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Information Systems and e-Business Management

Suggested Citation: Frank, Muriel; Kohn, Vanessa; Holten, Roland (2024) : Q methodology and the sociotechnical perspective, Information Systems and e-Business Management, ISSN 1617-9854, Springer Berlin Heidelberg, Berlin/Heidelberg, Vol. 22, Iss. 4, pp. 599-631, https://doi.org/10.1007/s10257-024-00679-x

Information Systems and e-Business Management (2024) 22:599–631
https://doi.org/10.1007/s10257-024-00679-x

ORIGINAL ARTICLE

Q methodology and the sociotechnical perspective

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Received: 13 October 2022 / Revised: 15 December 2023 / Accepted: 13 February 2024 /
Published online: 9 June 2024

Abstract
When studying information systems (IS) phenomena, scholars increasingly aim to take a socio-technical approach. This means that instead of focusing exclusively on the technical side, they also study them from a human perspective. An underrecognized yet powerful tool for examining the opinions and attitudes of individuals is the Q methodology because it makes subjective viewpoints on IS phenomena objectively measurable. Despite its benefits and wide application in other disciplines, the use of Q methodology in top IS journals is still rare. Based on a systematic literature review, this article explores the potential and fit of Q methodology within the sociotechnical systems framework. This analysis leads to two main insights. First, Q methodology enables the integration of the social and the technical component as well as instrumental and humanistic outcomes. Second, this qualiquantilogical technique enriches the understanding of IS phenomena by objectifying the approach to exploring subjective viewpoints. Thus, our work highlights the potential of the method for conducting IS research. And it also provides clear guidelines on how to use the method to uncover new patterns inherent in the data being studied.

Keywords Q methodology · Systematic literature review · Sociotechnical perspective · STS framework

1 Introduction

The application of Q methodology has a long tradition in behavioral sciences, e.g., political psychology, marketing, and sociology (Brown 1980; McKeown 1984; Stephenson 1986). In the information systems (IS) domain, however, scholars are

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reluctant to use this tool (Thomas and Watson 2002; Wingreen and Blanton 2018); only a few researchers acknowledge its potential for information systems (IS) research (Nurhas et al. 2019). One of the main reasons for the rare application in the field of IS is confusion about its fundamental principles (Dziopa and Ahern 2011) because it is neither a quantitative nor a qualitative approach but a qualiquantilogical one (Stenner and Stainton Rogers 2004), that is, a hybrid of qualitative and quantitative methods. The insecurities with respect to the general concept is reflected in the studies researchers conducted (Dziopa and Ahern 2011); many applications are not aligned with the method's basic principles (Stainton Rogers 1995). Moreover, with many researchers unfamiliar with the method itself (Wingreen and Blanton 2018), there remains uncertainty about whether the Q method can be a complementary element in IS research, for example, as previously suggested for design science research (Nurhas et al. 2019) that can integrate sociotechnical perspectives (Carlsson et al. 2011). This raises the question of whether the IS community is missing out on assumption-challenging research (Alvesson and Sandberg 2011) due to its skepticism towards Q methodology.

Academics criticize that information systems research has lost sight of its sociotechnical character, which is fundamental to how the discipline sees itself (Sarker et al. 2019). This lack of clear orientation puts researchers in an uncomfortable position (Schwartz 2014). This is aggravated by the fact that IS researchers have trouble integrating findings with respect to IS phenomena into theories that recognize the interdependencies of the social and technical subsystem (Lee 2001; Bostrom et al. 2009). This is where Q methodology comes in, because we argue that Q methodology is a tool that allows for critical reflection of sociotechnical assemblages, and thus IT applications (Williams and Pollock 2012). Moreover, it enables scholars to examine the interactions of the social and the technical, recognizing their potential for more meaningful IS research (Nurhas et al. 2019). With this in mind, the targeted outcome of our research is to assess whether Q methodology is able to uncover the sociotechnical perspective in IS research, and thus help IS research to return to the core of IS, as claimed by the researchers themselves (Sarker et al. 2019). Additionally, our article aims to clarify the purpose and techniques of Q methodology, raise awareness for its unique benefits to the IS community, especially regarding integrating research into the sociotechnical perspective, and exemplify its application for an IS phenomenon to guide future research. Taken together, our research question is as follows: What is the potential of the Q methodology for IS research—especially with regard to the integration of the socio-technical perspective?

To this end, this paper systematically analyzes the academic literature to examine the role and impact of the decision to use the Q methodology on the integration of the fundamental perspectives (social and technical) in IS research approaches. Our work addresses common misunderstandings about the premises of the Q methodology, thereby helping IS researchers understand how they could benefit from approaching IS phenomena using Q methodology. It becomes clear that this technique provides us with the means to objectively study people's subjective perspectives, which then serve as the basis for further investigations, such as experimental or quasi-experimental research. In this way, it promotes the effectiveness and efficiency of sociotechnical systems (STS) research.

The paper proceeds as follows: First, we describe the background of the method and the steps required for its application in research studies. We will then review the background of STS research that forms the core of the IS discipline. Next, we provide new insights into the prevalence of the Q methodology through a literature review, particularly regarding the methodological procedure and the results. Subsequently, we present a passage covering the identified papers' fit with the sociotechnical systems framework uncovering their position along the social-technical continuum. The next section discusses the identified potential for IS research and provides clear guidance on how to use Q methodology based on an example. We also discuss the implications and contributions of our study, before closing with concluding remarks.

2 Background on Q methodology

The concept of Q methodology traces back to William Stephenson, who introduced it in a letter to Nature in 1935 and elaborated on it in the following years (Stephenson 1935, 1936). His idea was to develop a technique capable of studying the subjectivity of the human mind because until then it was extremely difficult to measure subjectivity using the quantitative methods available at that time (Amin 2000). Since then, Q methodology has found considerable attention in different fields of behavioral science (Thomas and Watson 2002). For instance, it has been used to examine personality traits (Stephenson 1936), to uncover political opinions (Brown 1980), concerns in national forest management (Steelman and Maguire 1999) and archetypes of process improvement (Ponsignon et al. 2014). Employment in information systems research, however, is still scarce (Thomas and Watson 2002; Wingreen and Blanton 2018). Over the span of more than three decades, only nine studies have been published in prestigious journals of the senior scholar basket (see literature review in the next section). For instance, Dos Santos and Hawk (1988) used Q methodology for studying differences in systems analyst's attitudes towards information systems development. Q methodology has also been used to examine metaphors in the IS language that may help alleviate the systems development process (Kendall and Kendall 1993), user resistance with respect to mandatory enterprise system adoption (Klaus et al. 2010) and IT professional's person-organization fit regarding IT development and training (Wingreen and Blanton 2018). More recently, Kratzer et al. (2023) applied Q methodology to investigate the success factors for fractional chief information officer (CIO) engagement in small and medium-sized enterprises.

