Information Management Challenges and the Adverse Consequences of Using Reverse Auctions

Chaitanya Sambhara (Conceptualization)

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Author Information

Dr. Chaitanya Sambhara *chaitanya.sambhara@uta.edu
Assistant Professor
Department of Information Systems and Operations Management,
College of Business
University of Texas Arlington
Arlington, TX, 76010, USA

Abstract

Using reverse auctions (RAs) requires managing complex information. Yet, such challenges are not well understood and are often even underestimated. To address this knowledge gap, I conducted a Delphi study and follow-up interviews to identify information management challenges and the adverse consequences. Drawing on the agency theory and the garbage can theory, I developed three dimensions of information management challenges, advanced a theoretical model, and formulated propositions to suggest the adverse consequences. My findings suggest that deficiency, violation, and anarchy of information can result in procedural failure, financial and competitive loss to suppliers, and damage to buyer–supplier relationships.

Keywords: reverse auctions; information management; Delphi study; information deficiency; information violation; information anarchy

Introduction

Internet-enabled reverse auctions (RAs) are a pre-contract, real-time dynamic event between a buyer and suppliers. Unlike forward auctions where buyers compete by increasing their bid to purchase a product, in RAs, suppliers compete by reducing their bids to sell their products or services. Although the usual primary motive for buyers to use RAs is to reduce

procurement costs to achieve a cost–benefit of 5–15% even before a contractual agreement is signed [26], buyers also use RAs to evaluate the supply market, compel incumbent suppliers to reduce costs, and identify new suppliers [23]. Although suppliers are forced to reduce their profit margin to be competitive, RAs provide them with opportunities to expand their businesses and generate new sources of revenue [49]. The use of RAs, therefore, has increased significantly in the past two decades. Currently, buyers around the world procure products and services with an estimated value of US$1.4 trillion per year by using RAs [57].

Because of the recent surge in their use, RAs have attracted a significant body of research across many disciplines (e.g., information systems, marketing, supply chains). Studies have suggested that other (often offline) traditional procurement methods (in which a buyer negotiates with either incumbent suppliers or a limited pool of local suppliers) usually fall short of the savings that RAs can generate [2, 49]. The primary reason that RAs can generate higher savings for buyers is the greater amount of intrafirm, interfirm, and market information that is produced when using RAs [2, 44]. However, buyers and suppliers must manage this electronically produced, large, and complex body of information effectively to derive benefits from RA use [33]. To clarify, I use the term information management to mean the application of management techniques to collect information, communicate it inside and outside of a firm's boundaries, and process it to enable a firm to make optimal business decisions [10]. In the context of RAs, information management can include a variety of tasks such as accurately identifying and interpreting the specifications for products or services, estimating the total cost of ownership, understanding the current supply market and complex cost structures of suppliers, and managing the bidding activity [1, 2]. Failure to manage such information effectively can render the use of RAs futile by leading to failure of the RA process, loss of valuable time and opportunity, and wastage of resource investments. Because RAs require significant resource investments and

preparatory time [25], it is important for buyers and suppliers to develop a good understanding of information management challenges. Firms that are unaware of the possible consequences of information management challenges can be left unprepared and vulnerable when such challenges arise. This can have serious long-term repercussions such as damage to a firm's reputation in the market and loss of trust between business partners [27].

Although scholars have conducted extensive research to examine both the beneficial and adverse consequences of RAs, the current understanding of the information management challenges of RAs that can lead to adverse consequences is insufficient and unclear [31, 43]. Most researchers [e.g., 36, 38, 49] have focused on the beneficial impact of RAs for buyers and the adverse consequences for suppliers. Some, however, have argued that the use of RAs can have adverse consequences for both buyers and suppliers [e.g., 43, 46, 47]. Therefore, it is important to understand the relationship between information management challenges and the adverse consequences for both [31]. Theoretical examination of information management challenges, adverse consequences, and the relationship between them has not yet clarified implications for theory and practice. A key objective of my study, therefore, is to address these gaps by building a theoretical understanding of the information management challenges and the adverse consequences. The study of information management challenges provides insights into RA value and risk. Because information management is key to RAs as a Business-to-Business (B2B) market mechanism, responding to information management challenges can help to mitigate risks and amplify the value of RA use. I addressed the following research questions:

RQ1: What are the information management challenges when using RAs?

RQ2: How do the information management challenges of RAs result in adverse consequences for buyers and suppliers?

