Information Systems Research on Digital Platforms for Knowledge Work: A Scoping Review

Completed Research Paper

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Abstract

Digital platforms for knowledge work, such as Upwork, Freelancer.com and Amazon Mechanical Turk connect clients with millions of workers for a range of tasks, including software development, virtual assistance, and micro-tasks. Information systems research on this emergent phenomenon has gained traction in recent years regarding publication volume and research diversity. To identify relevant papers, to distinguish them from related types of digital platforms, and to guide future research, we conducted a scoping review, focusing on the information systems literature. Results are structured according to a theoretical framework of the knowledge work process, covering three phases: Worker-client matching, committing for future action, and executing commitments. While the first phase has been analyzed extensively, we contend that the main phases of the knowledge work process have received scant attention. In this emergent stage of extant research, our review identifies promising research directions to guide prospective studies.

Keywords: Digital platforms, knowledge work, literature review, scoping review

Introduction

With the growth of digital platforms, online markets for knowledge work are emerging as an important phenomenon in information systems (IS) research. In a nutshell, digital platforms for knowledge work (DPKW) refer to digital platforms that mediate the practice and exchange of knowledge work between clients and knowledge workers (we refine this definition below). Examples of digital platforms focusing on knowledge work jobs such as software development, graphic design, and digital marketing include Freelancer.com, Upwork, and Amazon Mechanical Turk. With a range of knowledge work jobs being performed on digital platforms, we are starting to witness the effects of this new digital phenomenon on our society. While DPKW already employ a substantial share of the global workforce (Manyika et al. 2015), research has just started to engage in the debate about this new form of work and the platforms that mediate it (Rai et al. 2019).

Recent research has advanced our understanding of specific aspects of digital platforms and knowledge work. Research on digital platforms has focused on socio-technical characteristics of the platform, including their layered modular architecture (Yoo et al. 2010). Examining the central role of the digital platform, scholars have studied the mediation of interactions between platform users, governance mechanisms, and the platform ecosystem (de Reuver et al. 2018). Research on knowledge work has studied the activities that workers engage in to apply, share, and produce knowledge, as well as the management of knowledge on an organizational level (Alavi and Leidner 2001; Newell et al. 2009). Focusing on the underlying assumptions of knowledge, scholars have begun to engage in an epistemological debate about whether knowledge should be viewed as a resource or a practice (Newell 2015). Being aware of and taking part in this debate is important to develop conceptualizations of knowledge work processes on DPKW that are well grounded in the current theoretical discourse. Overall, DPKW are beginning to emerge as a distinct phenomenon in the broader

literatures on digital platforms and knowledge work. These particular types of platforms, which mediate both short-term and prolonged knowledge work engagements, are on a trajectory to create unprecedented online labor markets with global labor mobility (Hong and Pavlou 2017). This clearly sets DPKW apart from other platforms that do not mediate the exchange of work (e.g., peer-to-peer funding) and from platforms that mediate the exchange of other (partially) offline services (e.g., mobility or hospitality).

However, despite the initial research contributions, there is no shared definition of DPKW with a plethora of terms, such as gig work, knowledge work, online labor, and on-demand labor, making it challenging to understand the scope of IS research on this topic. Furthermore, we are lacking a coherent understanding of what the process of knowledge work on DPKW encompasses, and which areas remain under-explored. With the current surge of conference papers, a growing variety and volume of upcoming papers can also be expected to appear in our leading journals in the future. This growth of the literature on DPKW clearly requires a synthesis of what extant research has accomplished, and guidance on how to fruitfully contribute to a shared body of knowledge on DPKW.

Therefore, the aim of this paper is to provide a definition of DPKW, to examine the nature of research on DPKW in IS, and to provide an agenda for future research. With DPKW still being an emerging phenomenon, we chose a scoping review methodology (Arksey and O'Malley 2005; Paré et al. 2015) to identify and guide the research contributions of the IS community and answer the research question: *What are DPKW, what do we know about them, and what are opportunities for future research?* We structure themes emerging from our review based on a theoretical framework of the knowledge work process on DPKW, which builds on extant literature, including the framework for cooperative inter-organizational relationships (Ring and Van de Ven 1994). In particular, we adopt a process model representing three phases of worker-client engagement mediated by DPKW: worker-client matching, committing for future action, and executing commitments. Starting with the original model, we developed our framework by iteratively reviewing and organizing the literature. The framework serves as a meta-model that organizes our mapping of the state of the literature, and guides the identification of gaps in the current understanding of DPKW. It adds value to the review because (1) it is based on a strong theoretical grounding, conceptually sound, and comprehensive; (2) it helps to bring clarity to the various research themes and to the sometimes heterogeneous terminology; and (3) it illustrates the stages that are relevant for knowledge workers, clients, and platform providers.

Our work offers three contributions. First, we develop a coherent definition of the phenomenon of DPKW. Specifically, we delineate DPKW from related types of digital platforms by formulating seven boundary conditions (BCs). Second, we provide a scoping review that maps the field of research on DPKW. We conceptualize the knowledge work process and provide a synthesis of extant IS research on this topic. Third, by drawing conclusions from the existing literature, we identify research avenues and formulate guiding questions for future research. Such guidance for future research on this emerging phenomenon is critical because published papers are increasingly heterogeneous, and insights from IS research are essential for managing DPKW, which have not only organizational but also societal impact and relevance.

The remainder of this paper is structured as follows: the related work section reviews research on digital platforms and knowledge work. Next, we define DPKW and specify concrete BCs. After presenting our theoretical framework to structure the review, we describe the methodology, including the literature identification and selection. The results are classified according to the three phases of the proposed process framework. Before concluding this paper in the last section, we discuss directions for future research.

Related Work

Digital Platforms

Digital platforms refer to "*the extensible codebase of a software-based system that provides core functionality shared by the modules that interoperate with it and the interfaces through which they interoperate*" (Tiwana and Konsynski 2010, p. 676). Research on digital platforms and the ecosystems into which they are embedded has become a major research topic for IS scholars (de Reuver et al. 2018; Parker et al. 2017). To fuel these ecosystems, organis ations often embrace layered modular architectures driving digital transformation and disruption in competitive markets (Yoo et al. 2010). Industries such as software development,

hospitality, and transportation have seen disruption from digital platforms based on sharing economy principles including Android, AirBnB, and Uber.

