Technology-Organization-Environment Meta-Review and Construct Analysis: Insights for Future Research

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Abstract

The Technology-Environment-Organization ("T-O-E") framework has been widely applied in more than 80 published empirical information systems ("IS") studies across multiple stages of organizational technology innovation adoption research in IS since its introduction in 1990. No prior review has traced studies and their factors back to the original framework categories and sub-categories to identify the existing lack of coverage. We address this research gap to guide future work. We present a meta-review and construct analysis derived from the most comprehensive collection of T-O-E articles collected and reviewed up to now. We present four major research contributions: 1) a guide to T-O-E constructs, 2) identification of new organizational sub-categories, 3) recognition of the existing levels of factor miscategorization, 4) identification of measurement gaps particularly relating to linking and communications sub-categories.

Keywords: Technology-Organization-Environment, Meta-Review, Theory, Construct Analysis

1. Introduction

Organizational technology selection, development, implementation, adoption, usage, and value (ie. organizational technology innovation) is a central research topic in the information systems (IS) field. While some theories and frameworks cover aspects of organizational technology innovation, none provides a comprehensive approach elaborating all necessary and sufficient contextual factors other than Organization-Technology-Environment (O-T-E, later re-ordered in IS literature and referenced as T-O-E). It is probably the most significant single model for understanding organizational level technology innovation success in the IS literature. Though it occupies this important role, no review to date has tracked its usage back to the original theoretical framework and assessed the relative completeness of coverage provided within the existing body of usage. The objective of this paper is to address this gap and enable future research to develop T-O-E into a stronger theory base for studying organizational technology innovation success.

Reviewing T-O-E right now is especially important because it addresses context. Recent IS research identifies major flaws in prior IS studies due to insufficient contextual capture and calls for improved attention to context to avoid theoretical fit/misfit (Hong et al., 2014) and potential construct reuse validity issues (Deborah Compeau et al., 2022). T-O-E's original intent was to collect and represent all of the necessary and sufficient context for enabling organizational technology innovation (DePietro et al., 1990). Unfortunately, the authors of this model used an unpublished set of 30 years of organizational technology projects supported by the National Science Foundation they had experienced and observed to base their claims (Tornatzky & Fleischer, 1990). The model was never fully elaborated as a theory (Sutton & Staw, 1995), but rather presented as a theorized framework (Weick, 1995). It was designed to incorporate key factors from diffusion of innovations theory, particularly the technology and organization factors (Rogers, 1983). It also includes aspects of environmental pressures from institutional theory (Scott, 1987). As such, it has generally been treated as theoretical framework model, enabling the incorporation of specific theoretical predictions from other theories together into unified models but not serving as a predictor on its own. Thus, studies applying it should still have representation of all factors if they are to adequately capture the context, but they may not in practice. And, a cumulative body of applications has the potential to develop a theory out of the framework.

Within the related IS literature on individual technology adoption, focus often centers on discovering factors related to the individuals such as their relevant perceptions, relevant historical experiences, and characteristics for predicting successful adoption and usage (Blut et al., 2022). For individual technology

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adoption, key papers have meta-analyzed the related studies and presented unified insights into the collective constructs in order to simplify and focus future research (Venkatesh et al., 2012). We see no such study related to consolidating and organizing the factors related to organizations in T-O-E and organizational technology innovation.

Over time, multiple research teams have reviewed studies employing T-O-E to identify its central tenets, strengths, and weaknesses. We have found seven of these reviews. At most, any given review up to now lists no more than 20 studies. In this study, we have re-reviewed all studies listed in those prior reviews along with additional studies we found through a systematic literature review. Our selection criteria indicated that many previous reviewed studies were not T-O-E studies Our process led to a collection of over 80 published studies we present here, 53 of which were not previously reviewed. Additionally, we conduct a systematic meta-analysis of all constructs found and present a new factor categorization and sub-categorization alongside frequency of coverage data. We then trace the constructs to the original theorization behind T-O-E to identify novel concepts in IS T-O-E research, which we then name based on our content analysis and present. Our discussion highlights key contributions and opportunities for future T-O-E research.