The paper is divided into several sections. In the literature review, I discuss themes of information management from the literature and the dominant theoretical perspective on each theme. I then discuss the gaps in the current understanding of information management challenges and build the case for this study. In the research methodology section, I discuss how the data (a Delphi study with a 28-member buyer panel and a 31-member supplier panel, followed by in-depth interviews with 14 experts) were collected and analyzed. In the theory development section, I present the logic for the theoretical model and formulate propositions based on the findings from the data analysis. I then discuss the contributions of the study, directions for future research, and my conclusions.

Literature Review

I searched for variations of the terms "reverse auctions," "information," and "information management" in multiple digital libraries (primarily Google Scholar, JSTOR, and Business Source). I limited the scope to journals concerned with management, information systems, marketing, operations, and supply chains. First, I compiled a list of 173 papers for literature synthesis. I identified these papers based on the title and the abstract. The papers included academic papers, government reports and opinions, and other practitioner reports. Over a period of 19 months, I read through each paper and developed a list of all the theoretical perspectives and the corresponding constructs/dimensions. I also developed a list of the identified risk factors of RA use and information management challenges. I shortlisted 33 papers (listed in Table A2 in Appendix A) that discussed one or more aspects of information management. Beyond these 33 papers, the discussion on information management challenges was repetitive. Therefore, I focused my literature synthesis on the shortlisted papers.

I first discuss the information management themes of these studies and the dominant theoretical perspective for each theme. I then examine the gaps in our current understanding.

Finally, drawing on the gaps in the current knowledge, I set the stage for this study and discuss why the existing theoretical perspectives are not sufficient for identification and classification of information management challenges. Table A1 in Appendix A shows the information management themes, the dominant theoretical perspective for each theme, selected references, and the risk factors that represent information management challenges. Discussion of the literature is organized as per the themes of information management shown in Table A1 of Appendix A.

Overemphasis on the Bidding Price

A common complaint of suppliers against the use of RAs is that buyers often overlook suppliers' information about their capabilities and focus on the bidding price [26, 56]. Drawing primarily on the concept of asset specificity from transaction cost theory, these studies have shown that because of RAs, suppliers' products are treated as commodities, their non-price value adds are unaccounted for, and their ability to reduce the total cost does not receive attention.

Suppliers' Control Over Information and Unethical Behavior

When buyers seek information from suppliers, they take the risk that the information will be incomplete or inaccurate. Prior studies [e.g., 4, 7, 8] that examined this risk factor primarily focused on the adverse selection problem from the perspective of agency theory. Adverse selection refers to the risk of unethical behaviors that include the misrepresentation of information. Prior studies have found that suppliers can deliberately bid low by not adhering to the specifications to win the business and then increase the price later, or compromise on the quality of products or services to maintain profit margins [4]. Studies have also suggested that suppliers can even go to the extent of colluding to control prices and protect their interests against RA use by the buyer [7, 8].

Buyers' Control Over Information and Unethical Behavior

Risk factors related to buyers' control over information and unethical behavior have garnered much more attention in the RA literature than in the general B2B literature. This is because RAs create a unique situation in which a buyer is in an advantageous position to control information. Without the knowledge of the suppliers, a buyer can manipulate the RAs by including suppliers only to induce competition, and conducting RAs but awarding business based on personal preference (thereby being unfaithful to the RA process) [17, 19, 36, 53]. Interestingly, these risk factors largely appear in practitioner journals and reports, and scholars have not examined them from theoretical perspectives.

Organizational Contingencies

Prior studies that have explored organizational contingency risk factors have focused on the pre-auction phase of the RAs. Organization theory suggests that to conduct successful RAs, both buyers and suppliers should (a) collect information regarding the views of internal stakeholders and (b) ensure that they have the necessary internal support and technology capabilities to use RAs properly [8, 47].

Buyer–Supplier Communication

One of the most discussed risk factors in the literature is that of buyer–supplier communication. Studies that have discussed these risk factors have largely drawn on relational theory [27, 39], while some have also used the information richness perspective [21]. Prior studies have shown that it is primarily the buyer's responsibility to share information with suppliers at all stages of the auctions. Before the RA event, the buyer should share accurate information regarding his or her requirements and the award terms. After the RA event is concluded, the buyer should give feedback to suppliers on their performance.