In general, Q methodology seeks to study subjectivity by measuring an individual's viewpoints and attitudes, also known as operants, without imposing the usual biases of scientific surveys (Brown 1993). Hence, it enables the systematic assessment of qualitative information. Statistically, Q methodology involves correlating individuals by their subjective measurement of a representative set of tests and thus can be seen as an inverted form of Spearman's two-factor theorem (Stephenson 1935; Brown 1980). Typically, the method is not designed for large subject samples (Dziopa and Ahern 2011). Literature on Q methodology typically describes the

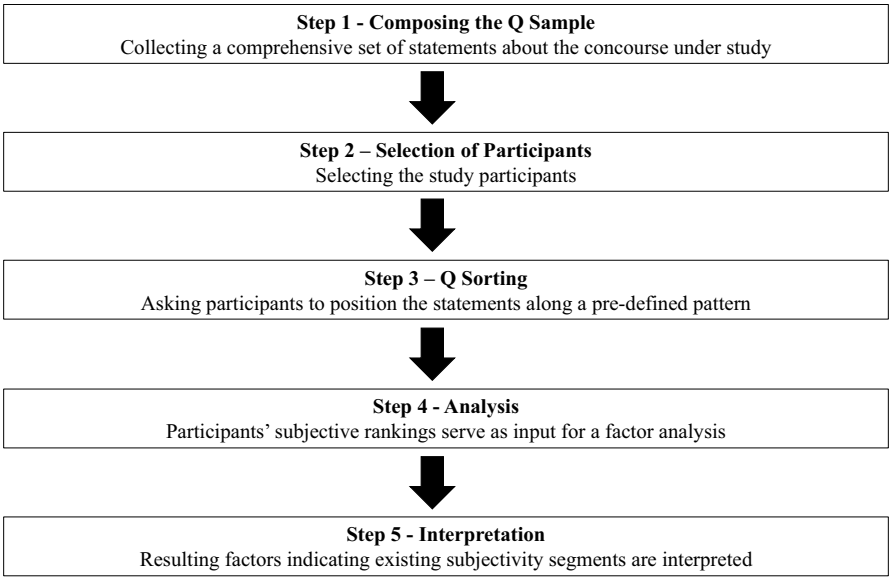

Fig. 1 Steps of Q methodology

process in three to seven steps. Those using fewer steps combine steps such as defining the concourse and deriving Q sample items from the concourse into one step (Chen and Chen 2018). While the number of steps differs, the generally accepted approach remains the same. As detailed below, we describe the process of conducting a Q methodology study using the five steps shown in Fig. 1.

Step 1 Composing the Q sample: Q sample items are a collection of viewpoints on the subject matter drawn from the concourse. The concourse refers to a wide range of ideas on a topic collected from various sources (Amin 2000). Q samples can be fashioned in several ways, however, the most preferable one is to conduct interviews as they enlarge the scope of relevant features (McKeown and Thomas 2013). The subject matter will largely determine the exact number of Q sample items. The final Q set often comprises 30–60 statements (Donner 2001; Watts and Stenner 2005), but there are also studies that use smaller or larger numbers of Q sample items (Stainton Rogers 1995). Reusability of the Q set makes the research process reproducible (Gauzente 2013). Unlike item selection of conventional survey constructs in R methodology[1], Q sample items neither measure a particular construct nor do they implicate other variables (Brown 1993).

Step 2 Selection of participants: Selected participants are referred to as person samples (P-sets). Since Q methodology has an intensive orientation (Brown 1974), the size of the person sample can be rather small and still allow for meaningful conclusions, as the goal is to make generalizations about the structure of a concourse

[1] R methodology describes non-Q methodologies, such as test theory, surveys and questionnaires, and is characterized by a-priori assumptions and results that are seldom operant (McKeown and Thomas 2013).

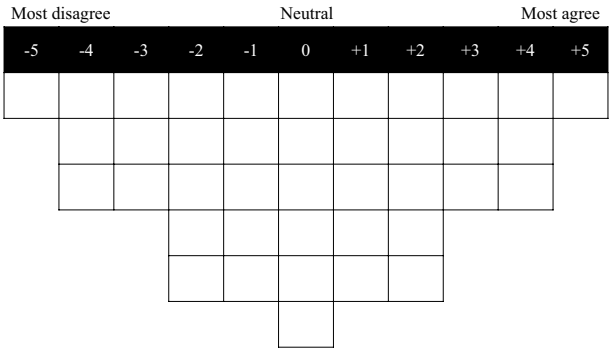

Fig. 2 Q sort response grid

rather than characteristics of a population of people (Watts and Stenner 2005). Accordingly, P-sets contain between 40 and 60 participants (Stainton Rogers 1995). Watts and Stenner (2005) suggest using a 1:1 ratio, i.e., the same number of participants as Q items. The selection of participants typically follows either theoretical or pragmatic considerations. Hence, samples are constructed based on theoretical adequacy or their mere availability (McKeown and Thomas 2013).

Step 3 Q sorting: Participants express their subjective viewpoints on the Q sample by comparing and ranking the Q sample items along a predefined pattern that resembles a quasi-normal flattened distribution (Brown 1980; McKeown and Thomas 2013). Figure 2 illustrates a typical response grid for Q sorting. Noteworthy is that participants performing Q sorting, as this procedure is also called, evaluate each statement in comparison to every other item (McKeown and Thomas 2013).

Step 4 Analysis: This step involves factoring the Q sorts which reveals the structures implicit in subjectivity. For this purpose, factor analysis is used to group individuals who show similarities in terms of shared views (Brown 1980; McKeown and Thomas 2013). The Q method uses similar statistical specificities, e.g., regarding the significance of the factors or their rotation, as the R method (McKeown and Thomas 2013).

Step 5 Interpretation: The final step is about interpreting the factors, thus distilling the core meanings while considering the broader context of their occurrence (McKeown and Thomas 2013). Unlike most research applications, factor interpretation in Q methodology is based on factor scores rather than factor loadings as this helps to understand the consensus and distinguishing items for a particular factor (McKeown and Thomas 1988; Stainton Rogers 1995; Donner 2001). A factor score is the normalized weighted average score of individuals that determines the factor. Typically, item statements at the extreme ends of the Q sort are used to emphasize the composite view of the factor (van Exel and de Graaf 2005).

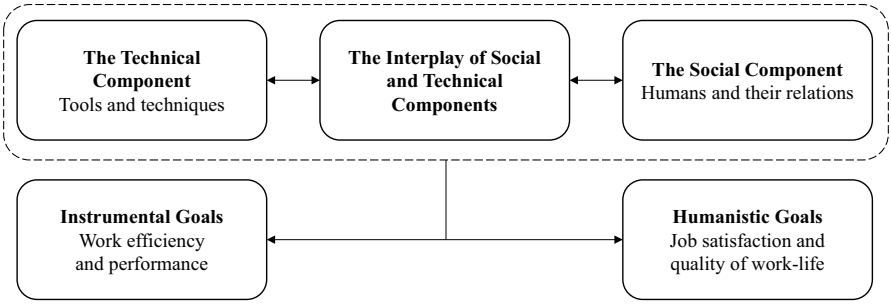

Fig. 3 Sociotechnical perspective adapted from Sarkar et al. (2019)

3 Background on the foundations of the sociotechnical perspective

The sociotechnical perspective marks one of the fundamental viewpoints within the information systems (IS) discipline (Sarker et al. 2019). It has its origins in multiple post-World War II studies designed to examine improvements in working life and establish the new field of sociotechnical systems (Trist and Bamforth 1951). Broadly speaking, sociotechnical systems comprise two distinguishable but mutually influencing components: the technical and the social system (see Fig. 3).