2. Data Collection

In this work, we conducted a meta-review. Our sample literature collection followed pre-existing guidelines (Watson & Webster, 2002). We searched for all papers including the terms "DePietro 1990", "Technology Organization Environment", "TOE", T-O-E", "O-T-E", "OTE" or "Organization Technology Environment" in the IS Senior Scholars Basket of 8 journals plus all IS papers found through searches in a unified search tool covering 88 databases including ABIinform, Ebsco, PubMed, Google Scholar, and others. Within this set of found articles, we then separated according to review or empirical study. Everything else, mostly conceptual works, was removed. To be qualified as having applied T-O-E empirically, a given article had to have intentionally categorized its constructs into the three T-O-E major categories and must have had at least one construct in each category. If they added additional categories, we accepted that. There were a couple of exceptions to include empirical works that missed one category but specifically argued they were applying T-O-E.

We began with the review articles. A meta-review seeks to collect reviews on a given topic into a unified structure to analyze agreements, variance, and gaps to guide future work in a given area (Alavi & Leidner, 2001; Herold & de Seta, 2014). The meta-review yielded a set of seven publications with reviews of T-O-E research.

The resulting sample set of reviewed T-O-E articles per review is shown in Table 1. Due to some duplication among the articles reviewed there were 74 reviewed studies in the reviews but only 43 unique articles.

Table 1 T-O-E Review Articles Reviewed Here

Review	Articles
Oliveira & Martins (2011)	20
Hameed et al. (2012)	8
Baker (2012)	9
Cao et al. (2014)	8
Gangwar et al. (2014)	9
Krishnan et al. (2017)	12
Chandra & Kumar (2018)	8

The literature search found the 43 articles in the reviews. It yielded 39 more empirical studies not already reviewed in the review articles (mostly quantitative; see Sample column in Appendix) for a total of 82 T-O-E empirical studies. Our review insights are embedded with the analysis of the overall sample of studies below.

3. Analysis Approach and Initial Mapping

The original T-O-E formulation was not a casual extrapolation and conceptualization by researchers lightly experienced in technology innovation within a narrow industry context. Rather, it was formulated by individuals who had been involved with running the US National Science Foundation programs focused on funding technology innovation projects for about 30 years (Tornatzky & Fleischer, 1990). These types of projects always include evaluation reports and analyses. Those data inputs from 100s of projects across many industries formed the dataset upon which they formulated T-O-E. It is therefore reasonable to expect that the T-O-E model would be comprehensive in scope and that the components should at least all be considered when crafting a study implementing it.

The original T-O-E model identified three categories, each with subcategories (DePietro et al., 1990). Those 3 categories and 9 subcategories were:

- **Organization**
  - Formal and Informal Linking Structures

    - Communication Processes
    - Size
    - Slack
- **Technology**
    - Availability
    - Characteristics
- **Environment**
    - Industry Characteristics and Market Structure
    - Technology Support Infrastructure
    - Government Regulation

Among the reviews of T-O-E none traces the applications of the model to the subcategories. The earliest review frames T-O-E nicely within IS literature, pointing out that models like the Technology Acceptance Model (TAM) or the Unified Theory of Acceptance and Use of Technology (UTAUT) and its predecessors are individual-level theories for predicting technology adoption and usage whereas T-O-E is organization level (Gangwar et al., 2014; Oliveira & Martins, 2011). Both levels of models can be useful for researchers and practitioners trying to understand organizational information technology innovation success (Hameed et al., 2012). Individual-level models focus on identifying the factors that need to surround individuals as they encounter, decide whether to try, learn, and begin to use information technologies to get tasks done. Implications can help organizations design and configure systems, time and deliver effective training, etc. Organizational-level technology adoption and use models offer insight into more macro factors like selecting the right information technologies to implement based on their chances of adding strategic value (especially in the case of technologies with many applications not limited to a small set of specific users and uses), analyzing what assets need to be augmented or changed to enable more effective deployment, or predicting the chances of success in a given organization (Agarwal & Lucas, 2005).

The application of additional theories within T-O-E often includes factors from Diffusion of Innovations (DOI), Institutional Theory, and the Iacovou et al. models (Baker, 2012; Oliveira & Martins, 2011). These include top-management (TM) support, perceived benefits, external pressures (including mimetic, coercive, and normative), organizational readiness, and technology characteristics from DOI like complexity, compatibility, trialability, observability, and relative advantage. Factors like ease of use and usability prevalent in TAM and subsequent individual-level research are absent typically at this level (Hameed et al., 2012). These can be considered in a nested fashion as there will be interactions between organizational investments and actual user acceptance and usage (Hameed et al., 2012). Such a model assumes that usage must be treated at an individual level, but T-O-E studies have somewhat frequently been applied to analyze, predict, or explain actual usage and ultimate value achievement (Cao et al., 2014; Krishnan et al., 2017). A good recent example of such a study applied T-O-E to analyze value achievement through investments in and usage of big data business analytics (Chen et al., 2015).