Preparation for the RAs, Suppliers' Lack of Knowledge or Access to Information, and Bidding Behavior and Issues

These three themes come from the process governance perspective of auction theory. The successful governance of the RA process requires that a buyer first identifies the accurate specifications and informs suppliers. Then, depending on the specifications, the buyer collects information regarding the capabilities of the participating suppliers to develop a shortlist of qualified suppliers. The buyer should then structure the auction lots according to the capabilities of the qualified suppliers [26, 27]. Importantly, the buyer should share process information with suppliers, so that they understand all the procedures and the award criteria [26, 29]. Studies show that if the RA event has fewer than six suppliers, the buyer can find generating competition difficult [47]. The buyer, therefore, should collect information about the market conditions and invite enough qualified suppliers for the RA. During the event, however, suppliers also face challenges when their bidding price is revealed to their competitors. It can be difficult for suppliers to bid effectively if a buyer applies a loading (or weighting) factor to their bids without informing them [11, 12, 20, 25, 50] .

Gaps in Current Understanding of Information Management Challenges

Although prior studies have identified some information management challenges, the research objectives of these studies were not related to information management. Instead, the mention and discussion of information management was incidental and peripheral to their research objectives. For example, although Adomavicius et al. [1] examined the role of information management, their focus was specific to the context of multi-attribute auctions and bidding mechanisms. Their research objective was to examine how bidding behavior and profits are affected by the amount of information that suppliers receive about the buyer’s preference in multi-attribute RAs. To cite another example, among papers that examined the buyer–supplier

communication aspect of information management, research objectives focused on examining the design parameters and governance of RAs [e.g., 27, 39] whereas outcomes of interest focused on the likelihood of future RA use and buyer–supplier trust. Thus, it is not clear from the literature specifically what information management challenges could occur when using RAs and which information management challenges result in which adverse consequences.

Similarly, although the theoretical perspectives used in these studies have an information management aspect, the focus of the theoretical perspectives is not on information management. For example, transaction cost theory suggests that a lack of information exchange between business partners can result in contractual hazards. However, it does not address the contractual hazard issue from the perspective of information management. Instead, it recommends devising an effective contract that includes clauses to account for potential contractual hazards.

Gaps in the Current Understanding of the Adverse Consequences of Information Management Challenges

Table A2 in Appendix A shows the goal, theory base, type of study, data, and outcome of interest for each of the 33 papers I reviewed. As I noted above, there was not a single study in the literature on RAs whose research objective was related to examining information management. Unsurprisingly, no paper discussed the adverse consequences of information management challenges. The outcomes of interest in these studies focused on examining (a) the impact of RA use on gains for buyers and loss for suppliers, (b) the impact of RA use on buyer–supplier trust and relationship, (c) how use of RAs affects suppliers' business policies and practices, (d) the likelihood of use of RAs, (e) the cost of conducting RAs, and (f) the probability of a supplier winning an auction. Collectively, therefore, prior literature on RAs (a) did not take a holistic view of information management challenges and the adverse consequences from both buyers' and suppliers' perspectives, and (b) did not theorize the nature of the relationships between

information management challenges and the adverse consequences. To address these gaps, I first conducted a Delphi study to identify the information management challenges of using RAs. I then conducted semi-structured interviews to identify the adverse consequences. Based on the findings from the interviews, I suggest a theoretical model that depicts the relationship between information management challenges and the adverse consequences of RAs.

Research Methodology

Data Collection Methodology – Delphi Study

I convened two separate Delphi panels. The panelists were recruited through professional contacts at the Institute of Supply Management (ISM). I obtained two lists, each consisting of about one hundred names and contact information of company executives who are ISM members. One list was for procurement managers and executives who had conducted RAs as buyers. The other list was for business development and sales professionals who had bid in RAs as suppliers. Twenty-eight buyers and 31 suppliers responded to my invitation emails and agreed to participate in this study. The demographic profile of the Delphi study panels is shown in table B1 of Appendix B.

I conducted a three-phase Delphi study with buyer and supplier panels [42]. The Delphi study took place asynchronously over the internet in fall 2010. I created a web-based interface using Visual C# programming and an SQL Server database. A website URL was sent to the panelists who were given two weeks to respond in each phase. In the first phase (brainstorming) each panelist was asked to suggest six or more risk factors that he or she considered a major threat when using RAs. Four researchers, including myself, first independently and later collectively developed a list of 34 unique risk factors for buyers and 49 unique risk factors for suppliers from the Delphi study responses. We identified a total of 65 unique risk factors and

found that 18 were common between the two panels. In the second phase (selection), the panelists were asked to identify 20 factors that in their view presented the most serious risks. In the third phase (ranking), we shortlisted 16 risk factors for the buyer panel and 21 risk factors for the supplier panel to rank in the order of importance. Only the risk factors selected by 60% or more panelists were selected for the ranking phase. This was done to ensure that panelists were provided with a reasonable number of items to rank. A cutoff lower than 60% would have resulted in more than 25 items to rank and would have been too cumbersome for this phase [48]. The ranking phase was stopped when a Kendall's W greater than 0.5 was reached after two rounds of ranking. A detailed description of each phase of the Delphi methodology is provided in Figure A1 of Appendix A.