The technical component consists of soft- and hardware tools and techniques needed to solve and fulfill organizational issues and tasks (Bostrom and Heinen 1977), while the social component is composed of individuals and collectives who bring certain attributes, such as skills, knowledge, or social capital to the work environment (Ryan et al. 2000; Bostrom et al. 2009). STS does not favor one of the two dimensions but contends that their joint interaction is necessary to realize instrumental and humanistic goals (Wallace et al. 2004; Bostrom et al. 2009). STS implies that employees use technology to perform work tasks to achieve predefined organizational and personal goals (Bostrom and Heinen 1977; Carayon et al. 2015). In other words, STS allow achieving both instrumental and humanistic objectives in a synergistic manner through the interplay of social and technical components.

In the subsequent section, we will first provide an overview of previous applications of the Q methodology in IS research, and then detail the extent to which the identified papers align with the STS framework. Our aim is to show if and how the tool enables the integration of social and technical aspects of IS phenomena. We also seek to determine whether the Q methodology has the potential to identify and answer research questions that arise in this context.

4 Application of Q methodology in information systems

To understand the current state-of-the-art with Q methodology in information systems research, we conducted a thorough literature review in well-ranked journals such as the senior scholar basket journals (Lowry et al. 2013), Administrative Science Quarterly, Management Science, and Organization Science. In general,

literature reviews help to establish a solid basis for answering the research question (Levy & Ellis 2006) because they provide a synthesis of a comprehensive body of knowledge in a reflective manner (Rousseau et al. 2008) that can be used as a framework for future research endeavors (Petticrew and Roberts 2016). Inspired by calls from researchers, e.g., Sarker et al. (2019), for a return to the sociotechnical roots of the IS discipline, this systematic synthesis of the literature aims to assess whether the Q methodology is able to uncover the sociotechnical perspective in IS research. Based on this objective, we searched a total of 14 renowned peer-reviewed scientific journals, yielding a total of 134 articles. The detailed protocol of the literature review can be found in Table 3 in the Appendix.

In the first round, we used the keywords 'q sort', 'q method', 'q methodology', 'q factor analysis', and 'concourse theory' to cover existing work on Q methodology. To also investigate whether any of the articles addressed sociotechnical aspects, we conducted another round of keyword searches using 'q sort + sociotechnical', 'q method + sociotechnical', 'methodology + sociotechnical', 'q factor analysis + sociotechnical', and 'concourse theory + sociotechnical'. Table 1 displays the scholarly journals we queried with which keywords.

After removing duplicates, 100 articles remained for full-text screening. Inclusion criteria were articles written in English that either used or referred to the Q method or Q techniques; exclusion criteria, on the other hand, were articles in which the keyword was not mentioned in a relevant context, e.g., when reference was made to another paper, or which referred to methods other than the Q method (e.g., Q + method or QQ method). In addition, articles were excluded from the systematic literature review if the author(s) mentioned the key term only as one of several possible research approaches or as part of a summary of an article. After applying the inclusion and exclusion criteria, 81 articles remained for analysis. We then synthesized and analyzed the identified literature, as described in the following section. Lastly, we also performed a backward search of relevant articles. A backward search refers to the process of checking the references of relevant articles with the aim of potentially identifying more relevant articles to include in the review (vom Brocke et al. 2009)—here: the nine articles using the Q method as proposed by Stephenson. However, it did not identify any new articles. Figure 4 illustrates the entire literature review process based on Shamseer et al. (2015).

4.1 Results of the literature review

As a result, we identified 81 research articles that fit the inclusion criteria and classified them into three main categories: the first category encompasses studies that applied Q methodology in Stephenson's sense (9 articles). The second category relates to articles using Q techniques out of Q methodology to evaluate and improve construct validity (70 articles). And the last category includes articles that deal with Q methodology and Q techniques only on a theoretical basis (2 articles). Figure 5 plots the publication outlets and their belonging to the three different categories. For a more detailed look at the publications, see Table 4 in the Appendix, where publications are listed with the assigned category and the purpose of the method.

Table 1 Considered Journals

Journal	Keywords	Hits	Reviewed
Administrative Science Quarterly (ASQ)	'q sort', 'q method', 'q methodology', 'q factor analysis', 'concourse theory', 'q sort + sociotechnical', 'q method + sociotechnical', 'methodology + sociotechnical', 'q factor analysis + sociotechnical', and 'concourse theory + sociotechnical'	3	2
Decision Support Systems (DSS)		5	4
European Journal of Information Systems (EJIS)		12	7
Information & Management (I&M)		28	24
Information & Organization (I&O)		1	0
Information Systems Journal (ISJ)		10	4
Information Systems Research (ISR)		3	3
Journal of the Association for Information Systems (JAIS)		6	6
Journal of Information Technology (JIT)		9	4
Journal of Management Information Systems (JMIS)		11	7
Journal of Strategic Information Systems (JSIS)		7	4
Management Information Systems Quarterly (MISQ)		22	13
Management Science (MS)		3	1
Organization Science (OS)		2	2
Total		122	81
Backward search		12	0
Total		134	81

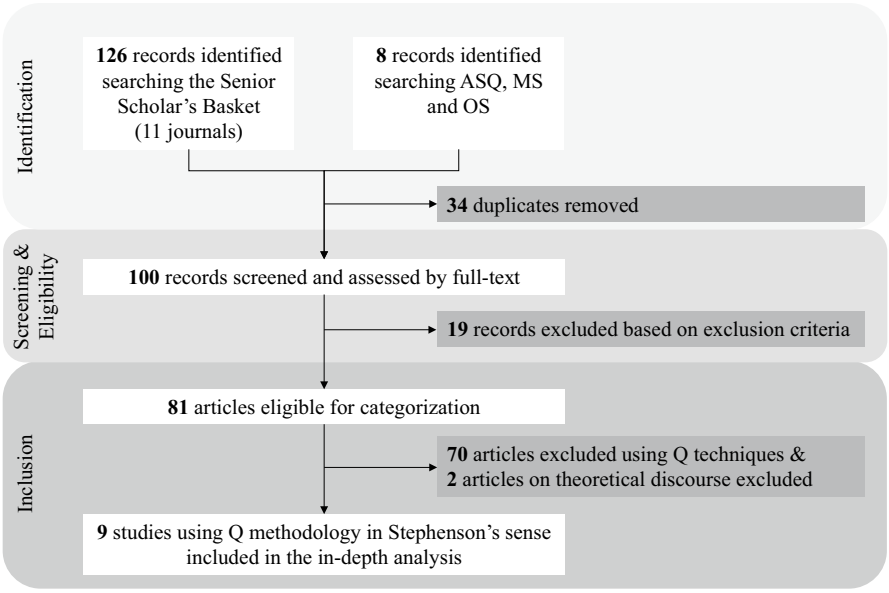

Fig. 4 Overview of the literature review process based on Shamseer et al. (2015)

