high level: when one attempts to increase two criteria beyond some point, it tends to happen at the cost of the remaining one.

When expressing Levins' three strategies not in terms of sacrificing but in terms of building such and such models (Weisberg 2006), one can distinguish three research strategies (Table 1).

Table 1. Three strategies of theory building and their desiderata

Inductive empiricism	Build realistic and general models/theories at the expense of precision
Theory specialization	Build realistic and precise models/theories at the expense of generality
Scientific idealization	Build general and precise models/theories at the expense of realism

The following sections introduce these strategies in more detail, starting with inductive empiricism and continuing then to theory specialization and scientific idealization. The strategies themselves are introduced as a kind of Weberian" ideal types" underlining their desiderata as described in Table 1. The paper does not attempt to discuss all variants of each strategy and still less how well actual research projects manage to achieve the desiderata.

3 Inductive Empiricism and Theory Construction

Induction commonly refers to "inference from a finite number of particular cases to further case or general conclusion" (Mautner 1996). The general conclusion may be theory inferred from observed particular cases.

Classic Grounded Theory Methodology (CGTM) (Glaser and Strauss 1967) is an excellent example of inductive empiricism. I will argue that it forms a kind of ideal of GTM, which has received considerable attention in the literature on IS theory building (see Swanson and Swanson 1990, Urquhart 2001, Fernandez and Lehmann 2005, Urquhart et al. 2010, Birks et al. 2013, Urquhart and Fernandez 2013, Urquhart 2016 for methodological discussions, and Wiesche et al. 2017 for a review of empirical GTM studies in IS).

3.1 Grounded Theory and Inductive Empiricism

The purpose of this section is not introduce GTM as such but to argue that CGTM emphasizes realism and generality at the expense of precision. CGTM suggests an iterative process of theoretical sampling, where theory in progress (its concepts and constructs) directs where to sample from next, and constant comparison, where a new slice of data is compared with the existing concepts and constructs (Urquhart et al. 2010). The concept of "theoretical saturation" illustrates the inductive nature of closing the process. It advices a researcher to continue collecting slices of data until new theoretical constructs cease arising so that the next slice likely brings nothing new (Birks et al. 2013). Yet, there is no guarantee that the next slice of data could not bring something new.

As for realism, CGTM was suggested as a reaction to armchair theorizing at that time (Urquhart et al. 2010). The basic idea is to let theory emerge from data. Glaser and Strauss (1967) advice a researcher "at first, literally to ignore the literature of theory (…) in order to assure that the emergence of categories of data will not be contaminated by concepts" of the extant theory (p. 37). As explained by Urquhart and Fernandez (2013) this does not mean that a researcher is assumed to enter the research process as a blank slate, but the point is that "the researcher has to *set aside theoretical ideas* in order to let the substantive theory emerge" (Urquhart 2016).

As for generality, Glaser and Strauss (1967) consider the generality of theory an important desideratum of grounded theories (p. 24). This aim at generality culminates in formal grounded theories. A formal grounded theory is a generalization of the initial substantive grounded theory – providing an explanation of a phenomenon in a particular substantive area - to cover similar phenomena in other substantive areas (Urquhart and Fernandez 2013). Although Urquhart and Fernandez note that both substantive and formal grounded theories can make valuable research contributions, they point out that the weak attention to formal theories - confirmed by Wiesche et al. (2017) – stops short the exploitation of full potential of GTM of theory building in IS research.

As for precision, the GTM literature does not provide as clear clues of its position. However, it is indicative that the literature on the quality of grounded theories (e.g. Berthelsen et al. 2018, Charmaz and Thornberg 2021) does not introduce precision as an evaluation criterion of resultant substantive and formal theories. However, rewriting techniques for advancing from substantive to formal theories easily make the theory more ambiguous[9]. The lack of precision increases the "interpretive flexibility" of theories and therefore their generality.

There are also variants of GTM which deviate from the characteristics of inductive empiricism. Firstly, one should note that all research methods characterized as "inductive" are not strictly so. Eisenhardt (1989) and Eisenhardt and Kraeber (2007), being heavily influenced by GTM, include aspects in which prior theory enters the process (e.g. "theoretical sampling" interpreted more broadly than in CGTM), implying that prior theory or theories may direct the sampling[10]. Secondly, McCall and Edwards (2021) point out that the three versions of GTM (Classic or Glaserian, Pragmatic or Strauss-Corbian, Constructivist or Charmazian) differ in their generality ambition.

Despite these deviations, one can claim that the inductive empiricism with generality and realism as primary desiderata forms an ideal of GTM in IS (Urquhart and Fernandez 2013, Urquhart 2016). However, Wiesche et al. (2017) note in their review that actual GTM studies in IS have produced mainly rich descriptions and substantive theories[11]. Substantive grounded theories as "developed for an empirical area of inquiry" (Wiesche et al. 2017, p. 687) provide natural candidates for theory specialization (De Vreede et al. (1998) and Gasson and Waters (2013) as examples), i.e. theories with scope of applicability confined to specific IT/IS artifacts and/or contexts-specific theories rather than IT artifacts in general without any contextual boundaries (see Section 4).