Data Collection Methodology – Follow-up Interviews

Building on studies such as the one conducted by Nevo and Chan [41], I conducted in-depth semi-structured interviews of selected panelists from each panel. Studies show that one-on-one interviews with panelists complement the findings from a Delphi study and lead to stronger contributions to theory and practice [28, 32]. I invited 20 experts from the panels (10 buyers and 10 suppliers) with the most experience of using RAs for in-depth interviews to expand and improve current understanding of the information management challenges. All these experts worked for Fortune 100 firms. Fourteen experts (seven buyers and seven suppliers) agreed to be interviewed. All 14 experts were senior executives who headed the respective divisions of their firms. All but one had used RAs since RAs were in their infancy and had witnessed the evolution of RAs over the years. The demographic profile of the experts is shown in Table B2 of Appendix B. The interviews were conducted over a period of two months in spring 2011.

Two interviews were conducted in person, and the remaining interviews were conducted over the phone or on Skype. Each expert was asked following questions:

1. Please verify and comment on the risk factors from the Delphi study that the four researchers concluded constitute information management challenges.
2. Please suggest any additional risk factors that in your view constituted information management challenges.
3. Please verify and explain the information management challenge constituted by each risk factor.
4. Please explain the adverse consequences of each information challenge.

On average, interviews lasted for 72 minutes (a range of 46–90 minutes).

Data Analysis Methodology – Developing Dimensions of Information Management Challenges

I analyzed the data with the help of three other researchers. We collectively deliberated over each risk factor to determine whether and how it related to information management challenges. We used the title and description of each risk factor to determine whether and how it represented an information management challenge. Among the 65 risk factors, 42 were identified as information management challenges. Of these 42 risk factors, ten had not been identified in any prior literature on RAs. We found that a majority of risk factors (i.e., 15 out of 23) that do not constitute information management challenges were not ranked by either panel. The details of the RA risk factors that constitute the information management challenges are shown in Appendix C. Pattern coding technique [37] was used to classify the RA risk factors into groups that represented information management challenges. We determined that the 42 risk factors constitute eight unique information management challenges.

I independently developed a list of theoretical perspectives, including the dimensions for those perspectives and the descriptions of the dimensions currently used in B2B interfirm governance and RA literature. The dimensions represent the constructs of the informing theoretical perspectives (e.g., opportunism is a dimension of agency theory). The list included among others, the following theoretical perspectives: transaction cost, relational, auction (process governance), dynamic capabilities, resource-based, prospect, game, organizational contingency, media richness, information processing, and the relationship constraints. The other three researchers then validated this list. The four of us deliberated over each information management challenge and how it mapped onto the theoretical perspectives and their dimensions. We discussed and compared each information management challenge with the dimensions of the theoretical perspectives to evaluate whether there was an alignment of ideas. We discarded the unmapped theoretical perspectives and dimensions and retained the ones that were mapped. For example, the information management challenges of unfair or unethical exploitation of the other party because of information asymmetry and creation of false information by the buyer capture the idea of information violation and aligned with agency theory's dimensions of information asymmetry and opportunistic behavior. Past studies (e.g., Jap [26], Griffiths [22]) on RAs that discussed these aspects of information management challenges also drew on agency theory and its dimensions. Three information management challenges could be mapped onto agency theory. However, there were five other information management challenges that we could not exclusively map onto the retained theoretical perspectives. For example, the information management challenge of a lack of information or assessment of internal market and stakeholders conveys the idea of information deficiency. However, no dimension of the above-mentioned theoretical perspectives effectively captured this idea.