Various definitions exist that conceptualize digital platforms adopting technical, socio-technical, or ecosystem perspectives (de Reuver et al. 2018). Studies adopting a technical perspective often focus on the "*extensible codebase*" of the platform, incorporating various modules that extend the functionality of the software product (Tiwana and Konsynski 2010). From a socio-technical perspective, digital platforms are conceived as two-sided and multi-sided markets with different economic conditions than other market arrangements (de Reuver et al. 2018). Studying platforms from an ecosystem point-of-view, IS research has focused on platform modularization and extensibility through external users (de Reuver et al. 2018). Within the wide range of studies on digital platforms in IS research, initial papers have started to explore platforms for knowledge work. While the research stream on digital platforms offers an essential building block, understanding DPKW requires the research stream on knowledge work as a second building block.

Knowledge Work

Knowledge work refers to "*the situated practice in an equipped context that produces work that is knowledgeable*" (Newell 2015, p. 3). Thereby, knowledge acts as the main input into the work, the major way of achieving the work, and the major output (Newell et al. 2009). This practice perspective, suggested by Newell (2015) and based on Cook and Brown (1999), views knowledge as emerging from work in localized situations and as something that cannot be separated from these practices. The emphasis lies on knowledge work as a process as opposed to knowledge as a resource that can be extracted, stored, and shared with others. Complementing the traditional IS and management literature, which has largely focused on knowledge itself and management of knowledge using knowledge management systems (Alavi and Leidner 2001; Nonaka 1994), this perspective emphasizes that knowledge itself cannot be managed but only the practices of knowledge work. It has been advanced by scholars who adopt a more interpretive and critical approach and espouse an epistemology of practice by problematizing the traditional epistemology of possession.

Knowledge work goes beyond the work of white-collar professionals, such as lawyers, accountants, and managers, but also includes contemporary occupations such as software developers, marketers, and designers. Much of the work in these domains now includes digital technologies, reshaping almost every process, form, and condition of human action and interaction (Newell et al. 2009). This digital transformation of knowledge work has led to increased modularization and task division, allowing for much knowledge work to be performed on digital platforms (Puranam et al. 2014). Emerging DPKW do far more than mediate the value exchanged, but act as fundamental shapers of knowledge work.

Definition of Digital Platforms for Knowledge Work

To delineate digital platforms for knowledge work (DPKW) as the object of analysis, we suggest a definition and examine the literature to carve out specific BCs that distinguish DPKW from related types of platforms. Building on previous literature on digital platforms and knowledge work, we contend that definitions of DPKW should not be restricted to properties of the platform artifact (cf. Tiwana and Konsynski 2010). Instead, the type of exchange, i.e. knowledge work, and the modalities, such as ex-ante vs. ex-post contractual agreements, need to be considered to yield a sufficiently homogeneous scope. Furthermore, aspects of centralized governance (e.g., through market, contract, and task management systems operated by the platform provider as a central entity) including the coordination of workflows of independent tasks, with varying degrees of control over work process and output standards have to be taken into account. Therefore, our review is based on the following definition, which emerged after several iterations of engaging with the literature and consolidating the results:

DPKW Definition: Platforms that rely on digital technology and centralized governance to continuously mediate practices of knowledge work in networks of clients and workers bound by contractual agreements.

Our definition aligns with general conceptions of digital platforms (de Reuver et al. 2018), and more specifically digital labor platforms (Rai et al. 2019). To operationalize and clarify this definition, we discuss its components in light of seven distinct BCs. The main rationale for specifying these conditions is to enable

clear decisions of whether or not a given platform falls within the scope of DPKW. The BCs are derived from the definition, focusing not only on the technical aspects of the platform but also on its users and their relationships, as well as the nature of knowledge work practices enacted on the DPKW. We revisit the BCs in the paper selection phase (Section 3).

With regard to the platform artifact, the first BC requires it to constitute a digital technology as opposed to a non-digital platform (de Reuver et al. 2018). Examples such as offline outsourcing of software development differs from DPKW with regard to this first component. Knowledge work platforms or markets that are based on an information system exhibit different characteristics, for instance with regard to the efficiency in knowledge creation, sharing, and exchange and the corresponding potential for rapid scalability of the workforce (Gol et al. 2019). The second BC requires the platform to implement centralized governance mechanisms in order to control and coordinate activities between workers and clients (de Reuver et al. 2018). Although digital technologies such as peer-to-peer networks enable decentralized governance mechanisms in principle, digital platforms have not yet started to implement purely decentralized governance mechanisms (Gol et al. 2019). Typical examples of centralized governance mechanisms implemented include monitoring and assessment of worker behavior (Gol et al. 2019; Liang et al. 2016) and informal (clan) control (e.g. Tiwana and Konsynski 2010). The third BC requires a connection between the digital platform and its users (clients and workers) that is designed for continuous mediation. This distinguishes DPKW from forums that match supply and demand of different types of work without mediating the process throughout the contracting and execution phases.

Concerning the actors who interact with the DPKW, the fourth BC requires workers to be organizationally independent from the clients and the platform provider. Combined with the centralized governance by the platform, this actor-centric condition reflects the fundamental paradox of control that characterizes digital platforms and DPKW (de Reuver et al. 2018). Thus, these platforms go beyond what is commonly referred to as knowledge management systems that facilitate knowledge creation, sharing, and exchange within and between organizations (Alavi and Leidner 2001; Nonaka 1994) by focusing on situations in which clients do not exercise formal organizational control over knowledge workers. Furthermore, workers can also be organized into sub-communities, such as agencies that bundle their expertise (Sison and Lavilles 2018).

The conduct and exchange of knowledge work is restricted by three BCs. The fifth BC specifies the network topology along which the workers and clients are organized. In the context of DPKW, independent workers and clients are connected as nodes in a loosely coupled network. As corollary of exchange between users constituting a network structure, the primary value generating activities (i.e. knowledge work) and the value consuming activities (i.e. consumption of the knowledge work product) must occur at the network nodes. The sixth BC specifies knowledge work as the main activity performed by the workers throughout the exchange and the main type of value resulting from the exchange. Based on the epistemology of practice[1], knowledge work is conceived as tasks and activities for which knowledge serves as the major input, the means of getting work done, and the major output of work (Newell et al. 2009). A distinctive characteristic of knowledge work on DPKW is that the work process and its result are customized to the particular transaction. While a certain degree of knowledge reuse (e.g. in the form of templates) should be observed in any knowledge work process, this BC excludes exchanges in which identical knowledge products are sold to customers without adjustments. The seventh BC requires the workers and clients to be bound by contractual agreements formed before the work commences. Although knowledge work is also performed as part of traditional working arrangements, DPKW typically employ temporary contracts that govern the relationship between workers and clients. Some platforms employ a model that allows calls for bids, trying to drive competition among multiple potential workers; however, these calls still result in a single contract between two individual parties (Guo et al. 2017). Contracts coordinate the terms and conditions of a particular job such as salary, milestones, deadlines, deliverables, task specifications, communication policies, and dispute resolution. Irrespective of the formal or informal nature of the contract, the transactional agreement between workers and clients serves as the main point of reference with regard to platform governance (Agrawal et al. 2015). Crowdsourcing calls and open innovation contests tend to be out of scope, because these types of knowledge work are not based on ex-ante contracts, but on ex-post selection (Majchrzak et al. 2013).