3.2 Views of Theory Building Challenging Inductive Empiricism

Popper (1963) and Hempel (1966) as leading advocates of the hypothetico-deductive method denied that theories are developed inductively from observations and saw theory development so creative process that decided to pass it by characterizing it as guesswork (Siponen and Klaavuniemi 2020). Hanson (1958) suggested that theory discovery is based on abductive thinking. However, if abduction is interpreted as inference to the best explanation (Mantere and Ketokivi 2013), it is not sufficient to explain the "heureka moment" of inventing the new theoretical explanation or hypotheses (Schickore 2022).

Scholars in behavioral sciences have adopted an intermediate position - between inductive empiricism and pure guesswork - that empirical material inspires theory building (e.g., Weick 1989, Ohlsson and Lehtinen 2007, Alvesson and Kärreman 2007, Klag and Langley 2013, Cornelissen and Durand 2014), but new theories are not directly discoverable from the empirical material. These ideas have influenced the recent discourse on theory building in IS research directly (Hassan et al. 2019, 2022) or indirectly (Rivard 2021). Drawing heavily from philosophy of science, Siponen and Klaavuniemi (2020) also emphasize guessing and imagination in theory building, and the inspiring role of observations and serendipity therein.

Advocates of this intermediate position have also suggested different heuristics to stimulate theory building focusing on dialectic tensions (Klag and Langley 2013), breakdowns of existing theories and related mysteries (Alvesson and Kärreman 2007) and making use of analogical and counterfactual reasoning as heuristics in the theory development (Cornelissen and Durand 2014).

Focusing more on natural sciences and mathematics, Ohlsson and Lehtinen (1997) criticise induction more radically. They argue that generality in science is not achieved by extracting similarities from particulars, but through abstraction and idealization (see Section 5). They employ theories such as the law of gravitation and the Darwinian theory of evolution as examples of their position.

[9] To take an example, conceptual generalization of "dying" into "nonscheduled status passage" Glaser and Strauss (1967, p. 80) illustrates the point. Obviously, "dying" is less ambiguous as a concept than "nonscheduled status passage". The latter entails the problem of what phenomena can be interpreted as such passages.

[10] More philosophically, one may also question whether any GTM study can be strictly inductive so that prior theories do not affect ("contaminate") emergence of data and data analysis.

[11] When limiting my Google Scholar search to Senior Scholar Basket Eight (SSB8) journals (EJIS, ISJ, ISR, JAIS, JIT, JMIS, JSIS, MISQ), I could identify only two projects that claim to proceed to the level formal theory - that of Walsh (2014a, Walsh 2014b) and that of Gleasure and Feller 2016).

4 Theory Specialization and Theory Construction

IS research typically has implicitly or explicitly preferred wide generality to narrow one (Lee 1989, Lee and Baskerville 2003, Cheng et al. 2016, Davison and Martinsons 2016, Siponen and Klaavuniemi 2019). Generality is, of course, an important desideratum of theories, but not the only one. Especially in practical (applied) disciplines (Strasser 1985), a researcher should be open to specific theories and to be ready to sacrifice generality for realism and precision.

By “theory specialization” I refer to building technology-specific theory and context-specific theory (cf. Tate et al. 2015)[12]. This paper focuses on context-specific theories and in particular on technology-specific theories at the level of different IT artifacts (opposite to technology-specific theories at the level of IT artifacts in general).

Theory specialization is closely related to “theory contextualization” (Hong et al. 2014) but differs from it in three respects. Firstly, theory contextualization assumes that there is a general theory to be contextualized (Hong et al. 2014). I do not presuppose such general prior theory but one may construct specific theories from ”scratch”. However, if there exists relevant, well-established, more general, theories to be specialized, it makes easier to develop a more specific theory.

Secondly, theory contextualization is wider, covering constructing theories that incorporate technology and context as factors moderating the relationships in the resultant theory. UTAUT2+ in Blut et al. (2022) is an example, in which both technology factors and context factors serve as moderators. They make it possible to theorize about moderating effects of alternative technologies and contextual differences, but do not provide technology-specific or context-specific theory[13].

Thirdly, contrary to Hong et al. (2014), I make a distinction between context-specific and technology-specific theories. The reason is that technology and context are qualitatively quite different phenomena. Technologies as human products are constantly evolving and proliferating but fairly concrete and analyzable whereas context is fairly stable when compared with technologies. Context may, however, comprise a myriad of potentially relevant demographic, psychological, managerial, economic, social, institutional, cultural, material, etc. factors (Avgerou 2019) related to individuals, groups, organizations, communities, industries, countries, etc.

Figure 1 depicts the resultant conceptual structure with illustrative examples, focusing on technology-specific and context-specific theories and distinguishing theory specialization with *prior* theory and without it.