We then expanded our search to literature on strategic management, administration science, and information systems to evaluate whether any other theoretical perspectives could explain information management in either intrafirm or interfirm contexts. Through this exercise, we discovered that the fundamental tenets of garbage can theory address information management issues and aligned with the five unmapped information management challenges identified in this study. Drawing on garbage can theory, and using an inductive reasoning approach [58], we developed two new dimensions to which we mapped the remaining five information management challenges. Finally, the information management challenges were classified into three dimensions that corresponded to two theoretical perspectives: information violation (agency theory), information deficiency (garbage can theory), and information anarchy (garbage can theory). The theoretical perspectives, the dimensions, and the information management challenges are shown in Table 1 and are elaborated in the next section.

– Insert Table 1 About Here –

Agency Theory

Agency theory identifies the task assigner as a principal and the task assignee as an agent. The agency problem arises when the principal's and the agent's goals are not aligned. When the goals are not aligned, one party, usually the agent, can misrepresent facts that the other party, usually the principal, cannot verify—a concept known as adverse selection, which results from information asymmetry. The party with the information advantage can act opportunistically against the other—a phenomenon called moral hazard in agency theory [13]. In the context of B2B relationships, the buyer is the principal and the supplier is the agent. Although research based on agency theory has typically examined the role of information asymmetry for the buyer (i.e., the supplier hides information) and opportunistic behavior by the supplier, research on RAs shows that they can have conditions in which a buyer can also create information asymmetry for

suppliers and act opportunistically [6, 8]. However, the findings of this study show that, apart from the deliberate creation and misuse of information asymmetry, a buyer can also fail to protect suppliers' sensitive information. Therefore, the information management challenges identified through the study represent intended as well as unintended violation of information. Accordingly, I refer to the agency information management challenges found in this study as information violation.

Information Deficiency

Information deficiency refers to a lack of sufficient information to execute plans successfully. Execution plans must be in place before anyone makes a decision, so the timing of information is critical. Garbage can theory presents this as a problem of information flow caused by a scarcity of information in the pre-decision-making phase [35, 59]. In the context of RAs, information deficiency problems arise before the execution of RAs (pre-auction phase) and, if not addressed, can lead to adverse consequences. Buyers and suppliers must process a range of information prior to the RA event to perform tasks such as ensuring the accuracy of the specifications, developing an understanding of the supply market, and assessing the internal market and stakeholders [14, 54]. Those who conduct RAs can find their efforts derailed by a lack of necessary information during event preparation [26]. Accordingly, a lack of information (i.e., information deficiency) can cause information management challenges.

Information Anarchy

Information anarchy refers to poor communication between two parties where one party is unsuccessful in communicating with or is unable to gather critical information from the other party. A core premise of garbage can theory is that firms are organized anarchies where participating actors must constantly scan and share information [9]. Access to the right actors when faced with unclear and ambiguous information is key to making optimal decisions [3].

When the quality of communication between two parties is poor, one or both parties are forced to make decisions that are not sufficiently informed, a situation referred to as decision-making in information anarchy [9, 35]. In the context of RAs, information anarchy arises when the buyer does not clearly communicate the award terms to suppliers, does not guarantee the award volumes, and does not provide post-auction feedback to suppliers regarding their performance in the RAs. It also arises when the only conduit of buyer–supplier communication is through RA tools.

Overlap Between Dimensions

Certain information management challenges could have been mapped onto more than one theoretical perspective or dimension. For example, the information management challenge of a lack of accurate specifications (information deficiency) could also be mapped onto the dimension of contractual hazards within transaction cost theory. However, my goal was to identify theoretical perspectives and the dimensions that are mutually exclusive yet collectively exhaustive and can cover all the information management challenges with as few theoretical perspectives and dimensions as possible. Other information management challenges within the dimension of information deficiency (e.g., lack of information or assessment of internal stakeholders) could not be mapped onto any dimension of transaction cost theory. Because the information management challenges aligned with two theoretical perspectives and three dimensions, I decided to build a minimalistic theoretical model for brevity and focus.