Overall, the reviews of T-O-E present a framework with broad applicability across stages of organizational information technology adoption from the evaluation and decision to the implementation, actual use, and accrual of strategic value from usage. Due to inclusion of a variety of theories within the framework when applied, there are also broad opportunities to integrate IS phenomena into unified organizational adoption models, an attractive option that meets the on-going need for integrated models in IS research (Alavi & Carlson, 1992; Blut et al., 2022). To better understand how this need has been met and document various options for researchers, we conducted coding and analysis of all constructs found in the 82 peer-reviewed, published T-O-E studies we collected.

4. Constructs Analysis

The construct analysis was not as straight-forward as it may seem here. Some papers presented models aligned and categorized within the T-O-E categories and sub-categories, but most did not. As a result, the researchers read through each paper and scanned for constructs using definitions of the sub-categories from the original source then discussed each paper to come to consensus on the constructs present and their proper category/sub-category. Disagreements were discussed until 100% consensus was reached. This process led to identification of 197 different constructs (see Appendix for complete list and analysis summary of studies). In 10 cases, there were constructs we could not differentiate between communication process (CP) or formal and informal linking structure (FILS). The overall breakdown is in Table 2.

Table 2 Constructs by Prevalence and Category

Category and Sub-Category	Coverage	Constructs
Technology Availability	21%	6
Technology Characteristics	58%	19
Organization Formal and Informal Linking Structures (FILS)	57%	37
Organization Communication Processes (CP)	3%	8

Organization Size (11%)	11%	4
Organization Slack (43%)	43%	10
Organization *New Construct* (84%)	84%	66
Organization CP and FILS (10%)	10%	5
Environment Industry Characteristics and Market Structure (ICMS)	80%	35
Environment Technology Support Infrastructure (TSI)	19%	10
Environment Government Regulation (GR)	38%	7

While every study contained constructs in the Organization category, we found that 4 lacked any Environment construct and 22 lacked a Technology construct. One may wonder how this may be possible. When categorizing constructs based on the definitions from the original source and its surrounding chapters, we found that some constructs were mis-categorized. This was especially the case with Technology constructs when researchers would create constructs that were specific to organizational settings rather than the technology itself.

An example would be Perceived Benefits. Sixteen studies used that construct and labeled it within Technology, but it is related to strategic value for a specific organization and therefore an organization construct. Notice that there is no place for that Organization construct within the original sub-categories of T-O-E. This is an example of a new organization construct. This process led to a new sub-category structure for T-O-E based on our analysis. Table 3 lists that structure plus the prevalence of the categories found in the studies analyzed.

Table 3 New T-O-E Categories and Sub-Categories

Category - Sub-Category	Usage	Constructs
Tech Char - DOI Compatibility	1	1
Tech Char - Security Features	8	2
Tech Char - Performance Features	5	4
Tech Char - Maturity	20	2
Tech Char - DOI Trialability	4	1
Tech Char - DOI Rel Adv	28	3
Tech Char - DOI Observability	2	2
Tech Char - DOI Complexity	15	2
Tech Char - DOI Compatibility	1	1
Tech Avail - Availability	23	6
Org Slack - Org Readiness	22	5
Org Slack - Financial	27	5
Org Size - Scope	11	3
Org User Capability, NEW	20	9
Org TM Support, NEW	39	2
Org TM Characteristics, NEW	11	4
Org Strategic Value, NEW	56	24
Org Security Concern, NEW	8	3
Org Readiness, NEW	7	5
Org DOI Complexity, NEW	2	1
Org DOI Compatibility, NEW	64	19
Org FILS - Vendor Support	1	1
Org FILS - Org Readiness	20	12
Org FILS - IT Capability	56	18
Org FILS - DOI Compatibility	3	1
Org CP and FILS - Org Readiness	8	4
Org CP and FILS - Communication Quantity	2	1
Org CP - Org Readiness	1	1
Org CP - Linking Quantity	1	1
Org CP - Communication Quality	1	1
Org - Size	33	1
Env TSI - Tech Support Infrastructure	17	10
Env ICMS - Industry Characteristics and Market Structure	119	34
Env GR - Government Regulation	38	7