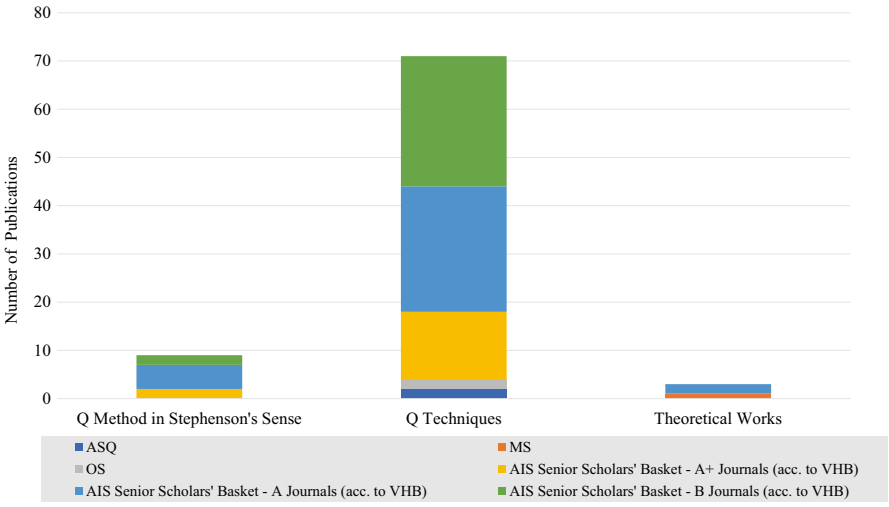

Fig. 5 Distribution of publications outlets in the three respective categories

The first category applies Q methodology in Stephenson's mold, that is, combining quantitative techniques with psychometric and operational, or qualitative principles to study human subjectivity (Brown 1980; McKeown and Thomas 2013). Of the nine papers, seven explicitly follow steps of Q methodology as outlined above, including an initial collection of concourse statements, the development of an

appropriate Q sample, followed by participants performing Q sorting, quantitative analysis to identify participants with similar thought patterns and finally development of coherent narratives for the identified set of factors. Two studies (Kendall and Kendall 1993, 1994) supplement their Q methodology analysis with dramatism. To elicit self-referent opinions on the topic at hand, researchers mostly resort to individual interviews (e.g., Klaus et al. 2010; Mettler and Wulf 2019; Kratzer et al. 2023). In some cases, the collection of the initial Q sample is extended by other sources such as literature reviews (e.g., Wingreen and Blanton 2018) or focus group interviews (e.g., Kendall and Kendall 1993). One study relies solely on statements identified by reviewing the literature and evaluated by subject matter experts (Dos Santos and Hawk 1988). Q samples consisted of 25 items (Kratzer et al. 2023) to 33 items (Dos Santos and Hawk 1988; Tractinsky and Jarvenpaa 1995) which is in the middle of the range of 20 to 60 statements considered meaningful to Q samples (Donner 2001). It is particularly beneficial to keep Q samples smaller if participants are unfamiliar with the method (Ockwell 2008).

The ratio of participants to Q items varies; three studies (Tractinsky and Jarvenpaa 1995; Mettler et al. 2017; Mettler and Wulf 2019) have a lower P sample to Q sample ratio, while three have significantly more participants than Q sort items (Klaus et al. 2010; Wingreen and Blanton 2018; Kratzer et al. 2023). Only Dos Santos and Hawk (1988) have a P-sample-Q-sample ratio of nearly 1:1, as Watts and Stenner (2005) suggested. Participants were mainly living in the U.S. or Europe. With regard to analysis, the majority use principal component analysis and varimax rotation (e.g., Mettler et al. 2017; Kratzer et al. 2023). Two studies apply centroid factor analysis (Klaus et al. 2010; Wingreen and Blanton 2018). Some studies do not mention the extraction method (e.g., Kendall and Kendall 1993). Regarding the results (statistical characteristics) presentation, researchers focus primarily on statements with highest and lowest agreement (e.g., Mettler and Wulf 2019), distinguishing and consensus items (e.g., Kratzer et al. 2023), and z-scores (e.g., Klaus et al. 2010). Table 5 in the Appendix shows the results of the research articles analyzed.

Q techniques can also be applied as a stand-alone technique without applying Q methodology (Dziopa and Ahern 2011), which pertains to the papers of the second category. The majority of those papers use Q techniques to develop or refine measurement instruments (see e.g., Segars and Grover 1998; Jahng et al. 2007; Varella et al. 2012; Bapna et al. 2019) and quantitatively assess a measurement's construct validity (Messerschmidt and Hinz 2013; Benlian et al. 2015). According to Stainton Rogers (1995), Q techniques incorporated into this kind of assessment are instrumentally R methodology. Nevertheless, as with Q methodology, participants are able to express their opinions in a Q sort, i.e., when sorting items back to the original constructs (e.g., Varella et al. 2012) or when assessing similarity of items and representativeness of statements for separate constructs (e.g., Segars and Grover 1998; Fan and Lederman 2017).

The final category eventually includes review papers that refer to Q techniques (Hardin et al. 2008) or Q methodology as propounded by Stephenson (Sheth 1967). However, they do not present an empirical application of the Q technique or methodology but rather a theoretical discourse.

4.2 Fit with the STS framework

In alignment with our research question, we assess how well the identified studies using Q methodology reflect the sociotechnical perspective, i.e., capture the dynamic interaction of social and technical systems. We focus on the nine studies of the first category. This is because the studies in the second and third category lack detailed information on Q methodology and/or ignore the primary premise of Q methodology, according to which communication of subjective viewpoints should come from a position of self-reference and not be compromised by a researcher's analytical frame (McKeown 1988; Stainton Rogers 1995).

Dos Santos and Hawk (1988) surveyed systems analysts from eight private and public organizations to determine their attitudes toward developing information systems. Their 33-item Q sample, developed on the basis of a literature review, spans all dimensions of the STS framework, with a special emphasis on the social component and the humanistic goals. For example, the social component is covered by items such as "The use of structured techniques in analysis, design and programming is essential. They shorten development time and reduce both development and maintenance costs" or "Good communication between users and IS analysts is necessary so that analysts understand users needs and users understand what analysts are proposing". The Q sample also contains instrumental ("Large projects should be avoided by splitting them up and working on a portion at a time. This way we work on a number of smaller projects that we can complete and turn over to the users in a short period of time. Large projects have a way of going on forever and always seem to run into problems") and humanistic objectives ("Users should have realistic expectations of what the system is to deliver. That way they are not disappointed and are happier with the system."). Finally, the technical component is addressed through statements such as "The user interface to a system is important. What the user sees is probably as important as anything else that the system does". Overall, their work emphasizes the need to integrate the human component and humanistic perspectives into the development process, since the attitudes of those involved can make or break the success of a developed IT system.

Building on work on metaphors in organizational life, Kendall and Kendall (1993) examine the language of IS users to uncover the relationship between metaphors and methodologies in IT practice. Since the authors provide only limited insight into their used Q sample, no information can be given on the extent to which the technical or social dimensions have been taken into account. We only know that at least some of the items reflect the social component, such as "Our leader looks out for the welfare of all of us". This also applies to the paper the authors published in 1994 since the data basis is the same (Kendall and Kendall 1994).

To investigate types of user resistance and management strategy expectations in a mandatory enterprise systems (ES) adoption environment, Klaus et al. (2010) implemented a study with representatives of ES user groups. Their Q sample recognizes the adoption process as consisting of social and technical considerations, arising from the understanding that both dimensions imbricate (Sarker et al. 2019). Items pertaining to the social component address, for instance, communication or management support, while items related to the technical component refer, for example, to

technical problems. With nearly half of the items, the Q sample considers primarily humanistic viewpoints (e.g., turnover intention, demotivation, refusal), highlighting the influence of human concerns in the adoption environment.

Mettler et al. (2017) explored shared beliefs about autonomous service robots in healthcare work environments like hospitals and nursing homes. The used Q sample items can be attributed to both the technical (e.g., "Service robots will cause new types of integration problems with our IT.") and the social component (e.g., "I am very much in favor of implementing service robots in hospitals."). Additionally, the Q sample considers instrumental (e.g., "Service robots will reduce the operating costs of the entire hospital.") and humanistic goals (e.g., "Service robots will reduce the workloads of low-skilled jobs."). Thus, the identified five niches display social and technical relationships as conceived within the STS framework.