Data Analysis Methodology – Developing Dimensions of the Adverse Consequences

I transcribed the interviews, and the other three researchers reviewed the transcripts. The four of us then analyzed the transcripts using a pattern coding technique [37] to identify the adverse consequences and classify them into dimensions. The experts suggested the adverse consequences of each information management challenge. Depending on whom they affect and

how, we classified the adverse consequences into three dimensions: (a) failure of the procedure, (b) suppliers' financial and competitive loss, and (c) damage to the buyer–supplier relationship. Table 2 shows the dimensions of the adverse consequences. The first dimension (failure of the procedure) refers to buyers and suppliers not achieving the objectives of using RAs. Experts also suggested two adverse consequences for buyers (buyer unable to extract RAs' desired benefits and buyer unable to enforce the outcomes of the RA) and two adverse consequences for suppliers (supplier unable to place an optimal bid and supplier's unsuccessful participation because of the unfair actions of other suppliers) that collectively illustrate the failure dimension of an RA use. The second dimension (suppliers' financial and competitive loss) refers to suppliers losing their profit margins and finding their critical information compromised. The third dimension (damage to the buyer–supplier relationship) refers to breach of contract and loss of credibility and goodwill between the buyer and the suppliers. Overall, we identified two new adverse consequences in this study that have not previously appeared in the literature: (a) suppliers' unsuccessful participation caused by the unfair actions of other suppliers and (b) compromise of suppliers' critical competitive information.

– Insert Table 2 About Here –

Theory Development

Drawing on the findings, I theorize how the information management challenges can result in adverse consequences. It was important to be parsimonious and take a high-level abstract view of the phenomenon being examined. A high-level abstract view increases the generalizability of the insights and reduces reliance on the context within which a phenomenon is being examined [58]. A laundry-list discussion of 42 factors that constitute information management challenges and the adverse consequences would not have helped me achieve that objective. Therefore, I developed propositions at the level of the dimensions of the information

management challenges and the adverse consequences (Figure 1). I first state each proposition and then discuss the findings from the interviews that led to the propositions. For each proposition I provide direct quotes from interviews. Some additional quotes are provided in Appendix D.

-- Insert Figure 1 About Here --

Adverse Consequences of Information Deficiency When Using RAs

Proposition 1: An increase in information deficiency when using RAs can result in:

- *an increased likelihood of failure of the procedure (failure of RA use for buyer and suppliers), and*
- *an increased likelihood of suppliers' financial and competitive loss.*

According to garbage can theory, execution plans can fail when decision-makers cannot access necessary information before making their decision. Information management challenges caused by a lack of information, therefore, lead to information deficiency problems that leave managers unable to make optimal business decisions. In the context of RAs, information deficiency results from a lack of several components: accurate specifications for the products or services being auctioned, information regarding internal markets and stakeholders, information about the supply market, and idiosyncratic information about the suppliers participating in RAs.

Information deficiency challenges surface primarily in the pre-auction phase. Preparation for the RA event requires buyers and suppliers to perform a variety of information-processing tasks. The buyer should first gather information from all internal stakeholders regarding their views on using RAs to procure certain products and services [22]. Disapproval from top management or internal clients can prevent the buyer awarding business to suppliers based on the outcomes of the RAs. A panel expert said, *"*I have seen it happening several times because it was

a problem when either internal clients or top management were not committed to the auctions. In such instances, we were not able to implement the outcomes of the auctions."

Next, the buyer should provide detailed and accurate specification to suppliers [2, 29]. A lack of detailed and accurate specifications can lead to the failure of RAs. The panel experts suggested that it is better to wait until the required information regarding specifications is gathered before conducting RAs. One expert said,

> We recently finished a project where we had vague specifications, and we ended up delaying the project for two months because it was very critical that we got our specifications accurate [sic]. We ended up saving 28% against the historical pricing. There was no way we could have achieved these savings without putting the work into it to get the specifications defined properly. When the specified requirements are inadequate or inaccurate, it is almost impossible to have a successful auction. I am aware of many auctions that failed quite badly. We, therefore, no longer allow the situations to get to that stage.

Likewise, suppliers should ensure that they understand the specifications and should validate the specifications with the buyer. Another expert said:

> Often buyers themselves do not know what exactly they want. For example, when a buyer wants to purchase multifunction printers, it first needs to do its own homework and come up with all the capabilities that it would like the printers to have. A buyer will never have the suppliers' level of expertise on the product it is auctioning.

Suppliers are unable to place an optimal bid in the RAs if they do not have a clear understanding of the specifications. It is also important that the buyer collect information about the supply market before using RAs. Prior studies have shown that suppliers can collude to control prices [20, 55], that there may not be enough suppliers to participate in the RAs [29], and

that the capability of suppliers to deliver in smaller or larger volumes can vary [54]. The buyer should ask for pre-bid prices and adequately screen suppliers to ensure that they have the capability to bid on the lots and are likely to place competitive bids. A lack of information or assessment of the supply market can result in low bidding activity and the failure of RA use for the buyer. After developing a good understanding of the supply market, the buyer should gather detailed information about suppliers' capabilities. Some suppliers may have idiosyncratic capabilities that include alternative products and non-price value adds that may not be reflected in the bid price [4]. The buyer can impose a loading/weighting factor on a supplier's bid to adjust and account for other costs and capabilities [8].