As for theory specialization of *prior* theory, De Vreede et al. (1998) and Pavlou and Fygenson (2006) are excellent examples. De Vreede et al. (1998) is a GTM study that investigates decision support systems (DSS) acceptance in Africa, adopting the original TAM as a general theory of acceptance. Pavlou and Fygenson (2006) suggest and empirically test a theory specific to e-commerce, using the theory of planned behavior as a general theory, extending it cover a number of e-commerce-specific factors to explain purchasing behavior.

Gasson and Waters (2013) and Burton-Jones and Volkoff (2017) provide examples of theory specialization without *prior* theory to be specialized. Gasson and Waters (2013) is a GTM study that suggests a substantive theory that “explains how students in asynchronous learning environments interact in progressive knowledge construction and how a community of learning forms around key thought-leaders” (p. 114). Even though they refer to a number of theories, according to my reading their substantive theory is not a specialization of any of prior theory. Burton-Jones and Volkoff (2017) construct a technology-specific theory of effective use of a community-care electronic healthcare record (EHR) system in the context of a Canadian health authority. They build their work on earlier ideas of effective use and affordances but do not introduce it as a specialization of any *prior* theory.

[12] By context I refer to the environment or surrounding of the phenomenon to be explained by theory, exerting influence on the focal phenomenon (e.g. use of IT artifacts) (Avgerou 2019).

[13] In the case of context, Avgerou (2019) makes quite a similar distinction between two ways of developing contextual theory: 1) deriving theory from the (interpretive) study of IS phenomena in a specific context, and 2) adding contextual factors to existing a-contextual theories. Differing from Avgerou (2019) I do assume that constructing context-specific theories necessarily demands interpretive research.

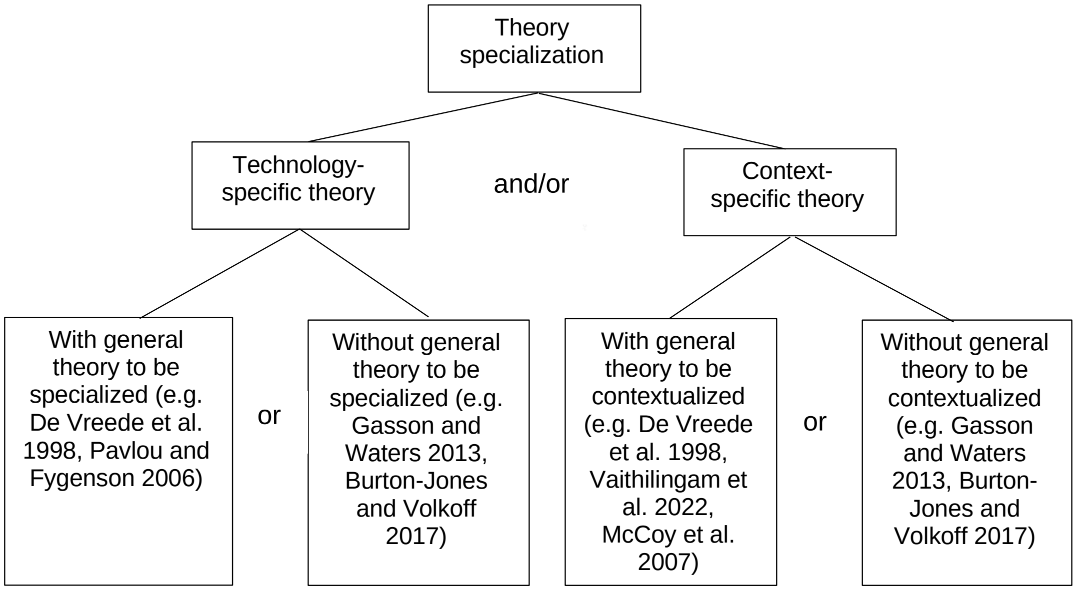

Figure 1. Types of Theory Specialization with Examples

De Vreede et al. (1998) and Vaithilingam et al. (2022) are examples of theory contextualization with a general theory to be contextualized, leading to a context-specific theory. De Vreede's et al. (1998) empirical material is from three English speaking south-eastern African countries. They extend TAM by a number of context-specific external factors and recommend further research to find out whether their findings may be valid in other English speaking countries in Africa and in Africa more generally. Investigating antecedents of instrumental and non-instrumental mobile phone use among urban poor in Malaysia, Vaithilingam et al. (2022) contextualize UTAUT by introducing a context-specific set of facilitating conditions. The study led to some modifications to the original UTAUT. It was, however, confined to in one region within Malaysia. The authors do not attempt to generalize it to urban poor in developing countries, for example.

As a third example of contextualization of a *prior* theory, McCoy et al. (2007) reports a study that does not change the nomological structure of prior theory (TAM) but its scope of applicability. They found that TAM does not hold in cultural contexts (Hofstede 1991) with low uncertainty avoidance, high masculinity, high power distance, and high collectivism. Based on these findings, the authors suggest that the validity of TAM is questionable at least in 20 countries.