Two years later, Mettler and Wulf (2019) examined the responses of employees who were faced with the introduction of wearables that measure physiological parameters at the workplace. The selected Q sample items predominantly reflect humanistic (e.g., "I would like to use algorithmic decision-making tools, which support me to become healthier in my free time.") rather than instrumental outcomes. In doing so, the authors consider the sociotechnical perspective showing the dark side of IT (Sarker et al. 2019) or its dehumanizing effects, respectively (Moore and Piwek 2017).

Our literature review also reveals studies with uneven emphasis on either social or technical ends. Concentrating on fractional chief information officers (CIO) mainly from New Zealand and the United States, Kratzer et al. (2023), for instance, investigate potential success factors for Fractional CIO engagement success. The developed Q sample items essentially disregard the influence of technology as they focus mainly on social aspect of the problem under investigation (e.g., the communication with client's top management team, trust, integrity and effective communication with non-executives). Accordingly, it is mainly the success factors attributed to the social component that distinguish the three identified fractional CIO groups. Orlikowsky (2010) speaks of technology's "absent presence" in this context. Using a similarly one-sided approach, Tractinsky and Jarvenpaa (1995) study thoughts about managing information technology (IT) in a global respective local context. The items generated from interviews with 65 project managers mainly represent the technical (e.g., reliable and robust systems) and the instrumental outcome dimension of IT management (e.g., minimizing hardware costs and maximizing the return from the existing hardware and software base), while the social component is rather neglected.

With the help of 298 IT professionals, Wingreen and Blanton (2018) examine subjective beliefs and behaviors related to the alignment of individual and organizational priorities respective preferences, also known as person-organization (P–O) fit. The five identified types represent the relationship between the subjective P–O fit in IT training and development. However, their cohesion of sociotechnical dimensions differs tremendously; Type 1 employees, for instance, have deeper technical preferences with a fair organizational fit, while Type 5 employees show preferences for personal development, but the organization does not meet these preferences. Thus, we see a disconnect between instrumental and humanistic outcomes regarding the

Table 2 Fit with the STS Framework

Source	Assessment of fit with the STS framework
Dos Santos & Hawk (1988)	Q sort items reflect all STS framework dimensions
Kendall and Kendall (1993)	Due to limited information on the Q sample no assessment possible
Kendall and Kendall (1994)	Due to limited information on the Q sample no assessment possible
Klaus et al. (2010)	Q sort items with a primary focus on humanistic outcomes
Kratzer et al. (2023)	Q sort items with a primary focus on the social component and humanistic outcomes
Mettler et al. (2017)	Q sort items reflect all STS framework dimensions
Mettler and Wulf (2019)	Q sort items reflect humanistic rather than instrumental outcomes
Tractinsky and Jarvenpaa (1995)	Q sort items mainly reflect the technical component and instrumental outcome
Wingreen and Blanton (2018)	Q sort items reflect both instrumental as well as humanistic outcomes

identified types. Sarker et al. (2019) take it as evidence that only linking humanistic and instrumental goals will lead to valuable synergies.

Table 2 summarizes our findings with regard to the fit with the STS framework. Overall, we see that the sociotechnical perspective is reflected in the majority of the papers reviewed (seven out of nine). Thus, we can conclude that using Q methodology in Stephenson's sense can help grasp the essence of information systems (Sarker et al. 2019).

5 Potential of Q methodology for IS research

Scholars already have an extensive set of tools for studying information systems phenomena within the sociotechnical perspective: the technical system, including processes and technologies, is well researched and its performance measurable (see, for example, Abu-Nimeh et al. 2007). The same is true for instrumental outcomes, as researchers have various performance indicators that they can adduce as inputs for models (Hübner-Bloder and Ammenwerth 2009). And the social system, i.e., the individual and their values, seems investigable with psychometrics. But studying humanistic outcomes, i.e., people's perceptions and attitudes, objectively is a difficult task to undertake. And this is where Q methodology can step in and reveal individuals' subjectivity without confounding them with operational measurements (McKeown and Thomas 2013). It gives researchers a robust technique for measuring attitudes that has the power to surprise, as no prior assumptions are built in (Dziopa and Ahern 2011). The appeal of Q methodology lies in the innovative way it approaches IS phenomena and analyzes data (Dziopa and Ahern 2011). Q methodology provides a unique opportunity to empirically observe and systematically measure subjective viewpoints, which proves especially useful when investigating controversial and sociotechnical issues. Beyond deepening the understanding of attitudes and perceptions, it can also be utilized for fit evaluation and trend identification (Gauzente 2013).

Unlike the hypothetico-deductive methods used in R research, the interactive nature of Q methodology allows for the objective study of emergent phenomena based on the subjective interactions of individuals with a concourse (McKeown and Thomas 2013). This interactive worldview inherent to Q methodology differs from simply observing how objective forces affect a person. As discussed in the theoretical background section, the interplay of social and technical components is at the core of STS and enables the achievement of both economic and humanistic goals. When a concourse under study involves social and technical aspects, the Q methodology provides a unique opportunity to study this interplay, because the Q sort statements obtained from this discourse represent direct observations of this interaction. As shown in Table 2, most of the current IS studies that apply Q methodology focus on single components of STS. We advise future research to aim at covering all components and especially their interplay in their Q items to take full advantage of the Q methodology.

Q methodology has been criticized for lacking reliability and replicability due to its small sample size. However, these concerns are unwarranted (Thomas and Baas 1993; Gauzente 2013). This is because the status of reliability and validity differs between Q methodology and R methodology (Wingreen and Blanton 2018). In R research, objective measurements are crucial for achieving the research objectives. Therefore, measures must be internally consistent, i.e., reproducible, and accurately capture the intended concept (i.e., be valid). In contrast, Q methodology aims to study the views of individuals. Therefore, reliability and validity pertain to the individual rather than the measurements, and subjective viewpoints can be considered valid by definition (Lincoln and Guba 1985; Wingreen and Blanton 2018). As any self-reported measure, it relies on participant's honesty and might be subject to social desirability bias. Consulting qualitative comments or conducting follow-up interviews is an effective approach to minimizing researcher's bias and verifying researcher's initial interpretations (Watts and Stenner 2005).

Finally, as Q methodology follows an exploratory approach, it is not suitable to confirm or reject a null hypothesis with regard to significance levels. However, the results of the Q methodology can be used as an input for further research efforts and, more generally, to help make STS research more effective. As our systematic literature review revealed, we see two different types of Q research. The first one applies Q methodology as originally proposed by Stephenson (1936); the second uses Q techniques to measure a theorized process without enabling participants to express their subjective thoughts on the subject under study. However, according to Stainton Rogers (1995), these applications ignore the primary premise of Q methodology, in which self-reference should be preserved to advance the understanding of subjectivity.