Many papers drew variables from theories such as DOI, TAM, UTAUT, and T-O-E and mixed them to develop new adoption models. TAM and UTAUT study adoption at an individual level, while DOI, institutional theory, and T-O-E are at the organizational level. The simple mix-and-match approach can complicate the level of analysis and mistakenly treat individual variables and organizational variables at the same level in the study. As a consequence, Hameed's (2012) T-O-E review paper developed a framework to separate the adoption process into two stages: organizational

adoption and end-user adoption. In such a view, the T-O-E model can be used in the early organizational adoption stages. Other papers have also demonstrated that T-O-E can be used to analyze actual usage and value achievement too, but these papers require more careful attention be paid to the level of analysis of the measures.

Among all these studies, the majority of them use survey methodology; some use interview data with multiple companies, and some also use secondary data sets (e.g. electronic government or electronic participation). A few use other methods like case studies or Delphi. Most studies examined the questions at one single time point, and very few carried out longitudinal studies. Many focus on a single adoption domain: decision, usage, or value. Thirteen analyze multiple domains in the same study. T-O-E can clearly be used effectively in this manner, which offers potential related to calls for better understandings of usage and its relation to value in context (Burton-Jones & Volkoff, 2017).

In most studies, the topics focus on the adoption of large-scale information systems, such as enterprise systems, e-participation platforms, and e-commerce platforms, which involve multiple parties and many different ways of usage. In this way T-O-E can analyze usage behaviors and decisions at the organizational level in the space of generalized usage and platform systems.

5. Discussion and Contributions

Many previous studies developed quite complicated frameworks and incorporated many factors in their T-O-E models, such as Grover (1993) with 23 constructs or Simoes et al. (2020) with 27. When DePietro et al (1990) initially proposed T-O-E, they intended it to be parsimonious and to include the necessary and sufficient factors. Some work has strayed from this concept while also not testing all pieces of T-O-E (see Appendix). A sophisticated model may add some explanatory power, but its complexity restricts its contributions to theory and practice. One of the largest problems facing the T-O-E body of literature is the lack of ability to draw insight across studies and develop a meaningful theory base (Baker, 2012). Studies should at least ensure that they cover all sub-categories within T-O-E or at least explain why they are not relevant in a given study. Ideally, they should also specifically identify the category and sub-category for each factor they employ. Our main theoretical contribution is that this work provides guidance to find the right measures and constructs, map them back to T-O-E, and build the parsimonious models which can create a more cumulative body of theoretical knowledge.

In coding the many constructs used in prior T-O-E studies, we found 67 new organizational constructs (see Appendix). Meanwhile, we found no technology nor environment constructs that could not be justified as within the original intent of sub-categories within the framework. This is not surprising. The IS field specializes in the overlap of technology innovation and organizational value creation (DeLone & McLean, 2003). One core specialty in IS as a field is strategic information technology deployment in organizations.

The second major theoretical contribution is identifying these important new organizational sub-categories that extend the organizational part of T-O-E (Table 3). T-O-E is intended for analyzing the important contextual factors that enable information technology innovation within organizations (DePietro et al., 1990). Four of the new factors are more prevalent and test more significantly in IS studies: Top Management Support, User Capability, Strategic Value, and Compatibility. These should be considered in any future T-O-E model. Additionally, assessing IT capability needs further factoring and analysis in future research, as it is sometimes significant and sometimes not. This is a very interesting construct for IS researchers and practitioners as it directly relates to IT workforce management and development. Organizational readiness versus technology relative advantage remains an unclear area that needs more attention. Many variables overlapped these areas and the strategic value sub-category. The source theories for these constructs need further attention in future work.

Many papers claim they applied the T-O-E model, not all the papers categorize the variables in the same way. Our third theoretical contribution is that factors in T-O-E studies need to be faithfully categorized according to the T-O-E framework. The distinctions between the three categories, technology, organization, and environment, are clear in the original framework but not clear at all in many papers. For example, “perceived benefits” is classified as a technology variable in some studies while an organizational variable in others. In the original framework, technology factors should be associated with the technology features, which are uniquely linked to the technology itself without consideration of any organizational contexts. These meet the need for IT artifact specific inclusion into IS research. Organizational variables should be tied to a certain and specific organizational context. Environmental variables have to be tied with the external environment context, not internal organizational settings. The distinctions are not well defined or recognized by researchers.