The findings also suggest that, to the extent possible, suppliers too should collect information about the supply market. An incumbent supplier can have an information advantage over other suppliers [25], and some may outsource to cheaper foreign suppliers. It is difficult for a supplier to gather such information about competitors' business models, cost structures, and bidding strategies. When a supplier tries to compete on price without sufficient information about other suppliers, he or she risks cutting profit margins too thin and becoming financially vulnerable.

Prior literature that has examined issues related to a lack of information in a project, particularly in IT or IT-related projects [e.g., 30, 51], shows how the likelihood of the project's success is adversely affected. Our findings, however, expand the existing literature by showing that over and above the failure of RA use for buyers and suppliers, information deficiency can also jeopardize suppliers' financial well-being and their competitiveness. The adverse consequences of information deficiency, therefore, are not limited to the failure of a project.

Adverse Consequences of Information Violation When Using RAs

Proposition 2: An increase in information violation when using RAs can result in:

- *an increased likelihood of suppliers' financial and competitive loss, and*
- *a greater damage to buyer–supplier relationships.*

Agency theory underscores the importance of alignment of goals and information between two parties in a transactional exchange. Misalignment of goals can motivate an agent (supplier) to derive benefits from its information-advantaged position by violating information. When using RAs, however, both buyers and suppliers have information that is not available to the other party. Information violation occurs when (a) buyers and suppliers exploit information asymmetry to their benefit, (b) the buyer creates false information, and (c) a buyer fails to protect suppliers' sensitive information. Information violation can be deliberate or unintended. Information violation by buyers or suppliers can result in suppliers' financial and competitive loss and can damage buyer–supplier relationships.

Information violation occurs primarily during the RA event. Consistent with the tenets of agency theory and the literature on RAs, findings from the present study show that suppliers can take advantage of information asymmetry and act opportunistically. A supplier can bid low by not adhering to the specifications, introduce hidden costs, and compromise the quality of products or services [5, 7, 16]. Such acts can result in the loss of suppliers' credibility and damage their relationships with the buyer.

Studies on RAs, however, show that the use of RAs can create conditions that favor buyers, and buyers can also be responsible for information violation and opportunistic behavior [7, 8]. The buyer can use RAs to drive prices down and pressure incumbent suppliers [7, 26]. Because the buyer has strong control over the RA process, the buyer can create artificial bids or intentionally include low-bidding suppliers with no intention of awarding business to them. An expert from the buyer's panel admitted,

> A supplier who was to bid very low was included in the auctions. That supplier would not have been awarded our business. The supplier was included only to drive competition. We were not faithful to the auction process; we were not faithful to the suppliers.

Another expert said:

> It happens quite often when a buyer is not faithful to the auction process. I have seen a buyer bending rules when it was not happy with the outcome of the auctions, particularly when the supplier they expected to bid aggressively did not participate or did not bid aggressively enough. At such times, you have to create a market.

A buyer can deviate from the RA process also by accepting quotes outside of the RA event and awarding business to preferred suppliers regardless of the outcome of the RA. Such acts by a buyer can make suppliers financially vulnerable and hurt the buyer's reputation among suppliers. Suppliers lose their goodwill toward the buyer and may breach the contract to make up for financial losses.

The findings from the current study uncovered another aspect of information violation that is not yet well understood. They suggest that information violation is not always a deliberate act. Information violation can occur when a buyer fails to secure suppliers' sensitive information. The buyer can ask suppliers to disclose their cost structures and manufacturing processes before participating in RAs. Reverse auction software or system malfunctions can interrupt the auction and require that it be rerun, thus exposing the initial bid strategies of suppliers to their competitors. Design elements of RAs (e.g., rank-only RAs or bid amounts) can also discourage suppliers from participating for fear of revealing sensitive pricing information. Buyers may not deliberately intend to harm suppliers' interests; nonetheless, such factors can have a negative impact on their critical competitive information.

Findings from prior studies that have drawn on agency theory, however, have been limited to (a) deliberate manipulation of information and (b) adverse consequences for the principal alone. Findings from this study go beyond that and show the adverse consequence for the agent, where the loss is not limited to its finances. An agent (i.e., a supplier) can suffer competitive loss as well from information violation. The findings also show that information violation, either deliberate or unintentional, can damage buyer–supplier relationships.