Gasson and Watson (2013) and Burton-Jones and Volkoff (2017) also are examples of constructing a context-specific theory without any general theory to contextualized. Gasson and Watson (2013) do not clearly state the scope of applicability of their substantive theory, but it is based on findings in one institute of higher education. They claim that it is transferable to similar populations and contexts. Burton-Jones and Volkoff (2017) suggest that their theory explains what effective use involves in the particular context. They claim, however, that it can help other similar organizations to figure out how to use EHR systems effectively but warn about its broader generalization without additional studies.

De Vreede et al. (1998), Gasson and Waters (2013) and Burton-Jones and Volkoff (2017) illustrate a single study can be both technology-specific and context-specific.

A critical question in the case of technology-specific theory specialization is the granularity of technologies (IT artifacts). Orlikowski and Iacono (2001) made a call for theorizing the IT artifact and suggested thirteen views of technology for that purpose. However, twenty years later, Burton-Jones et al. (2021) on "next-generation IS theorizing" does not explicitly emphasize the role of IT artifacts in such theorizing but warns about focusing current technology fads and underlines the importance of finding "a balance between focusing on fundamentals and fads in our theorizing".

The concern of Burton-Jones et al. is justified, since for understandable reasons IS researchers are prone to commercial faddism[14]. One should note, however, that new technologies seldom come out in vacuum, but they build on existing technologies. Therefore, one means to counteract against faddism is to emphasize technological continuities (Iivari 2014a).

As for context-specific theory specialization, Avgerou's (2019) main concern is the generalization of context-specific research findings. The reason is that she seems to interpret that context-specific research focuses on single instances, using case studies as the major research approach. This paper does not make such an assumption as implied by Vaithilingam et al. (2022) in Figure 1.

Davison and Martinsons (2016) call for more particularistic (indigenous) constructs specific to country in question when attempting to test IS theories originally developed in other contexts. The reason is that universalistic constructs (e.g. Hofstede's cultural dimensions) and the neglect of indigenous ones artificially reinforces the view that the IS theory in question is universally valid without testing any alternative explanations. One can also expect that indigenous contextual constructs result more in context-specific theories than universalistic contextual theories.

5 Scientific Idealization and Theory Construction

Scientific idealization refers to the intentional introduction of untrue assumptions or assumptions that are true only in extreme conditions into scientific theories (e.g. Cartwright 1983, McMullin 1985, Wimsatt 1987, Potochnik 2017, Mäki 2020). It has been effectively used in physics and economics, in particular (e.g. the idea free movement of particles in the Newtonian theory of classical mechanics, and the idea of perfect competition, assuming firms with perfect knowledge and totally free entry to and exit from the market, and "homo economicus" actors). Turing machine in Computer Science is also an example of scientific idealization.

Generally, philosophers see idealizations to be advantageous in science. Potochnik (2017) claims that resorting to idealizations is explained by the fact that science is practiced by human beings with limited cognitive capabilities to understand the incredibly complex world. Mäki (2020) identifies a number of functions of idealizations. They make it possible to simplify theories, they help isolate causal dependencies in theories, they may serve as benchmark models to which actual world (or more realistic models) can be contrasted, and they may allow exploring normative ideals involving ethical and political ideals (pp. 219-220).

Nowak (1992) suggests that there are at least five approaches to idealization: 1) Idealization as a method of correcting and transforming raw empirical data into scientific facts (neo-Duhemian approach). 2) Idealization as a method of constructing scientific notions (neo-Weberian approach). 3) Idealization as a deliberate falsification which never attempts to be more than truthlike (neo-Leibnitzian approach). 4) Idealization as a means of filling the discrepancy between a mathematical formalism and the imprecise reality the mathematical formalism attempts to describe (neo-Millian approach). 5) Idealization as a separation of the essence of the phenomenon from its appearance (neo-Hegelian approach).

Nowak does not provide concrete examples of these five approaches. In the case of neo-Duhemian idealization I could imagine an example of a transition from empirical data, which normally includes errors, to an idealized error-free theoretical concept or construct. I think that the Weberian concept of bureaucracy illustrates the neo-Weberian idealizations, more generally. The neo-Leibnitzian approach is the architypical form of idealization. In the case of neo-Millian idealization assumptions of shapes of the mathematical relationships (linearity vs. nonlinearity, derivatives, etc.) are concrete examples. Even though Hegel is not considered a key representative of phenomenology, the neo-Hegelian approach can be considered as phenomenologial search for essences, which may be idealizations[15].

Furthermore, Nowak (1992) identifies pseudo-idealization, which allows that the idealization can be true in some cases (i.e. have empirical instances) and semi-idealization when scientists deliberately omit some factors affecting the magnitude in question (usually making a contrafactual *ceteris paribus* assumption that

[14] Technology (IT artifacts) form the *raison d'être* for the existence of the disciplines of computing (Computer Science, Software Engineering, Information Systems) and technology development is a *primus motor* of IS practice and research. This combined with the ambition for novelty, innovativeness and practical relevance of research, creates temptation to focus on fads and a tendency to introduce them as radical or disruptive innovations rather than incremental ones.
[15] I am not any expert on phenomenology, but Klawiter (2004) claims that according to Husserl studies of natural sciences are based on "ideal essences", which are scientific idealizations.

the omitted factors remain constant)[16]. Idealization as used in this paper comprise all these approaches and their combinations and furthermore pseudo-idealizations and semi-idealizations in the above meanings.