[1]The knowledge work as a practice perspective was adopted to theoretically frame the paper. However, literature on DPKW was included in the review regardless of its epistemological view.

Theoretical Framing of the Knowledge Work Process on DPKW

We derive the framework for research on DPKW from the theory of cooperative inter-organizational relationships (IORs), which was originally developed by Ring and Van de Ven (1994). This framework was adopted after careful examination of work, organizational, and inter-organizational frameworks available in the literature. It represents a cyclical model of cooperative IORs, which explains how (inter-organizational) work relationships emerge, grow, and dissolve over time (cf. Figure 1). While these IORs include traditional forms of inter-organizational relationships such as strategic alliances, partnerships, coalitions, joint ventures, franchises, or research consortia, it also includes new forms of relational organizations such as network organizations — that is the type of organizing relationships that workers and clients engage in on DPKW. Before explaining the three stages associated with the temporal development of cooperative IORs, we clarify the key assumptions underlying Ring and Van de Ven's (1994) original model. Specifically, we show how these assumptions are equally valid in the context of DPKW, which led us to adopt this particular model to conceptually structure the research pertaining to client-worker interactions on DPKW.

Among extant literature and theory on organizational relationships (e.g., Dwyer et al. 1987), we feel that the assumptions underlying the model of Ring and Van de Ven (1994) provide the best fit with the DPKW context. First, relations between organizations can arise from one-time tasks and may develop into long-term, interdependent commitments (p.6). Second, since expectations of both parties are emergent and changing over time, corresponding uncertainties require trust and reputation mechanisms, such as internal dispute-resolution. Third, IORs are based on situated role relationships. Fourth, IORs are assessed on principles of 'fair dealing', which imply that parties are motivated to socially maintain their working relationship.

Although originally developed in the context of IORs, the examination of these four underlying assumptions suggests that Ring and Van de Ven's model is well suited for DPKW as this context shares similar assumptions. While parties on DPKW do not necessarily represent organizational entities, they typically act as such when engaging in short or long-term relationships. As it is the case in IOR, workers and clients have to deal with uncertainties inherent to the nature of knowledge work and rely on trust mechanisms to deal with this uncertainty. Due to the collaborative nature of knowledge work, which is characterized by emergent requirements, implementation challenges, and potential for innovation, internal coordination mechanisms, including conflict resolution services, are critical. The actions of individual parties on DPKW can be considered as a function of the situated role they take up in a particular knowledge work practice. For example, while a worker can act as a content creator in one work relationship, she can act differently in another job offering proofreading skills, or in a third relationship where she is acting as the client looking for a web developer. Finally, workers and clients balance the objective of extracting maximum surplus from each transaction with the objective of maintaining a reputation for fair dealing and trustworthiness to continue existing work relationships and establish new ones.

Figure 1 depicts our organizing framework that expands on the notion of the knowledge work process as a cooperative work relationship in a manner consistent with the developmental process of cooperative IORs model presented by Ring and Van de Ven (1994). Starting with the original model, which included the three phases negotiations, commitments, and executions as well as an assessment mechanism, we developed an adapted framework based on extant literature and the authors' participation in various online DPKW. In particular, the analytical process to develop this theoretical framework was as follows: we started reviewing the literature with a working conceptualization of the practices enacted on DPKW and iteratively refined the theoretical framework during the process of reviewing and organizing the literature. Charting the DPKW literature according to Ring and Van de Ven's model, our theoretical framework conceives the practices of knowledge work as consisting of a cyclical sequence of three phases: worker-client matching, committing for future action, and executing commitments. These phases are mediated by the DPKW through a governance mechanism. A detailed discussion of these three phases follows.

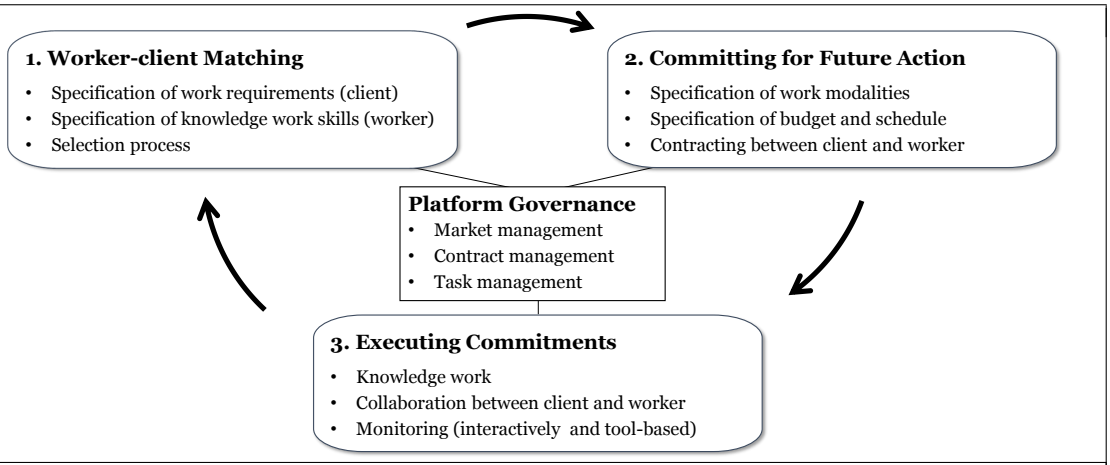

Figure 1. The Knowledge Work Process on DPKW (based on Ring and Van de Ven (1994))

Worker-client Matching

The first phase refers to the matching between multiple or individual workers and clients. In this phase, the demand-side of clients specifies job requirements and explores the market by issuing a call for bids, posting micro-tasks, or contacting workers directly. These actions are characterized by the uncertainty associated with the workers, for instance regarding their actual skill-set and future actions related to the confidentiality of the exchanged data. The supply-side of workers in turn has the option to submit a bid, to accept offered micro-tasks, and to present their skill-set in worker profiles. Worker profiles may be augmented by a history of past jobs, aggregated success rates, client reviews, and further performance indicators. Similar to other platforms, workers engage in a continued process of reputation building in order to be considered for more lucrative contracts (e.g., Holthaus and Stock 2017). Specific bargaining and bidding processes, which may be more or less formal, occur between parties with individual cultural backgrounds and preferred patterns of interaction. They are further mediated by platform governance mechanisms that restrict or enable options for discussion, persuasion, and bargaining on the DPKW. Ultimately, the transition to the second phase occurs when the client selects a worker and initiates the contracting process (cf. Hong et al. 2016, p. 64).