Our fourth theoretical contribution is this study identifies several measurement gaps within the existing body of T-O-E literature, especially with regard to the organizational linking and communications sub-categories. For organizational variables, most studies focus on variables that are easy to measure, such as company size, scope, and financial commitment. Meanwhile, two important organizational variables from the original framework, formal and informal linkage structure and communication process, get tested in only 60% of studies and then only one or the other usually with just one measure. This could be due to the difficulty of measuring these two constructs. But these constructs are essential in deciding the success of new technology adoption as they are directly attached to the quality of organizational collaborations internally among developers and users and externally with vendors. They are the variables that best represent the actions of IT employees. Not surprisingly, IS researchers have developed and tested 18 different measures for IT capability as an organizational construct. One or more of these appear in 45% of the articles. On closer examination they do not measure the internal degree of collaboration or boundary-spanning practices that IS literature often associate with the success of IT workers and managers. These could be more aligned with T-O-E as well as more specific and accurate measures directly tapping into the IT role in linking structures and communication practices. They should be elaborated in future work.

For external linking structure variables, many authors recognize the importance of partners, but different partners take different roles in the IT adoption process. Trading partners and suppliers have direct business collaboration with the company. Business partners' support enables smooth transactions in the value chain, while their pressures could help force a company to adopt a system. Technology vendors do not have direct business connections of this sort. Rather, their interaction with the company facilitates the company to learn and implement the new technology by sharing technical knowledge. Thus, it is important that researchers distinguish business partners from technology vendors. Only a few do this at present. The vendors serve directly within the adoption process and would especially be more important in markets demanding change and industries in which organizations have relatively low technology innovation knowledge internally. This too should be elaborated in future work.

6. Conclusion

This study presents the most comprehensive review of IS applications of the T-O-E framework to date. T-O-E serves as the most important overarching model for IS researchers to explore organizational technology innovation adoption. Future work needs to apply T-O-E more faithfully and completely as well as open the black box of IT worker activities within the model by improving measures of linking and communications. Future work can also draw on the additional organization sub-categories identified here to more easily craft and conduct T-O-E studies.

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8. Appendix: Table of T-O-E Articles and Constructs

Year	Author(s)	Research Domain	Adoption Domain(s)	Sample	Tech Availability	Tech Characteristics	Org Formal and Informal Linking Structure	Org Comm. Processes	Org Size	Org Slack	Env Industry Char. And Market Structure	Env Tech. Support Infrastructure	Env Government Regulation	Org NEW	CP and FILS
1993	Grover	Customer IOS	decision	226 surveys	0	3	3	0	0	1	7	0	0	8	0
1997	Chau and Tam	Open Sys Tech	decision	89 interviews	0	1	1	0	0	0	1	0	0	5	0
1999	Thong	ERP	decision, usage	166 surveys	0	2	1	0	0	0	0	0	0	4	0
2001	Kuan and Chau	EDI	decision	575 surveys	0	0	1	0	0	1	1	0	1	1	0
2003	Zhu et al.	E-business	usage	3552 interviews	0	1	2	0	1	0	3	0	0	0	0
2004	Zhu et al.	E-business	usage, value	612 surveys	1	0	0	0	1	1	1	0	1	0	0
2004	Gibbs and Kraemer	E-commerce	usage	2139 surveys	0	0	1	0	0	1	1	0	2	2	0
2004	Grandon and Pearson	E-commerce	usage	83 surveys	0	0	1	0	0	2	1	0	0	1	0
2005	Zhu and Kraemer	E-business	usage	624 interviews	0	0	1	0	1	1	1	0	1	0	0
2006	Zhu et al.	E-business	usage, value	1857 interviews	1	0	0	0	2	0	1	0	1	1	0
2006	Teo et al.	B2B E-commerce	usage	249 surveys	1	1	1	0	0	0	1	0	1	4	2
2006	Zhu et al.	E-business	usage, value	1415 interviews	0	1	1	0	0	1	2	0	0	2	0
2006	Henriksen	IOS	decision	247 surveys	0	1	1	0	0	2	1	0	0	3	0
2006	Hsu et al.	E-business	usage	294 surveys	0	0	1	0	1	0	1	0	1	1	0
2008	Khoumbati et al.	EAI	decision	12 interviews	0	0	1	0	0	0	2	1	1	2	1
2007	Lee and Shim	RFID	decision	126 surveys	0	0	1	0	0	0	2	0	0	2	0
2007	I-Chiu et al.	E-Signature (healthcare)	decision	53 surveys	0	1	0	1	0	1	1	0	1	2	1
2007	Tan et al.	B2B E-commerce	decision	134 surveys	0	0	3	0	0	3	2	0	0	2	0
2007	Mishra et al.	E-procurement	usage, value	424 surveys	2	1	0	0	0	0	2	0	0	1	0
2007	Chan and Ngai	EDI adoption	usage	10 case studies	0	0	0	0	0	1	1	0	0	1	0
2008	Oliveira and Martins	Web site	decision	3155 sm and 637 lg firms surveys	1	1	2	0	0	0	2	0	0	3	0
2008	Pan	ERP	decision	99 interviews	1	1	0	0	0	0	1	0	1	1	0
2008	Lin and Lin	E-business	usage	163 surveys	0	1	1	0	0	0	2	0	0	2	0
2008	Li	E-procurement	decision	120 interviews	0	2	0	0	0	1	2	0	1	2	0