It is clear that idealized assumptions compromise the realism of theories or models. As for generality of idealized theories, they are not necessarily true representations any real phenomenon. This raises the puzzle of how they can be epistemologically beneficial and how they are related to truth (e.g. McMullin 1985, Elgin 2004, Sullivan and Khalifa 2019). It is beyond the scope of the paper to delve into this discussion. However, it is clear that it is not particularly fruitful to assess the truthfulness of theories with idealized assumptions and their scope of applicability (generality) in terms of simple truth (true vs. false), since theories may differ in their closeness to truth, i.e to what extent they are "approximately true" (McMullin 1985) or how "truthlike" they are (Niiniluoto 1999)[17].

When generality (i.e. scope of applicability) is interpreted in terms of approximate truth or truthlikeness, scientific idealization - especially simplification of theories and isolation of causal dependencies (Mäki 2020) – supports the generality of theories.

As for precision, the approaches identified by Nowak (1990) to a large extent attempt to increase the precision of theories (scientific facts, scientific notions, mathematical representations, essences of phenomena).

Despite the ubiquity of idealizations in theories, recent accounts of theory and theory building in IS (e.g. Weber 2012, Hong et al. 2014, Burton-Jones et al. 2015, Grover and Lyytinen 2015, Markus and Rowe 2018, Niederman and March 2019, Rivard 2021, Burton-Jones et al. 2021, Lee et al. 2021, Mithas et al. 2022) do not pay any attention to them. However, Krämer in his contribution in Bichler et al. (2106) discusses idealization to some extent. He largely builds his discussion on theorising and modelling in economics. Siponen and Klaavuniemi (2019, 2021) also touch scientific idealizations pointing out that they complicate generality (generalizability) issues and challenge the "absolute" truth as the criterion of generality, but do not discuss the weaker forms of truthfulness as possible criteria. With ideal types as exceptions (see below), it is also difficult to find examples of explicitly introduced scientific idealizations in papers published in the SSB8 journals, for example[18].

One should note, however, that approximately true idealized theories make their falsifiability (Popper 1963, Weber 2012) and their empirical testing challenging. This may partly explain the weak attention to idealizations in IS research[19].

This paper specifically focuses on Weberian ideal types, which represents scientific idealizations in social sciences. Weber (1949) defines ideal type as follows (p. 90):

> *An ideal type is formed by the one-sided accentuation of one or more points of view … In its conceptual purity, this mental construct (Gedankebild) cannot be found empirically anywhere in reality.*

Mäki (2020) discusses Weber's ideal types as idealizations. He notes that Weber is not very clear about what ideal types are. He also points out that the accentuation or exaggeration must be taken to an extreme to be idealization. On the other hand, Weber assumes ideal types to be so extreme that they cannot be found in reality. Mäki also concludes that ideal types can be used as benchmark models (theories): an ideal type has "the significance as a purely ideal limiting concept with which the real situation or action is compared and surveyed for the explication of certain of its significant components" (Weber 1949, p. 93).

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[16] "Ceteris paribus" is used in this paper in the sense of "other things being equal" rather than "other things being right" (Cartwright 1980).

[17] Concepts of "approximate truth" and "truthlikeness" are tricky in the philosophy of science. Despite it I agree with Johansson (2017) that the notion "truthlikeness" is important as a non-formal comparative concept despite the difficulty of formalizing it perfectly (Oddie 2014, Niiniluoto 2020).

[18] IS papers may implicitly introduce scientific idealizations when borrowing theories from reference discipline (e.g. rational choice theory, ideal speech situation in speech act theory). IS scholars with economics as a central reference discipline may also unconsciously adopt idealizations as a normal scientific practice in their IS theory building.

[19] Even though it is beyond the scope of this paper to address "strong testing" of theories, let me remark that a highly idealized theory may provide reasonable and possibly insightful predictions (e.g. Schelling's (1978) model of population segregation). Furthermore, deviations from the idealization may explain the accuracy of predictions. However, due to the approximate truthfulness of idealized theory, it is unlikely that a single replication study or observation is sufficient to falsify it. Instead, a series of replication studies (Dennis and Valacich 2014) is needed to accumulate empirical evidence (confirmatory and disconfirmatory) just as in the case of theories with probabilistic causal relationships and predictions.

Rather than viewing individual ideal types independently, Doty and Glick (1994) introduce “ideal types” as constituents of typologies. The latter are “conceptually derived interrelated sets of ideal types” (p. 232). They differ from classifications and taxonomies that categorize objects into mutually exclusive and exhaustive sets. Classifications and taxonomies are therefore empirical, whereas typologies are more conceptual.