In summary, this state-of-the-art article shows that the social and technical relation varies considerably within the research studies reviewed. At the same time, it highlights that by using Q methodology, IS researchers can approach their work and research questions from a sociotechnical perspective. To illustrate how this technique can be used, we will outline the introduced steps for a study on sociotechnical system realignment during the COVID-19 pandemic (Kohn et al. 2023). In this way, we demonstrate the feasibility of gaining insight into STS through the use of Q methodology and exemplifies the implementation of its five steps:

- *Step 1* In this research project, remote work and the alignment of sociotechnical systems were studied from the perspective of workers affected by the transition to remote work during the COVID-19 pandemic. We used interviews to ensure a representative collection of ideas and viewpoints on the study's topic (Amin 2000; McKeown and Thomas 2013). We also reviewed the relevant literature to identify other factors that influence employees' attitudes toward remote work. Finally, we selected 40 items which is in the range of 20–60 statements considered meaningful for Q method (Donner 2001). They covered organizational and individual drivers of employees' attitudes toward remote work.
- *Step 2* Following Watts and Stenner (2005), we aimed for a 1:1 ratio of statements to participants. The selection of participants followed both theoretical as well as pragmatic considerations (McKeown and Thomas 2013), i.e., participants had to have experience with remote work but also be available to participate in the study.
- *Step 3* Next, participants were asked to compare the Q sample items on remote work and rate the extent to which they agreed, disagreed, or felt neutral about them. We used a web-based response grid (Aproxima 2015) and instructed them to place the items along a predefined pattern resembling a quasi-normal distribution (Dziopa and Ahern 2011).
- *Step 4* Since many software packages such as "qmethod" (Zabala 2014) are available to perform the data analysis of Q sorts, we will only give a brief overview of the next steps. Analysis began with the calculation of the correlation matrix, which represented the similarity or dissimilarity in terms of remote work between workers. The correlation matrix was then used for the process of factoring. We used PCA and varimax rotation. The objective was to identify groups with similar viewpoints on the topic (Brown 1980, 1993), consequently, workers with similar attitudes toward remote work shared the same factor. Finally, the analysis included calculating both the factor scores and the scores for the distinguishing and consensus statements (van Exel and de Graaf 2005) as these are required for interpretation (Stainton Rogers 1995).
- *Step 5* The final step was about distilling the meaning of the identified factors while taking into account the context in which they occurred (McKeown and Thomas 2013). For this purpose, we focused on the statements ranked at the extreme ends of the sort of a factor as they serve as characterizing statements for the factor (van Exel and de Graaf 2005). We identified two distinct groups of workers: one working remotely in highly aligned sociotechnical systems ("high STS alignment group") and the other working remotely in sociotechnical systems with a low degree of alignment ("low STS alignment group"). We relied on distinguishing and consensus statements to emphasize the differences and similarities between the two groups of workers (McKeown and Thomas 1988; Donner 2001; van Exel and de Graaf 2005).

6 Contributions and implications

Based on our findings, several implications and contributions arise, which we will explain in the following. Firstly, our literature review provides an overview of the state-of-the art of Q methodology research in leading IS journals and gives an insight into the research areas that have benefited from integrating Q methodology

so far. Secondly, it provides guidance for future IS research in the decision for or against the application of Q methodology as well as its implementation to ensure rigor and practicability. This is prerequisite for future research that want to build on results from Q methodology. Thirdly, our review confirms that Q methodology has received little attention in the IS community so far—especially when compared to other techniques that are used for similar ends, such as focus groups or interviews (Zabala et al. 2018). However, it is hoped to encourage other researchers to consider Q methodology as a beneficial research method in the IS domain. Fourthly, and most importantly, we build on this review to provide an understanding of how Q methodology can enable IS researchers to approach their work and research questions from a sociotechnical perspective. Our analysis concludes that Q methodology can reveal the dynamics of objectified subjective viewpoints in sociotechnical systems, which can serve as a basis for further experimental and quasi-experimental research projects.

As shown in our literature review, existing Q methodology research in IS has generated knowledge in several areas, including the identification of unique user types and their language, niches, attitudes, subcultures and design choices (e.g., Mettler et al. 2017; Kratzer et al. 2023). However, despite the fact that the method is perfectly suited for integrating all sociotechnical dimensions, none of the articles in our literature review makes explicit reference to STS. To investigate and outline the potential of this methodology to re-enforce the STS perspective in IS research, our study reviews the existing literature from a sociotechnical perspective and determines the extent to which existing Q research reflects the STS framework. In doing so, our work echoes the call for a return to the sociotechnical roots of the IS discipline (Sarker et al. 2019).

Previous studies have applied Q methodology in different ways, ranging from superficial and theoretical mentions or use of single Q techniques to thorough implementations of all Q methodology steps. We classify existing research according to the extent of their Q methodology usage and clarify the purpose of Q methodology in each category. We find that most studies that use Q methodology in Stephenson's sense also reflect some dimensions of the STS framework. In doing so, they do not only serve their individual self-stated purposes, but also the higher goal of strengthening the sociotechnical character of IS research. However, as they typically reflect only one or two dimensions of the STS framework, we recommend that future research focus on including Q sort items that reflect all dimensions of the STS framework.

From the analysis of the results of our literature review, we can draw various practical conclusions for maximizing the utility of the Q methodology in future IS studies. These include using Q methodology in Stephenson's sense, being transparent and striving for a holistic view of all STS components. By providing an example of the application of Q methodology to advance the understanding of STS, we provide researchers with practical insights into its process and potential. We also show how the Q methodology can pave the way for further research by providing methodologically robust results on which to build. This reduces the risk of wasted research resources and makes STS research efforts more efficient.

In short, our paper bridges the gap between Q methodology and the STS framework to assess the status quo and determine whether it provides a means to strengthen the sociotechnical character of future IS research. We acknowledge that other methodologies may

be equally suitable for strengthening the sociotechnical perspective in IS research, which can be explored in future research. Nevertheless, we can conclude that Q methodology is an appropriate tool to address sociotechnical relations and to shed light on the humanistic and technical aspects of issues in the information systems domain (e.g., Mettler et al. 2017; Wingreen and Blanton 2018; Mettler and Wulf 2019; Kratzer et al. 2023). Both are necessary to fully understand the interlocking contexts in which IS phenomena emerge (Williams and Pollock 2012). Moreover, using Q methodology to better understand STS may yield unexpected results because it focuses on the individual's perspective and does not make assumptions about participants' views that could be influenced by potential biases of the researchers (Bashatah 2016; Dziopa and Ahern 2011). For instance, a surprising consensus, previously overlooked deviations from the status quo, or the interplay of certain phenomena might be revealed. The exploratory and interactive nature of Q methodology can bring coherence to research questions that may have numerous intricate and socially controversial answers (Stainton Rogers 1995; Watts and Stenner 2005). Such research, which challenges assumptions and goes beyond simply filling in gaps, is in high demand (Alvesson and Sandberg 2011). At a societal level, Q method even promotes stakeholder engagement because it inherently incorporates a diversity of views and ideas. This creates a natural confrontation of different perspectives, which can then be used to facilitate dialogue between those involved (Cuppen 2012).

7 Conclusion

Since the late 1980's, only a few research studies published in the leading IS journals have used the Q methodology, although scholars advocate a more extensive use of this tool. This article explores the potential and fit of Q methodology within the sociotechnical systems framework. Our literature review indicates that Q methodology is suitable for a deeper understanding of perceptions and attitudes towards the IS phenomena under study for several reasons. First, it allows researchers to tackle research questions that may not be readily approachable within the prevailing behavioral science paradigm. Second, Q sort statements extracted from the discourse represent direct and detailed observations of the interaction between social and technical elements. This makes it possible to operationalize behavioral interactions and understand where views on human interactions with the technological world coincide or diverge. Third, the tool provides researchers with the opportunity to examine sociotechnical relationships of IS and assess the interdependencies of both the social and the technical component. However, it is recommended that future studies applying the Q methodology to IS research questions not focus on individual dimensions of STS, but rather take a holistic approach. The rationale behind this is that studies that use Q methodology in Stephenson's sense benefit most from the unique advantages of Q methodology and can best capture the essence of IS. Besides, being transparent about the applied steps increases confidence in the results.