Year	Author(s)	Research Domain	Adoption Domain(s)	Sample	Tech Availability	Tech Characteristics	Org Formal and Informal Linking Structure	Org Comm. Processes	Org Size	Org Slack	Env Industry Char. And Market Structure	Env Tech. Support Infrastructure	Env Government Regulation	Org NEW	CP and FILS
2008	Soares-Aguiar and Palma-Dos-Reis	E-procurement	decision	240 surveys	0	0	2	0	1	0	2	1	0	0	0
2008	Huang et al.	EDI	decision	219 surveys	0	3	0	0	0	1	2	0	0	8	0
2009	Oliveira and Martins	E-commerce	decision	2626 firms	1	1	2	0	0	0	2	0	0	3	0
2009	Oliveira and Martins	E commerce	decision	3155 sm firms	1	1	2	0	0	0	2	0	0	3	0
2009	Chong et al.	C-commerce	decision	109 surveys	0	2	3	0	0	1	2	0	0	3	0
2009	Ramdani et al.	Enterprise Systems	decision	102 surveys	0	4	1	0	0	1	4	1	0	2	0
2009	Salwani et al.	E-commerce	usage	165 firms	0	0	1	0	0	0	1	0	0	1	0
2009	Scupola	E-commerce	decision	4 case studies	0	2	0	0	0	1	1	1	1	3	0
2009	Kouki et al.	ERP	usage	6 case studies	0	0	5	0	0	0	0	1	0	3	1
2009	Wang and Amhed	E-commerce	usage	88 surveys	0	0	0	0	0	1	1	0	0	1	0
2010	Oliveira and Martins	E-business	usage	6964 interviews	1	1	2	0	0	0	1	0	0	3	0
2010	Wang et al.	RFID	decision	133 surveys	0	2	1	0	0	0	3	0	0	2	0
2010	Srivastava and Teo	E-government	value	113 countries secondary data	0	1	0	0	0	0	2	0	0	1	0
2011	Ifinedo	E-business in sm business	decision	237 surveys	0	0	1	0	0	1	1	1	0	2	0
2011	Bose and Luo	green IT integration	usage	conceptual	0	1	0	0	0	1	2	0	1	3	0
2011	Krishnan and Teo	E-service in government	value	123 countries secondary data	0	1	0	0	0	0	0	0	1	1	0
2011	Pujianto	E-government	usage	118 surveys	0	0	3	0	0	0	1	0	1	2	0
2011	Troshani et al.	HR management system	decision	11 interviews	0	2	1	0	0	0	1	0	1	3	0
2012	Venkatesh and Bala	IOS	decision, usage, value	234 matched pair surveys	2	0	0	0	0	0	1	0	0	3	0
2012	Krishnan et al.	E-participation	decision	170 countries secondary data	1	0	1	0	0	0	0	0	1	0	0
2013	Krishnan et al.	E-government	usage	secondary data	1	0	0	0	0	0	0	0	1	1	0
2013	Yang et al.	E-health wireless vital signs	decision	2 case studies	0	0	0	0	0	1	0	1	1	4	1