Doty and Glick (1994) also argue that typologies as such are theories. One should recognize, however, that they use the concepts of “typology” and “ideal type” in a slightly different meaning as above. They associate a “typology” with some dependent variable(s) and interpret “ideal types” as internally consistent patterns that are effective with regard to the performance variable(s): greater similarity to an ideal type will result in greater effectiveness.

The present paper does not assume a typology is by definition associated with any dependent variable(s). As a consequence, typology is Type I theory, i.e. “theory for analyzing”, without any prerequisite that the related ideal types are effective. Referring to Bunge (1967), one can claim that typologies do not have any truth value: they are more or less adequate and useful in subsequent building of theories for explaining and/or predicting. If these theories based on a specific typology turn out to be valid, they provide support for the validity of the underlying typology, too.

Despite the early attempt to apply the idea of “ideal type” to make sense of IT applications at that time (Dutton and Kraemer 1978), the IS literature refers to ideal types quite sparingly. When writing this (March, 2023), I could find 84 papers published in SSB8 journals referring to “ideal types” and only a handful of them introducing a typology of ideal types. The proposed typologies cover a wide variety of IT/IS phenomena: for example, configurations of IT organizations (Johnston and Yetton 1996), strategies for knowledge management (Earl 2001), user profiles (Walsh et al. 2010), growth tactics of digital infrastructures (Koutsikouri et al. 2018), collective IS use (Negoita et al. 2018), user liability to IT addiction (Vaghefi 2017), digital application marketplaces (Ghazawneh and Hendfridsson 2019)[20].

These are notable theoretical contributions at the level of theories for analyzing but, as far as I know, research on them has not continued at the level of theories for explaining and predicting (Gregor 2006), not even when the typology explicitly or implicitly makes empirical assumptions. For example, in line of the idea of “fit” in contingency theory (Drazin and Van de Ven 1985), Johnston and Yetton (1996) assume a fit between organizational configuration and the configuration of IT organization to be effective. Negoita et al. (2018) are less explicit but conceptualize each ideal type of collective use as a fit between task interdependence on the one hand and user interdependence and system interdependence on the other hand, likely implicitly assuming that each ideal type represents an effective combination (in some respect) of the three interdependencies. Vaghefi et al. (2017) suggests a number of propositions associating each of the ideal types of his typology with user liability to IT addiction. To my knowledge these assumption and propositions have not been empirically tested[21].

6 TAM/UTAUT Research as an Illustration

6.1 Introduction

Since most IS scholars are already familiar with TAM/UTAUT (Davis 1989, Venkatesh et al. 2003), I will use it to illustrate the major points - scientific idealization and theory specialization - of this paper.

Although Davis does not initially introduce TAM as theory (Davis 1989, Davis et al. 1989), it has later received such a status in the IS literature. Nowadays it is without any doubt the most cited theory contribution of IS research, not only within IS but also outside it. Quite interestingly, it seems that early TAM research has implicitly followed the strategy of scientific idealization (see Section 6.2).

The major attention of TAM research has been on various contextual factors (Lee et al. 2003, Venkatesh et al. 2003), how they affect perceived usefulness (PU) and perceived ease (PEU), and ultimately all them together explain the acceptance and use of IT artifacts. Actually, the baseline theories/models on TAM/UTAUT research - TAM (Davis et al. 1989), TAM2 (Venkatesh and Davis 2000), UTAUT (Venkatesh

[20] Both Earl (2001) and Walsh et al. (2010) speak about taxonomy rather than typology but seem to refer to a typology in any case. Walsh (2014b) has changed her terminology compared with Walsh et al. (2010).

[21] The typology of user profiles of Walsh (2010) may be an exception. It is referred to in her later papers introducing a formal grounded theory of IT use (Walsh 2014a, Walsh 2014b). However, it seems that this formal theory is not directly based on the typology of user profiles in question.

et al. 2003), UTAUT2 (Venkatesh et al. 2012) and UTAUT2+ (Blut et al., 2022) have all the time focused on contextual factors rather than on characteristics of "IT artifacts".

It is hardly much need to keep on replicating studies that attempt to confirm the downstream effects of PU and PEU on acceptance and use of IT artifacts[22]. Instead, there is still need for to understand "what makes the system useful" (Benbasat and Barki 2007), "what makes the system easy to use", and "what makes the system enjoyable" (Davis et al. 1992), "what makes the system sociable to use" (Iivari 2014b), "what" being expressed in actionable qualities (similar to treatments in medicine)[23].

6.2 Scientific idealization and TAM/UTAUT research

Table 2 adapted from Iivari (2007 and 2014a) introduces a typology of IT applications. It is based on the primary purpose or function of the application type, in question (indicated in **bold**). When foregrounding the primary purpose/function of each ideal type instead of the implementation technology (e.g. infrastructure, platform and acquisition choices) research into IT applications can be expected to be more cumulative than research fore-fronting constantly evolving implementation technology[24].