Committing for Future Action

The second phase refers to the commitments for future actions, covering questions of when and how knowledge work is to be performed. Here the involved parties reach a mutual agreement on the obligations and rules for future action in the work relationship. In this phase, workers and clients specify work modalities with regard to deliverables and conditions of the knowledge work process such as budget, milestones, schedule, and means of communication (Liang et al. 2018b). These structures are either codified in a formal relational contract or informally understood in a mutually agreed-upon informal arrangement depending on whether the DPKW technically supports the specific agreements of the contract. To establish the underlying economic processes of transactions and relational contracts, the DPKW acts as a mediating legal agent that enforces key commitments such as duration and salary of a job through platform governance mechanisms. This specification of the job characteristics in advance provides workers with stability, being able to rely on contractual agreements and guaranteed payments through escrow services.

Executing Commitments

The third phase refers to the actual executions of commitments - the practices of knowledge work. The execution of knowledge work in this phase is defined by the commitments mutually agreed upon in the previous phase. The worker functions as the main actor in the practice of knowledge work with the DPKW continuously shaping such practices through mediation of interactions or monitoring of work practices. In some instances, platforms even enable the work activities themselves to be conducted on the platform. Therefore,

a range of underlying organizational processes of task allocation, collaboration, and coordination are at play here that define the relationships between worker and client, as well as between other workers.

Platform Governance

Lastly, mechanisms of platform governance mediate the exchange in every phase of the process. Platform governance refers to the mechanisms with which the DPKW controls the processes and coordinates the interactions between workers and clients. While the original framework of Ring and Van de Ven (1994) focuses on assessments based on efficiency and equity, our framework conceives this aspect more broadly. In the context of DPKW, platform governance includes market management systems (e.g. rating systems), contract management systems (e.g. payment automation, conflict resolution mechanisms), and task management systems (e.g. monitoring systems) (cf. Deng and Joshi 2016; Gol et al. 2019; Liang et al. 2016).

Methodology

Our objective is to examine the nature and extent of IS research on DPKW. Specifically, the review is designed to comprehensively cover papers published in IS that are explicitly presented as research on DPKW. We aim at an inclusive assessment of research and do not restrict the inclusion to papers using specific search terms. At the same time, we do not to include papers that violate the specified BCs (cf. Section 2). We conducted a scoping review (Arksey and O'Malley 2005), which is suitable for synthesizing and mapping research activity emergent domains. The descriptive statistics of the sample of papers show that IS research on DPKW is emergent. The volume of recent literature on this topic, the heterogeneity of systems labeled as *digital platform* and the variety of tasks that may qualify as *knowledge work* make it necessary to systematically assess the range of papers available and how they contribute to our understanding of this type of digital platform. We carefully designed the scoping review with systematicity and transparency in mind (Paré et al. 2016; Templier and Paré 2018). We followed standardized methods documented in the literature (Templier and Paré 2018) and the stages recommended by Arksey and O'Malley (2005): (1) identifying the research question, (2) identifying relevant papers, (3) paper selection, (4) charting the data, and (5) collating, summarizing and reporting the results. [2]

Literature Search

The implemented search strategy comprises a range of search methods to identify relevant papers. The specified scope is not limited to a certain time frame, covering peer-reviewed research published in English and in IS journals and conferences. We include publication outlets listed in the top 40 IS journals identified by Lowry et al. (2013) and proceedings of leading IS conferences, i.e. *ICIS*, *ECIS*, *AMCIS*, *PACIS*, and *HICSS*.

In the first stage, we scanned tables of contents to identify papers focusing on DPKW. Since these manual analyses of titles and abstracts are not restricted to pre-specified search terms, they offer a robust search technique for emergent topics, such as DPKW. This search, which covered the whole *AIS Senior Scholars' Basket of Journals* between 2000 and 2019, was conducted between January 28th and February 23rd, 2019.

In the second stage, we ran database searches on *Google Scholar* and in the *AIS Electronic Library* (AISeL). Consistent with the objectives of the review we specified the search terms *"knowledge work platform"*, *"digital platform"*, *"digital labor platform"*, *"online labor markets"*, or *"digital labor markets"*. Since search terms are particularly difficult to justify for emergent phenomena characterized by heterogeneous terminology, the selection of search terms was primarily derived from prominent exemplars of extant literature (de Reuver et al. 2018; Gol et al. 2019; Rai et al. 2019). Additional search-terms (e.g., *"knowledge work"*, *"gig work"*, or *"online work"*) resulted in papers that often lacked the platform element of the DPKW definition. Nevertheless, with further resources for more extensive screening and exclusion, these additional search-terms could be covered in an extended literature search. Results from the database searches were restricted to the pre-specified journals and conferences using the "source" tag (*Google Scholar*) or the filter functionality (*AISeL*). Database searches were conducted between March 7th and August 12th, 2019.

In the third stage, we asked colleagues to check our sample of relevant papers selected after the 2nd screen,

[2] References of all papers included in this review are available in a supplementary online appendix: doi:10.5281/zenodo.3360875

and to identify missing papers. This search yielded 11 additional papers.

Papers identified by the search were imported into a literature database (BibTeX). Duplicates were cleaned by the semi-automated matching algorithm of Jabref (4.3.1). In addition, manual checks for duplicates were conducted, resulting in four additional duplicates. Overall, 88 duplicates were merged.

Our search methodology, and the comprehensive table of content scan in particular, allow for reasonable confidence in the completeness of the sample in the respective search scope. The possibility that further papers might be identified with broader searches and search terms cannot be ruled out and substantial amounts of additional papers can be expected to be published in 2019 and the years to come.