Appendix A

See Tables 3, 4 and 5.

Table 3 Detailed literature review protocol

Search term	Initial hits	Final hits
Administrative science quarterly (ASQ)		
q sort	3	2[a]
q method	0	0
q methodology	0	0
q factor analysis	0	0
concourse theory	0	0
q sort + sociotechnical	0	0
q method + sociotechnical	0	0
q methodology + sociotechnical	0	0
q factor analysis + sociotechnical	0	0
concourse theory + sociotechnical	0	0
	3	2
Decision Support Systems (DSS)		
q sort	4	4
q method	1	0[a]
q methodology	0	0
q factor analysis	0	0
concourse theory	0	0
q sort + sociotechnical	0	0
q method + sociotechnical	0	0
q methodology + sociotechnical	0	0
q factor analysis + sociotechnical	0	0
concourse theory + sociotechnical	0	0
	5	4
European Journal of Information Systems (EJIS)		
q sort	8	7[a]
q method	0	0
q methodology	2	0[b]
q factor analysis	0	0
concourse theory	0	0
q sort + sociotechnical	2	0[b]
q method + sociotechnical	0	0
q methodology + sociotechnical	0	0
q factor analysis + sociotechnical	0	0
concourse theory + sociotechnical	0	0
	12	7
Information & management (I&M)		
q sort	25	24[a]
q method	1	0[b]
q methodology	2	0[b]
q factor analysis	0	0
concourse theory	0	0
q sort + sociotechnical	0	0
q method + sociotechnical	0	0
q methodology + sociotechnical	0	0

Table 3 (continued)

Search term	Initial hits	Final hits
q factor analysis + sociotechnical	0	0
concourse theory + sociotechnical	0	0
	28	24
Information and *organization* (I&O)		
q sort	1	0[a]
q method	0	0
q methodology	0	0
q factor analysis	0	0
concourse theory	0	0
q sort + sociotechnical	0	0
q method + sociotechnical	0	0
q methodology + sociotechnical	0	0
q factor analysis + sociotechnical	0	0
concourse theory + sociotechnical	0	0
	1	0
Information systems journal (ISJ)		
q sort	3	3
q method	1	0[b]
q methodology	3	1[a,b]
q factor analysis	1	0[b]
concourse theory	2	0[b]
q sort + sociotechnical	0	0
q method + sociotechnical	0	0
q methodology + sociotechnical	0	0
q factor analysis + sociotechnical	0	0
concourse theory + sociotechnical	0	0
	10	4
Information systems research (ISR)		
q sort	2	2
q method	0	0
q methodology	1	1
q factor analysis	0	0
concourse theory	0	0
q sort + sociotechnical	0	0
q method + sociotechnical	0	0
q methodology + sociotechnical	0	0
q factor analysis + sociotechnical	0	0
concourse theory + sociotechnical	0	0
	3	3
Journal of the association for information systems (JAIS)		
q sort	6	6
q method	0	0
q methodology	0	0
q factor analysis	0	0
concourse theory	0	0

Table 3 (continued)

Search term	Initial hits	Final hits
q sort + sociotechnical	0	0
q method + sociotechnical	0	0
q methodology + sociotechnical	0	0
q factor analysis + sociotechnical	0	0
concourse theory + sociotechnical	0	0
	6	6
Journal of information technology (JIT)		
q sort	4	4
q method	1	0[b]
q methodology	1	0[b]
q factor analysis	2	0[a]
concourse theory	1	0[b]
q sort + sociotechnical	0	0
q method + sociotechnical	0	0
q methodology + sociotechnical	0	0
q factor analysis + sociotechnical	0	0
concourse theory + sociotechnical	0	0
	9	4
Journal of management information systems (JMIS)		
q sort	7	7
q method	0	0
q methodology	2	0[a,b]
q factor analysis	1	0[a]
concourse theory	0	0
q sort + sociotechnical	1	0[b]
q method + sociotechnical	0	0
q methodology + sociotechnical	0	0
q factor analysis + sociotechnical	0	0
concourse theory + sociotechnical	0	0
	11	7
The journal of strategic information systems (JSIS)		
q sort	6	4[a]
q method	0	0
q methodology	0	0
q factor analysis	1	0[a]
concourse theory	0	0
q sort + sociotechnical	0	0
q method + sociotechnical	0	0
q methodology + sociotechnical	0	0
q factor analysis + sociotechnical	0	0
concourse theory + sociotechnical	0	0
	7	4
Management Information Systems Quarterly (MISQ)		
q sort	17	13[a,b]
q method	1	0[a]

Table 3 (continued)

Search term	Initial hits	Final hits
q methodology	2	0[b]
q factor analysis	1	0[a]
concourse theory	0	0
q sort + sociotechnical	1	0[b]
q method + sociotechnical	0	0
q methodology + sociotechnical	0	0
q factor analysis + sociotechnical	0	0
concourse theory + sociotechnical	0	0
	22	13
Management Science (MS)		
q sort	3	1[a]
q method	0	0
q methodology	0	0
q factor analysis	0	0
concourse theory	0	0
q sort + sociotechnical	0	0
q method + sociotechnical	0	0
q methodology + sociotechnical	0	0
q factor analysis + sociotechnical	0	0
concourse theory + sociotechnical	0	0
	3	1
Organization Science (OS)		
q sort	2	2
q method	0	0
q methodology	0	0
q factor analysis	0	0
concourse theory	0	0
q sort + sociotechnical	0	0
q method + sociotechnical	0	0
q methodology + sociotechnical	0	0
q factor analysis + sociotechnical	0	0
concourse theory + sociotechnical	0	0
	2	2

[a]Due to any of the defined exclusion criteria

[b]Due to redundancy

Table 4 Results of the literature review

Source	Journal	Purpose of Q method/technique use	Category
Fu et al. (2010)	ASQ	Refinement of measurement instruments	2
Luque et al. (2008)	ASQ	Refinement of measurement instrument	2
Beemer & Gregg (2010)	DSS	Pretest and refinement of measurement scale	2
Ghasemi et al. (2023)	DSS	Check the discriminant validity of measures	2
Li & Lin (2006)	DSS	Pre-assessment of convergent and discriminant validity of scales	2
Wu & Saunders (2016)	DSS	Instrument validation	2
Fan et al. (2017)	EJIS	Content validity	2
Jahng et al. (2007)	EJIS	Refinement of measurement items (content validity)	2
Kendall & Kendall (1994)	EJIS	Identification of unique subcultures within the general population	1
Mettler et al. (2017)	EJIS	Identification of distinct niches of service robot end-users in hospitals	1
Mikalef et al. (2020)	EJIS	Pre-test of survey instrument	2
Oberländer et al. (2017)	EJIS	Assessing the reliability and validation of taxonomy	2
Simon (2000)	EJIS	Review of open-ended questions	2
Akter et al. (2013)	I&M	Assessment of domain coverage	2
Banerjee & Chua (2021)	I&M	Assessment of questionnaire items	2
Benitez et al. (2018)	I&M	Validity of construct measures	2
Cui et al. (2015)	I&M	Verification of content, convergent and discriminant validity	2
Cui et al. (2022)	I&M	Verification of content, convergent and discriminant validity	2
Dos Santos & Hawk (1988)	I&M	Differences in analyst's attitudes towards systems development	1
Goyal et al. (2022)	I&M	Purification and validation of items	2
Grover & Segars (2005)	I&M	Establish construct validity	2
Guillemente et al. (2014)	I&M	Establishing content validity	2
Hsu et al. (2015)	I&M		
Kayhan (2015)	I&M	Assessment of content validity	2
Kratzer et al. (2023)	I&M	Factors for fractional CIO success	1