Table 2. A Typology of IT Applications and their Design Focus

Ideal type	Primary design quality characteristics or design parameters
Automating applications	*System quality* (in the sense of DeLone and McLean, excluding aspects of usability).
Augmenting applications (e.g. personal productivity tools)	*Usability* (in the sense of ease of use and ease of learning). *User-to-system interactivity* (see entertaining applications below).
Mediating (communicating) applications (e.g. Internet call systems)	*User-to-user interactivity* (supported by qualities such as reciprocity, multimodality, and responsiveness of user-to-user interaction). *User identifiability* (covering user anonymity as a special case).
Informating applications (e.g. information systems proper)	*Information quality* (in the sense of DeLone and McLean).
Entertaining (enjoying) applications (one player digital games)	*Funniness* (of the characters, story, sound, graphics, interface, etc.). *User-to-system interactivity* (supported by qualities such as user control of the interaction, multimodality, and system responsiveness of the user-to-system the interaction).
Artisticizing applications (pieces of computer art)	*Artistic quality* (comprising technical skill and originality). *Aesthetic quality* (referring to the beauty of IT artifacts, covering classical aesthetics and expressive aesthetics).
Accompanying applications (e.g. social robots, digital pets)	*Emotional quality* (the quality of emotions built in the IT artifact).
Fantasizing applications for constructing fantasy worlds (e.g. Second Life)	*Identity constructability* (by choosing nicknames, wearing different embodiments (e.g. Avatars), and talking, discussing, and negotiating about various identities.
All	*Functional quality*: the extent to which the system provides the expected or desired functionality to its clients and users or user groups and the extent to which the system excludes undesired or not-allowed functionality from clients, users or user groups.

The resultant typology comprises eight ideal types. The first four are close to "technology as a labor substitution tool", "technology as a productivity tool", "technology as a social relations tool" and "technology as an information processing tool" in Orlikowski and Iacono (2001), while the next four are still more esoteric types of applications primarily used for leisure purposes. However, their features may be

[22] For simplicity I use the TAM terminology rather than UTAUT terminology in this paper, i.e. PU ≈ Performance expectancy and PEU ≈ Effort expectancy.
[23] "Sociability of use" describes a user's belief of to what extent using an IT application helps him or her to create and maintain social contacts (Iivari 2014b).
[24] If implementation technology (e.g. a distinction between traditional and cloud infrastructure) is discovered to be an essential from the viewpoint of research interest, it can be used to distinguish subtypes in the typology.

included in more conventional IT applications as exemplified by the gamification phenomenon (Hamari et al. 2015)[25].

Benbasat and Barki (2007) point out that TAM and related research has been weakly linked with design. To address this shortcoming, Table 2 also identifies primary design quality characteristics or design parameters (Lee et al. 2021) in the case of each ideal type (indicated in *italics*). In automating applications proper functionality and systems quality (DeLone and McLean 1992), especially reliability and safety, are primary. Safety critical software in self-driving cars provides a timely example of such an application. Interactive productivity tools - such as word processing software or computer-aided design software - made usability (≈ ease of use) critical. In the case of computer mediated communication application such as e-mail and Internet call systems, user-to-user interactivity is essential in addition to the proper functionality. In information systems proper, which attempt to serve their users by providing information, information content and its quality (DeLone and McLean 1992) are crucial. In the case of computer games, the game should be funny, engaging and enjoyable to play.

Table 2 also suggests examples that are as close as possible to the ideal type, in question. If one considers the history of early TAM research, it has - possibly unintentionally - made use of IT applications close to the ideal types. Davis (1989) reports results of empirical studies of using e-mail (mediating application) and of three augmenting applications (file editor, two graphics software), and Davis et al (1989) draws on results obtained in the context of word processing (augmenting application). According to Yousafzai's (2007) review, these two application types heavily dominated early TAM research up to year 1994.

Since then, TAM has been investigated in the context of different IT artifacts and applications. Most modern IT applications are, however, hybrid ones, combinations of several ideal types. I will argue in the next section that ideal types are, nevertheless, useful in theory construction.

6.3 Typology of IT Applications and Theory Specialization

As noted above, early TAM/UTAUT research as at least implicitly followed the specialization strategy but has since then proceeded from the fairly simple augmenting and mediating applications to more complex (hybrid) ones without any systematic framework.

Despite the massive TAM/UTAUT research up-to-now, there is still need for to understand IS acceptance and use in terms of actionable design characteristics leading to the following research question:

> **RQ: What design characteristics make IT applications of type i useful/easy to use/enjoyable/ sociable?", where i = (automating, augmenting, mediating, informating, entertaining, artisticizing, accompanying, fantasizing) and thereby affect their acceptance and use**

Table 2 suggests that there are – at least partly - different design quality characteristics that explain the usefulness of IT applications of each ideal type. The same situation may be in the case of ease of use, enjoyment and sociability of use. All this implies theory specialization.

Although one can identify examples close to the eight archetypes in Table 2, many IT applications in practice are hybrid ones that combine aspects of several ideal types (Iivari 2007). To take an example, e-commerce applications may comprise aspects of each of the eight application types.