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2014	Cao et al.	Hospital RFID	decision, usage	14 interviews	0	1	2	0	0	1	1	1	1	4	0
2014	Schwarz and Schwarz	EMR	decision	547 surveys	0	1	0	0	0	1	1	1	1	5	0
2014	Picoto et al.	M-business	usage	180 surveys	0	2	2	0	0	0	2	1	0	2	0
2014	Ruey-Jer et al.	SCM, supply-vendor collaboration	decision, usage	240 surveys	0	0	1	0	0	0	1	0	1	2	0
2014	Kim et al.	knowledge management	usage, value	141 surveys	1	0	0	0	0	0	1	0	0	0	0
2015	Kurnia et al.	B2B E-commerce	decision	8 case studies	0	3	2	0	0	2	3	1	2	4	0
2015	Gangwar et al.	Cloud computing	decision	280 surveys	0	2	1	1	0	0	2	0	0	1	0
2015	Bhattacharya et al.	RFID	decision	74-expert delphi	0	2	1	0	0	1	2	1	0	2	0
2015	Wei et al.	RFID	usage	102 surveys	0	2	1	0	0	0	2	0	1	1	1
2015	Chen et al.	big data usage in SCM	decision, value	161 surveys	0	0	0	0	0	1	1	0	0	2	0
2016	Wang and Lo	open government	usage	342 surveys	0	1	0	0	0	1	1	0	0	2	0
2016	Sharif et al.	E-government	value	173 surveys	0	0	1	0	0	0	2	0	0	4	0
2016	Awa et al.	ERP	decision	244 surveys	0	2	0	0	1	0	1	0	1	3	0
2016	Awa et al.	ERP adoption	decision	244 surveys	1	1	1	0	1	0	2	0	1	4	0
2016	Weerd et al.	SaaS	usage	18 interviews	0	1	0	0	0	0	0	0	0	1	0
2017	Shafique et al.	E-government	decision, usage	175 surveys	0	2	0	0	0	2	1	0	1	3	0
2017	Krishnan et al.	E-participation	decision	secondary data	0	1	1	0	0	0	0	1	0	0	0
2017	Alomar and de Visscher	E-procurement portal	usage	760 surveys	0	0	0	0	0	1	2	0	0	1	0
2017	Chiu et al.	mobile application	usage	411 surveys	0	4	1	0	0	0	2	0	1	3	1
2018	Tajudeen et al.	social media marketing	usage	171 surveys	0	2	1	0	0	1	1	0	0	3	0
2018	Dewi et al.	smart city applications	decision	144 surveys	0	1	1	0	0	1	2	1	0	6	0
2018	Chandra and Kumar	AR	decision	107 surveys	0	1	1	0	0	0	1	0	0	2	0
2019	Awa et al.	ERP	usage	262 surveys	0	0	1	0	0	0	0	0	0	6	0
2020	Ziba and Kang	E-government	decision	259 surveys	1	0	0	0	0	1	2	0	0	2	0

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2020	Caron-Fasan et al.	revisit Hameed's model	decision	28 interviews	0	1	2	0	0	0	2	0	0	2	0
2020	Simoes et al.	cobots	decision	13 interviews	1	3	3	0	1	2	3	1	1	11	0
2020	Rich and Pather	community network ecosystem	usage	43 cases from secondary sources	0	1	3	0	0	2	1	0	2	2	0
2020	Sallehudin et al.	cloud computing apps	usage, value	169 surveys	0	2	0	0	0	2	1	0	1	2	0
2020	Alabri et al.	CRM systems	usage	282 surveys	0	2	0	0	0	0	0	0	0	1	0
2020	Ahmad et al.	enterprise architecture	decision	255 surveys	1	0	1	1	0	1	2	1	1	3	0
2020	Thomas and Yao	E-healthcare	decision	880 surveys	1	0	0	0	0	1	0	0	1	0	1
2020	Sin and Sin	E-commerce	usage	283 surveys	0	1	0	0	0	0	1	0	0	1	0
2021	Kimiagari and Baei	E-banking	decision, usage	362 surveys	0	0	0	0	0	0	0	0	1	0	0
2021	Lei et al.	logistics	usage	690 surveys plus some interviews	0	1	3	0	1	0	1	0	0	0	0
2021	Looy	BPM	decision	surveys + interviews	0	1	1	0	0	1	2	0	0	6	1
2021	Toufaily et al.	blockchain	decision	46 interviews	1	4	0	0	0	2	2	0	1	4	0