Table 4 (continued)

Source	Journal	Purpose of Q method/technique use	Category
Liu et al. (2021)	I&M	Verification of content, convergent and discriminant validity	2
Lokuge et al. (2019)	I&M	Establishing clarity	2
Saeed & Abdinnour-Helm (2008)	I&M	Scale development	2
Sedera & Dey (2013)	I&M	Model conceptualization	2
Sedera et al. (2016)	I&M	Attaining content validity	2
Sedera et al. (2017)	I&M	Attainment of content validity	2
Sedera et al. (2022)	I&M	Establishing content validity	2
Shi et al. (2023)	I&M	Verification of content, convergent and discriminant validity	2
Torres et al. (2018)	I&M	Validation of the construct	2
Tsai & Hung (2019)	I&M	Illustration of reliability and validity	2
Wiesböck et al. (2020)	I&M	Support of face validity	2
Zhang et al. (2014)	I&M	Identify conflict sources	2
Zhu et al. (2015)	I&M	Refinement of questionnaire	2
Mettler and Wulf (2019)	ISJ	Identification of five distinct user types characterized by a specific viewpoint on physiolytics at the workplace	1
Tarafdar et al. (2019)	ISJ	Assessment of content validity	2
Wingreen & Blanton (2018)	ISJ	Identification of five distinct P–O fit types of perspectives	1
Burton-Jones & Straub (2006)	ISR	Improvement of construct validity	2
Smith et al. (2011)	ISR	Construct validation	2
Segars & Grover (1999)	ISR	Assessing item purification and content validity	2
Gable et al. (2008)	JAIS	Content validity	2
Gefen & Larsen (2017)	JAIS	Verifying items before a pre-test	2
Grgecic et al. (2015)	JAIS	Instrument development and construct validity	2
Hardin et al. (2008)	JAIS	Validation of formative measures	3

Table 4 (continued)

Source	Journal	Purpose of Q method/technique use	Category
Sharma et al. (2022)	JAIS	Construct validity and reliability	2
Sutton et al. (2008)	JAIS	Sorting of risk items into two factors	2
Benlian et al. (2015)	JIT	Assessment of content validity	2
Klaus et al. (2010)	JIT	Initial investigation into types of user resistance and the management strategy expectations of users in a mandatory adoption setting	1
Söllner et al. (2018)	JIT	Conceptual refinement to ensure reliability and construct validity of the questionnaire items	2
Wolf et al. (2012)	JIT	Ensuring construct validity	2
Bhattacherjee (2002)	JMIS	Establishing content validity of complex variables	2
Chang & King (2005)	JMIS	Ensuring content validity	2
Gold et al. (2001)	JMIS	Refinement of measurement instruments	2
Grover et al. (1995)	JMIS	Validation and modification of categorization	2
McMurtrey et al. (2002)	JMIS	Model evaluation	2
Moody et al. (1998)	JMIS	Content analysis	2
Nehme & George (2022)	JMIS	Scale validation	2
Saeed et al. (2005)	JMIS	Assessment of content validity	2
Gerlach et al. (2015)	JSIS	Validation of construct	2
Messerschmidt & Hinz (2013)	JSIS	Improving construct validity	2
Oberländer et al. (2021)	JSIS	Establishing the usefulness of the taxonomy	2
Shi et al. (2022)	JSIS	Content validity of measurements	2
Sheth (1967)	MS	Review	3
Bapna et al. (2019)	MISQ	Validation of categorization	2
Kaplan & Duchon (1988)	MISQ	Interpretation of items	2
Karhade & Dong (2021)	MISQ	Determining content, construct & convergent validity	2
Kendall & Kendall (1993)	MISQ	Examination of the language of information systems users	1

Table 4 (continued)

Source	Journal	Purpose of Q method/technique use	Category
Kettinger et al. (1997)	MISQ	Test of reliability	2
Liang et al. (2019)	MISQ	Purification and validation of items	2
Lu and Ramamurthy (2011)	MISQ	Test of construct validity	2
Luo et al. (2012)	MISQ	Ensuring content validity	2
Nadkarni and Gupta (2007)	MISQ	Validation of the dimensionality of items	2
Ou et al. (2014)	MISQ	Ensuring content validity	2
Segars & Grover (1998)	MISQ	Item refinement and content validity	2
Sun (2012)	MISQ	Ensuring content validity	2
Tractinsky & Jarvenpaa (1995)	MISQ	Studying information systems design decisions in a global vs. domestic context	1
Lu et al. (2023)	OS	Categorization	2
Varella et al. (2012)	OS	Item refinement	2

Table 5 In-depth analysis of the nine selected research articles

	Q-sample	Items	P-sample	Extraction method	Rotation method	Factors	Reporting results
Dos Santos & Hawk (1988)	Literature review	33	30 participants (system analysts); origin unknown	PCA	Varimax	3	Consensus/distinguishing statements
Kratzer et al. (2023)	Based on 40 semi-structured interviews	25	36 participants from the U.S. and New Zealand	PCA	Varimax	3	Factor scores and ranks + consensus/distinguishing statements
Mettler et al. (2017)	15 interviews and scoping review	31	19 participants from Switzerland	PCA	Varimax	5	Consensus/ distinguishing
Mettler & Wulf (2019)	Consideration scholarly sources but also recent news articles, science and technology magazines, personal blogs, or websites of device manufacturers	32	20 participants from Switzerland	PCA	Varimax	5	Statements with highest and lowest agreement
Klaus et al. (2010)	Using transcripts of a focus group of 11 ES users and 34 individual interviews of ES users from three different organizations	29	128 participants; origin unknown	Centroid Q-factor analysis	Varimax	8	Z-scores
Kendall & Kendall (1993)	Focus group interviews	na	na	na	na	9	na
Kendall & Kendall (1994)	Focus group interviews	na	na	na	na	9	na

Table 5 (continued)

	Q-sample	Items	P-sample	Extraction method	Rotation method	Factors	Reporting results
Tractinsky & Jarvenpaa 1995	Interviews with IS professionals and IS literature as being important on the application's distribution decision	33	Participants in the main study were 47 experienced project managers drawn from 13 large companies in the Southwest	na	Varimax	4	Factor scores
Wingreen & Blanton (2018)	(1) Literature review, expert panel discussion, (2) Focus group discussion about potential items to include in the set of q-statements and (3) Data collection in a small ($n < 30$) group	na	218 IT professionals; origin unknown	Centroid factor analysis	na	5	Z-scores

Acknowledgements This research was funded in part by the Luxembourg National Research Fund (FNR) and PayPal, PEARL grant reference 13342933/Gilbert Fridgen. For the purpose of open access, the authors have applied a Creative Commons Attribution 4.0 International (CC BY 4.0) license to any Author Accepted Manuscript version arising from this submission.

Funding Open Access funding enabled and organized by Projekt DEAL.

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