When a researcher gets interested in (a class of) new IT applications such as "social media" (10-20 years ago), the first question is what the class of IT application is. It is usually interpreted to consists of a number of social networking sites (SNSs) such as Facebook, Twitter, LinkedIn, Instagram, etc.

The second question is, what the IT applications of interest are made of? One option is to focus on affordances provided by the system (e.g. Burton-Jones and Volkoff 2017, Karahanna et al. 2018, Bao et al. 2020). Karahanna et al. (2018), for example, identifies social media affordances as a part of needs-affordances-features perspective of social media use. They suggest that users are motivated to use those STS sites which provide affordances that satisfy their psychological needs.

Affordances as used in Karahanna et al. (2018) do not tell anything about the quality of the system. Even though providing the same set of affordances, systems may differ in its functional quality, i.e. in the degree

[25] The typology is open-ended, since IT applications represent artificial reality and fundamentally new IT applications may be invented that cannot be interpreted in terms of the eight archetypes of Table 2.

to which affordances satisfy the user needs. The systems may also differ in their usability, systems quality, information quality, etc. (see Table 2). All these quality characteristics can be conjectured to affect the system use.

Analyzing the profile of a class of IT applications in terms of the ideal types of Table 2 provides systematics in identifying relevant design quality characteristics[26]. The analysis may show considerable differences between instances of the class of IT applications, in question. In the case of social media, for example, Facebook is fairly rich when compared with ResearchGate. It makes it questionable whether a single model (theory) covering the SNS technology as a whole is enough or whether specialized theories of different types of SNS technologies are needed possibly at the level of individual SNSs. But it is ultimately an empirical question: to what extent does the general theory explain the dependent variables (e.g. intention to use and actual use) when compared with the specialized theories and to what extent do design features (parameters) included explain PU, PEU, enjoyment, sociability of use when compared with specialized theories.

I argue that it is reasonable to proceed in research from more simple settings (IT applications close to ideal types) to more complex ones (hybrid applications comprising aspects of many ideal types), but in a more systematic way than has done in the case TAM/UTAUT research. One option in the case of complex hybrid applications is to start with aspect models, investigating separately which system features make the system useful, easy to use, sociable, and enjoyable.

After aspect models, one can focus on "total" models that focus on interactions between aspect models. It may well be that different aspects of hybrid IT applications may interact and hybrid systems may have "emergent" properties which cannot be reduced to the properties of the constituent parts or aspects. This is an open research question, however.

6.4 Summary

Even though existing TAM/UTAUT and related research has made valuable knowledge contributions, it is extremely difficult to make sense of them. Existing systematic literature reviews and meta-analyses help somewhat, especially if they focus on delimited application domains of interest to a reader. However, attempts to integrate different application types (technologies), application domains and different contexts into a single unified model (such as Blut et al. 2022) seem to lead to extremely complicated models which are really hard to interpret.

Instead of such a single model one can imagine that TAM/UTAUT research would develop specialized models for each technology type (different IT artifacts/applications) in different application domains in different broad contexts (e.g. country; national, professional and organization culture; economic conditions) and generalize or merge the models when sufficiently similar.

7 Conclusions

This paper suggested and discussed three strategies for theory building in Information Systems (IS): 1) inductive empiricism, 2) scientific idealization, and 3) theory specialization. Inductive empiricism aims at high realism and high generality of theories, even at the cost of precision; scientific idealization at high generality and high precision, even at the cost of realism; and theory specialization at high realism and high precision, even at the cost of generality.

Despite the ubiquity of idealizations in disciplines such as physics and economics, IS research has not paid much attention to them in theory building. I believe that it is a missed opportunity. Idealizations might make it possible to build to sharper and simpler theories, which isolate causal dependencies, serve as benchmarks to which more realistic models can be contrasted, and allow exploring normative ideals involving ethical and political ideals (Mäki 2020). Furthermore, idealizations add a new aspect to "imagining counterfactuals" as the upmost ladder of causal thinking in Pearl and Mackenzie (2016)[27]. Thinking in terms of counterfactual idealizations, which are known not to be true, opens a new space for imagining in theory building. The message is "dare to imagine, dare to idealize".

[26] More formally, the typology of Table 2 could be used to express profiles of the IT applications, in question, using a vector $(x_1,\ldots, x_8)$, x_i -> [0,1], where each x_i describes to what extent the application in question is automating, augmenting, mediating, informating, etc. In terms of fuzzy sets, x_i is the value of membership. An additional requirement might be $\mathrm{Sum}(x_i) = 1.0$

[27] The lower two ladders are seeing associations and doing interventions.

Of course, all idealizations do not turn to be fruitful and productive in advancing theory development, but their potential has been almost totally be neglected in the IS literature.

As for theory specialization, it should be noted that generality is only one desideratum of theories. As a consequence, the point of this paper is that theories should be as general as possible but not too general. If a specialized theory explains more convincingly the phenomenon in question and, in practical disciplines in particular, provides a theoretical explanation for the efficiency and effectiveness of a specialized intervention (treatment or technology) to address some practical problem, the scientific community should be open to accept it rather than rejecting it as too specialized.

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