Paper Selection

We use the definition presented in Section 2 to derive criteria for the inclusion screen. Throughout this process, we recognize that there is further research that could transferred to DPKW. However, the formal inclusion criteria applied throughout this review focus on research explicitly conducted on DPKW. We do not actively extrapolate studies that originally do not focus on DPKW as defined in Section 2. At the same time, we recognized that for some boundaries (e.g., BC 3), exact binary decisions were difficult and therefore considerate judgment was needed. Throughout the inclusion screen, the main focus and the empirical part of the papers (if applicable) were considered; mere speculation that the results and conclusions could be transferred to this type of platform (e.g., in the discussion section) did not warrant inclusion.

In the first screen, we include papers that focus broadly on digital platforms and fall inside the formal search scope (e.g., correcting for indexing errors in the search databases). Papers whose relevance was difficult to judge were retained and checked to a structured exclusion screen based on formal boundary conditions in the next step. The high number of papers excluded during the first screen (as indicated in Figure 2) results from the amount of papers identified in a table of content scan.

In the second screen, each of the boundary conditions was iteratively applied to the whole set of 436 papers. Borderline cases were retained for additional iterations in which they were compared to similar papers to ensure consistency of the inclusion decisions before final reconciliation. Although requiring extensive amounts of time, this procedure was necessary to consistently select eligible papers. Figure 2 provides statistics of the violated boundary conditions.

Overall, 28 papers are included in the synthesis. Figure 2 provides an adapted PRISMA-ScR chart (based on Tricco et al. (2018)), displaying the flow through the paper identification and inclusion process.

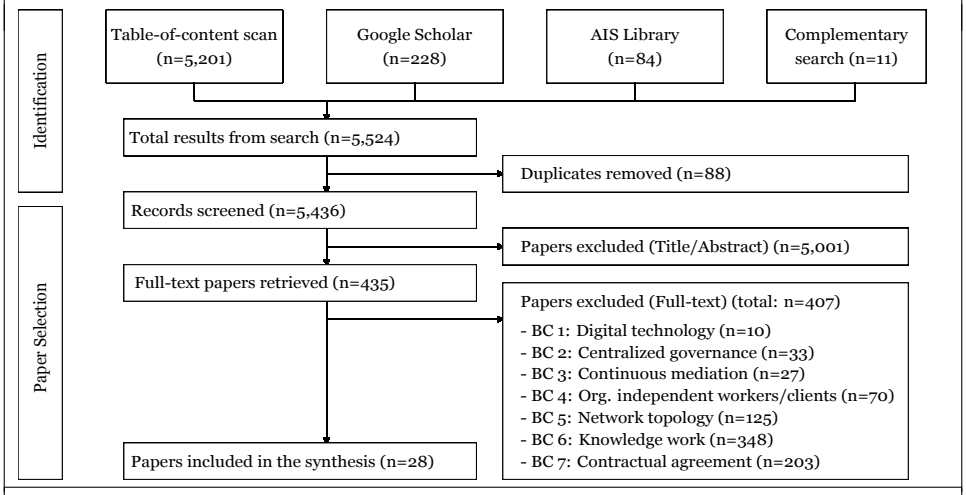

Figure 2. PRISMA-ScR Flow Diagram (adapted from Tricco et al. 2018)

Data Charting

We extracted data from all 28 papers and charted it according to the phases of the framework (Figure 1), (1) worker-client matching, (2) committing for future action, and (3) executing commitments. We allowed for papers to focus on one or more phases. After data extraction, terminology was homogenized (e.g. consistently referring to clients and workers). Borderline cases were discussed and resolved between the authors.

While allowing us to explore and chart an emerging topic, a limitation of fixed classification schemes is that they are less sensitive to new topics that could be recognized in the literature, such as differences between labor platform and traditional labor relationships. To mitigate this limitation, we summarized the main focus and conclusions of the papers independently from the framework and considered them in the synthesis. Our analyses of these summaries generally supported the suitability of the framework for classifying DPKW research. When more research is available, open coding could provide additional valuable insights.

Results

The profile of included papers shows that DPKW is an emergent stream of research that is gaining momentum and attention by the IS research community. In particular, the last few years have seen a strong increase in publication volume, with papers published in top-tier IS conferences and journals such as the *International Conference on Information Systems* and *Information Systems Research*. The amount of completed and research-in-progress conference papers are indicative of further extended journal papers that can be expected in the years to come.

In the sample, 17 papers (60.71%) use quantitative methods, 9 papers (32.14 %) are qualitative, and 2 papers (7.14%) use mixed methods approaches. Interestingly, there are 11 papers (39%) that implement empirical research designs with identification strategies for causality (e.g. difference-in-difference approaches, natural experiments, etc.). This results in a unique constellation in IS research, in which early exploratory research coincides with causal effects at the early stages of the theory development process.

With regard to the empirical contexts, 7 papers (28.57%) focus on Freelancer.com and 7 papers (25.00%) on Amazon Mechanical Turk. Upwork (previously Elance-oDesk) was analyzed by 2 papers (7.14%), and ZBJ and TaskCN were analyzed by one paper (3.57%) respectively. The specific platform was not reported by 10 papers (32.14%), in some cases for confidentiality reasons.

The type of knowledge work was categorized as software development for 11 papers (39.29%), as routine (micro) tasks such as labeling, transcription, or categorization for 6 papers (21,42%), and as creative knowledge work for 4 papers (14.29%). The specific type of work was not reported by 7 papers (25.00%).

Only 10 papers (35.71%) reported characteristics of the workers in their sample. Reporting practices are highly diverse, covering years of experience on the platform, platform-specific worker status, self-reported amateur or full-time worker status, skill-set, and further statistics, including country and gender.

Contract sizes tend to fall into the categories of IT projects averaging a few 100 dollars or micro-tasks approximately averaging minimum wages per hour. Types of contracts include open and sealed call-for-bid contracts (9 papers, 32.14%), or the Amazon Mechanical Turk HIT micro-tasks (5 papers, 17.86%). The type of contract was not reported by 14 papers (50%).

We present the results according to the foci of the respective phases of the framework introduced in Section 2. The results are summarized in Table 1, in which the focus of the papers is emphasised in bold. Results are clustered according to their primary focus and the research streams. The paper by Taylor and Joshi (2018) discusses use cases related to DPKW for IT leaders before a decision to source knowledge work was made. We consider this decision to be exogenous to the framework and therefore it was not included in Table 1.

Worker-Client Matching

The first phase of *worker-client matching* has been the clear focus in extant research, with 19 papers (67.86%) considering this phase as their unique focus (as indicated in Table 1). In fact, only two papers do not include this phase in their analysis. Naturally, a focus on the first phase, which is the most accessible and observable

phase of the framework, coincides with less detailed insights on the commitments and executions phases. In the first phase, two emerging streams can be distinguished: (1) research on worker participation decisions, expectations, and abilities, and (2) research on worker or contract selection decisions.

An incipient stream of research focuses on worker's participation decisions, expectations, and abilities in the matching phase. Extant research has analyzed the supply-side of the matching process, identifying a range of economic drivers. For instance, workers increasingly participate in DPKW when they are incentivized by monetary effects induced through exchange rate fluctuations (Gong et al. 2018) and when there are unemployment shocks in the offline labor market (Huang et al. 2018). More broadly, there is initial evidence that workers participate for reasons of skill enhancement, peer reputation, enjoyment, and work autonomy (Ye and Kankanhalli 2017), while also considering costs of cognitive effort and loss of knowledge power (Ye and Kankanhalli 2017). Further exploratory research suggests that there is a broad range of motivational factors, including task characteristics and work control, that explain worker satisfaction motivation for continued participation (Deng and Joshi 2016). In contract re-negotiation settings, experimental evidence indicates that workers react negatively to wage cuts (Chen and Horton 2016). Furthermore, they are dependent on a fair and transparent design of platform governance mechanisms (Deng et al. 2016), rendering trust in the platform a critical antecedent of worker intention to continue to participate (Ye and Kankanhalli 2017). Finally, the matching process on the supply-side occurs throughout different skills, associated utility for workers, and expected payoffs (Kokkodis and Ipeirotis 2014), with different demand-side requirements and intensities (Andrea and Lorenzo 2010).

A further research stream that is primarily situated in the worker-client matching phase focuses on conceptualizing aspects that explain selection and contracting decisions. For larger contract sizes, which coincide with a higher worker qualification and a need for more client-worker communication, clients have been found to prefer workers with similar country characteristics, such as language, time zone, and culture (Hong and Pavlou 2017). This preference for similar country characteristics ("home bias") has been found to be stronger for clients whose cultural background is shaped by traditional values and lower diversity (Liang et al. 2018a). Further research explores the degree to which the gender wage gap (approx. 19%) can be explained by differences in bidding behavior and job preferences (Liang et al. 2018b). The role of uncertainty related to the knowledge work in selection decisions has also started to receive attention. For instance, initial research suggests that uncertainty associated with the description of calls for bids (related to codifiability, requirements, and flexibility) have different effects on selection decisions (Guo et al. 2017). The uncertainty of the market price of projects has been found to affect selection decisions negatively (Hong and Zheng 2015; Zheng et al. 2015). Market price discovery and insights into competition intensity have been considered as a theoretical rationale for open bid calls outperforming sealed bid calls with regard to selection and contracting decisions, as well as client surplus and satisfaction (Hong et al. 2016). Workers have been found to influence selection decisions in their favor by signaling their skills, e.g. through self-promotion and skill tests offered by the platform (Holthaus and Stock 2017; Holthaus and Stock 2018), and by contacting clients before the selection decisions (Hong et al. 2018). Finally, initial research suggests that governance mechanisms, such as (the introduction of) IT-enabled monitoring systems, have an effect on client surplus, reputation premiums, and client's preferences for reputable workers (Liang et al. 2016; Liang et al. 2017).

Committing for Future Action

This phase, which occurs between worker selection and the contract conclusion, is not covered well by extant IS research on DPKW. In fact, our research did not identify any paper that considers this phase as an exclusive focus. A cluster of 7 papers that implement quantitative methods considers the outcome of contracting decisions as a proxy variable for the respective process. Although these papers focus on calls for bids, which are based on pre-specified requirements, it has been noted that worker selection does not necessarily lead to an agreement on commitments for future action, i.e. a contract (Hong et al. 2016).

Initial exploratory research is tapping into how clients and workers commit to particular work process arrangements (work specification, non-disclosure agreements, salary, and schedule), which may vary in their degree of formality (Sison and Lavilles 2018). The critical role of informal agreements that complement formal contracts (Lavilles and Sison 2017) suggests that the complexity of the processes of committing for future action is not captured fully by the outcome of formal contracting decisions. There are limited in-

sights into how trust mechanisms, such as requirements analysis services and contract formation services (Du and Mao 2018), and platform governance functionality, such as contract and incentive management mechanisms (Gol et al. 2019), affect this process.

Executing Commitments

Research has started to explore the execution of commitments phase, with 3 papers (10.71%) focusing exclusively on this phase. In addition, a few papers specify proxy variables for this phase, including wages (Kokkodis and Ipeirotis 2014) and self-reported performance (Holthaus and Stock 2017).

Focusing on knowledge workers, research has started to explore themes such as the uncertainty of payments, accomplishment of tasks through continuous communication, software support offered by platforms, work practices of knowledge workers, and trust relationship between clients and workers (Lavilles and Sison 2017). Additional analyses provide insights into the evolution of knowledge workers (software developers) and their strategies for work execution, such as IT-enabled collaborating, delegating in teams, and supervising other knowledge workers (Sison and Lavilles 2018). Ultimately, task characteristics and work control, which are situated in this phase, are likely to predict worker satisfaction (Deng and Joshi 2016) and their intention for (continued) participation (Ye and Kankanhalli 2017). Compensating for challenging working conditions, such as low wages and unfair treatment by clients, worker participation in independent communities has been shown to mitigate their desire to quit (Ma et al. 2018). While most research on the executions of commitments phase focuses on the worker side, Wang et al. (2017) consider the need of clients to assess the quality of routine labelling tasks and design a corresponding quality control scheme. Covering both the client and worker side, DPKW governance mechanisms provide quality control and task management mechanisms (Gol et al. 2019), and further trust mechanisms, such as periodical evaluation and harmonious conflict resolution (Du and Mao 2018).

Platform Governance

Initial research offers insights into governance mechanisms implemented by DPKW, with 2 papers (7.14%) focusing primarily on this aspect. Providing an overview of institutional mechanisms for trust development, Du and Mao (2018) offer insights into the governance mechanisms that facilitate trust building through the initiation, augmentation, and maintenance phases. These include escrow services, feedback mechanisms, and accreditation systems (initiation phase), requirements analysis and contract formation services (augmentation phase), and periodical evaluation and harmonious conflict resolution (maintenance phase). The effectiveness of platform governance in the context of DPKW has been suggested to depend on the efficiency of control and coordination systems (Gol et al. 2019). Control pertains to aspects such as reputation systems of workers, accountability of clients, and quality control, while coordination pertains for instance to contract management, task management, and incentive management (Gol et al. 2019). Finally, IT-enabled monitoring capabilities have been suggested as a further governance mechanism which can be critical for successful conflict resolution and prevention (Liang et al. 2016; Liang et al. 2017).

Table 1. Charting of Papers across the Phases of the Work Process on DPKW

Paper, Method	1. Worker-client Matching	2. Committing for Future Action	3. Executing Commitments	Platform Governance
Gong et al. (2018) ^{qn,i}	**Effect of monetary incentives (IV) on foreign worker participation (DV)**	NA	NA	NA
Huang et al. (2018) ^{qn,i}	**Effect of offline unemployment shocks (IV) on supply of workers (DV)**	NA	NA	NA
Andrea and Lorenzo (2010) ^{m}	**Classification of requested worker abilities**	NA	NA	NA
Chen and Horton (2016) ^{qn,i}	**Effect of wage cuts (IV) on workers' intention to quit (DV)**	NA	NA	NA

Deng and Joshi (2016) [ql]	**Worker motivation for (cont.) participation (DV)**	NA	Task characteristics and control mechanisms (IV)	Control mechanisms
Ye and Kankanhalli (2017) [ql]	**Effect of cost, benefits and trust (IV) on worker participation (DV)**	NA	Work experience (e.g. enjoyment, autonomy, effort) (IV)	NA
Kokkodis and Ipeirotis (2014) [qn]	**Analysis of utility and development of worker skills**	NA	Wages	NA
Guo et al. (2017) [qn]	**Effect of uncertainty of call for bid descriptions (IV)**	Contracting (DV)	NA	NA
Hong and Zheng (2015) [qn]	**Effect of price (of received bids) and quality (of worker ratings) dispersion (IV)**	Contracting (DV)	NA	NA
Hong et al. (2016) [qn,i]	**Differential effects of open/ sealed auction types (IV)**	Contracting (DV)	NA	NA
Hong and Pavlou (2017) [qn,i]	**Effect of country characteristics of workers and clients (IV)**	Contracting (DV)	NA	NA
Liang et al. (2018) [qn,i]	**Effect of country characteristics of workers and clients (IV)**	Contracting (DV)	NA	NA
Zheng et al. (2015) [qn]	**Effect of bid-price dispersion (IV)**	Contracting (DV)	NA	NA
Hong et al. (2018) [qn,i]	**Effect of pre-contract communication (IV)**	Contracting (DV)	NA	NA
Holthaus and Stock (2017) [qn]	**Effect of worker signaling (IV)**	NA	Self-reported performance (DV)	NA
Holthaus and Stock (2018) [qn]	**Effects of self- promotion and flattery (IV)**	NA	Wages (DV)	NA
Liang et al. (2016) [qn,i]	**Selection preferences (DV)**	NA	Effect of IT-enabled monitoring (IV)	Work monitoring capabilities
Liang et al. (2017) [qn,i]	**Selection preferences (DV)**	NA	Effect of IT-enabled monitoring (IV)	Work monitoring capabilities
Liang et al. (2018) [qn,i]	**Analysis of gender differences in selection decisions**	NA	NA	NA
Lavilles and Sison (2017) [ql]	NA	Exploratory analysis of formal and informal agreements	**Exploratory analysis of worker experiences**	NA
Ma et al. (2018) [qn]	Worker's desire to quit (DV)	NA	**Effect of community participation (IV)**	NA
Wang et al. (2017) [m,i]	NA	NA	**Design of a quality control scheme for labeling tasks**	NA
Du and Mao (2018) [ql]	Exemplary trust mechanisms			**Institutional trust mechanisms**
Gol et al. (2019) [ql]	Exemplary governance mechanisms			**Governance effectiveness (DV)**
Sison and Lavilles (2018) [ql]	**Exploratory analysis of contract search**	**Exploratory analysis of knowledge work coordination**	**Exploratory analysis of work execution**	NA
Deng et al. (2016)[c]	**Values shared by workers**			NA
Rahman (2018) [ql]	**Analysis of client-worker communication to explain rating inflation**			NA

Notes. Focus of the paper emphasized in ***bold****.* [qn] *quantitative methods,* [ql] *qualitative methods,* [m] *mixed methods,* [i] *identification design. DV dependent variable, IV independent variable.*

Directions for Future Research

The synthesis of research on DPKW and our interpretation of the results identified in Table 1 suggest several directions for future research. We therefore discuss gaps and recommendations for this emergent stream of research. Beginning with observations related to the profile of the studies, we outline an agenda including four avenues for future research on DPKW according to our conceptual framework.

Initial observations of the sample characteristics offer first indications for future research. Notably, research has either focused on micro-tasks (e.g. Amazon Mechanical Turk) or software development (e.g. freelancer.com), leaving open gaps in the area of non-routine, non-IT tasks such as design, translation, editorial, and creative work. In this regard, the leading platform Upwork has received scant attention, and further empirical contexts, such as Toptal and WorkGenius, have not yet been considered. Furthermore, the role of teams of knowledge workers (agencies) has only received cursory attention (cf. Sison and Lavilles 2018). There are no insights into teams regarding their initiation (both by clients and workers), formation process, or differences in effectiveness for varying types of knowledge work.

The heterogeneity of extant DPKW research and the growing diversity of empirical contexts that can be anticipated suggest that appropriate reporting practices will be critical for developing a cumulative body of knowledge in this area of research. Since DPKW are an evolving phenomenon, platform-specific worker characteristics, such as the "Master Qualification" on Amazon Mechanical Turk, may not be comparable between platforms and over time. While common measures have not yet been established, aspects such as worker experience, including time on the platform and overall vs. average volume of contracts, and status, such as full-time vs. part-time, should be reported to facilitate future qualitative systematic reviews.

Consistent with our focus on the distinct contributions of the IS community, we envision further design oriented research. Extending the IS tradition of design science projects, the centralized platform artifact of DPKW offers a natural starting point for theorizing constitutive architectural components and their effects on different worker-client interactions. Further design science research may follow the precedent of Wang et al. (2017) developing process models and tools supporting clients in (automatically) sourcing knowledge work from DPKW. Finally, the distributed work execution process, which is facilitated by a range of cutting-edge tools, offers promising opportunities to theorize mechanisms allowing workers to navigate the paradox of simultaneous cross-client knowledge reuse and confidentiality requirements (cf. Lavilles and Sison 2017).

Research Avenue 1: Worker-client Matching

In the worker-client matching phase, which has attracted the bulk of DPKW research, we identify three opportunities for future research. First, while extant research has focused on calls for bids for which any worker may apply, there are limited insights into more targeted approaches of clients, who may contact qualified workers with a particular skill-set, experience, and reputation. How prevalent is this approach throughout varying contract sizes and types of knowledge work and what are the procedural characteristics? While the effect of wages (and reductions thereof) has been shown to affect continued participation of workers in micro-tasks (Chen and Horton 2016), the factors that motivate highly qualified knowledge workers to continue repeated contracts with the same clients remain to be explored.

Second, while micro-task settings are dominated by traditional worker supply of labor as requested by organizations and driven by unemployment shocks or variation in monetary incentives (cf. Gong et al. 2018; Huang et al. 2018), it remains to be explored whether these insights apply to highly qualified knowledge workers, who may be less sensitive to wage fluctuations and consider different work-related aspects.

Finally, with a growing industry of DPKW platforms, there are further opportunities to examine multi-platform settings. For instance, what are the clients' platform selection criteria, and how do they depend on tasks characteristics and contract volume? We articulate the following research questions:

RQ 1: *How can the targeted contracting of specific knowledge workers, including the motivation to initiate, the process of tendering, and the decision to continue, be explained?*

RQ 2: *What are the differences between micro-clickworkers and highly qualified knowledge workers, e.g., regarding their motivation to participate in DPKW, or their preferences in job selection?*

RQ 3: *Why do workers and clients select a particular platform and under which circumstances do they interact on multiple platforms?*

Research Avenue 2: Committing for Future Action

The striking lack of research on the commitments phase (cf. Table 1) may be explained by the high degree of automation of this phase, especially in micro-task contexts, and by the challenges involved in gaining access to respective communication processes, which is not publicly accessible. Nevertheless, we encourage prospective authors to design studies that provide insights into these confidential processes (cf. Rahman 2018), and to extend extant exploratory research (cf. Lavilles and Sison 2017; Sison and Lavilles 2018). Cases in which the commitments are specified in a bi-lateral exchange offer opportunities for analysing the processes that lead to a contract, the different formal and informal components involved, and their variation over different categories of knowledge work. Further research could analyze settings in which commitments are redefined, for example due to changes emerging during the practice of knowledge work (cf. Lavilles and Sison 2017). For instance, workers may adopt different strategies to communicate changes, and there are limited insights into how they are incorporated in specified budget and schedule commitments after both parties have reached an agreement. We articulate the following research question:

RQ 4: *How do workers cope with the emergent nature of knowledge work in (re)negotiating formal and informal commitments?*

Research Avenue 3: Executing Commitments

The actual practice of knowledge work, despite being the purpose of DPKW, has largely remained a black box. In contrast to the range of quantitative papers analyzing publicly accessible data, studies examining this phase require access to the actual conduct of work, for instance through the platform provider (cf. Rahman 2018), workers, or clients. Once researchers gain such access, there are plenty of open research questions. Most of these questions focus on how work content and practices are being altered, including the way knowledge is transformed, shared, and created because of the mediating function of the DPKW. Further research could also try to unpack the role of the technological artifacts involved in the work practice itself. This could improve our understanding of how datafication and automated algorithms augment the relationship between workers and clients.

We further emphasize the trade-off between confidentiality and learning synergies across projects. Confidentiality and intellectual property requirements need to be managed throughout the work process and with regard to the final outcome. Does this process typically rely on contractual agreements (Lavilles and Sison 2017), and how do clients control and perceive confidentiality-related aspects on DPKW? A competing objective of workers is to learn throughout multiple projects and to formalize and transfer corresponding insights. In this regard, there is limited knowledge on whether these practices are based on particular types of knowledge reuse (cf. Sison and Lavilles 2018), and how they are supported or discouraged by platform governance mechanisms. We articulate the following research questions:

RQ 5: *How can the practice of knowledge work and the mediating role of the IT artifact on DPKW be conceptualized and explained?*

RQ 6: *How do clients and workers manage the competing objectives of protecting confidential data and leveraging lessons learned across projects?*

Research Avenue 4: Platform Governance

With regard to platform governance, extant research lacks systematic empirical analyses of the governance mechanisms implemented by DPKW. Existing work (cf. Gol et al. 2019) could be extended in order to gain a more comprehensive and in-depth picture of how DPKW mediate the knowledge work process. For instance, there is limited knowledge on mechanisms supporting particular trust-building measures, such as conflict resolution services (Du and Mao 2018). Furthermore, the literature has not yet analyzed how system features, such as warnings not to communicate outside of the platform systems, which are observable for clients and/or workers, are associated with governance mechanisms such as fraud prevention, or with ser-

vice improvement measures. Deepening this understanding of DPKW governance is necessary to strengthen the basis of further empirical research. We articulate the following research question:

RQ 7: *What is the effect of DPKW governance mechanisms (e.g., digital nudges, conflict resolution services, and fraud prevention), on outcomes such as trust and unintended behavior?*

Conclusion

In this review, we sought to understand emerging IS research on DPKW. This paper provides contributions in three areas: first, we develop a definition of DPKW; the type of online labor platforms that focus on knowledge work tasks. In deriving a coherent and well-bounded definition from the extant literature on digital platforms and knowledge work, we seek conceptual clarity in this upcoming stream of research. Second, we present a scoping review that maps the field of research on DPKW based on a process framework. We develop a chart of published research through a systematic collection and identification of literature following methodological guidelines for scoping reviews. Third, we outline recommendations for future research. We present a range of research gaps structured according to the theoretical framework to guide the future discourse on this phenomenon.

With a major share of the papers published in conference proceedings and a range of open research gaps, we conclude that DPKW is still an emerging topic in IS research. We trust that this first review will stimulate more research on the phenomenon and provide guidance with regards to under-explored areas. Each of the identified research opportunities also has the potential to make contributions to the practice of DPKW development, implementation, and governance. All three phases of our theoretical framework comprise fundamental interactions between workers and clients. In conclusion, DPKW is a current and exciting research topic that will continue to grow as new technologies and new forms of organizing, such as artificial intelligence or block-chain, further push the limits of next-generation digital platforms.

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