Adverse Consequences of Information Anarchy When Using RAs

> *Proposition 3: An increase in information anarchy when using RAs can result in greater damage to buyer–supplier relationships.*

Information anarchy, as per garbage theory, refers to one party's inability to communicate with the other party to gather critical information. Without having access to critical information, the decision-makers are forced to make decisions based on speculations. Information anarchy challenges span all phases of RAs (i.e., pre-auction, during auction, and post-auction). Information anarchy arises from poor communication between a buyer and a supplier. The onus of maintaining a proper and effective channel of communication lies with the buyer. Suppliers often reduce prices in the RAs, hoping that the buyer will award them a large-volume contract so they can recover their profit margin. Therefore, it is important that the buyer clearly communicates the RA rules and awards terms to suppliers in the pre-auction phase [5, 25]. A buyer's failure to communicate effectively can create resentment among suppliers, who may feel little goodwill toward the buyer already. One expert from the supplier panel said:

> It comes down to interpersonal communication and personal connections between the buyer and supplier. When a buyer has fluctuating demand for its own products and when it has unforeseen requirements, it will have a difficult time convincing the suppliers it put

through reverse auctions. The use of reverse auctions and forced price reduction takes away the suppliers' incentive to be flexible for their customer.

To gain suppliers' trust, the buyer should be willing to communicate with suppliers outside of the RA tools and provide them with (a) any needed clarification about specifications, and (b) an opportunity for the supplier to inform the buyer about his or her firm's capabilities. Reliance on RA tools as a medium of communication can create information anarchy and is a major cause of concern for suppliers [33, 34]. One expert from the supplier panel said,

> If we do not get the opportunity to speak with the buyer, we do not know what they want, and they do not know what we can deliver. To concentrate purely on price is a major fault of auctions. The buyer should not rely on the auction process alone and (should) rather have a holistic view.

Another expert said, "When an incumbent customer refused to have a conversation and preferred to talk only via an electronic medium, we did feel that we did not have the relationship that we thought we had." All experts from the supplier panel agreed that reliance on RA tools as the only mode of communication hurts buyers' credibility and can be damaging to their relationships.

The findings suggest that it is important for a buyer to communicate with suppliers after the RA event even if they will not be awarded the business contract. A lack of post-auction feedback can (a) erode losing suppliers' confidence in the RA process, (b) reduce their incentive to participate in future RAs, and (c) weaken their willingness to establish a relationship with the buyer. Prior studies that examined the relationship between RA use and buyer–supplier relationships have suggested that reliance on RA tools as a communication medium has a detrimental impact on suppliers' trust in the buyer and can weaken buyer–supplier relationships [19, 21, 27]. My findings expand the current understanding by showing that information anarchy

is not limited to the medium of communication. The willingness of a party to communicate with other parties is also a key determinant of information anarchy. In the context of RAs, reliance on RA tools as a communication medium, in addition to buyers' unwillingness and refusal to communicate with suppliers outside of RA tools, leads to information anarchy that can cause damage to buyer–supplier relationships.

Discussion

The goal of my research was to increase the theoretical understanding of (a) the information management challenges when using RAs, (b) the adverse consequences, and (c) the relationship between the two. To achieve this goal, I needed to take a high-level abstract view of the information management challenges and the adverse consequences. As a first step, therefore, I created research questions designed to identify information management challenges and adverse consequences. The first research question dealt with the identification of information management challenges when using RAs. I identified three dimensions of information management challenges: information deficiency, information violation, and information anarchy. The second research question asked about the adverse consequences of the information management challenges. I answered this research question in two steps. In the first step, I developed three dimensions of adverse consequences: failure of the procedure, suppliers' financial and competitive loss, and damage to buyer–supplier relationships. In the second step, I advanced a theoretical model and formulated propositions to describe the relationships between the dimensions of information management challenges and the dimensions of the adverse consequences. Next, I reflected on how this study, in its quest to answer the research questions and build a theoretical model, contributed to the body of research, and makes important incremental contributions.

First, although numerous theoretical perspectives (e.g., transaction cost theory, relational theory, organization theory) used in the prior literature contain aspects of information management, the boundary conditions of the theoretical perspectives limited the extent to which they explored information management challenges. This is so because B2B theoretical perspectives have focused on suggesting process mechanisms to find ways to circumvent information management challenges rather than addressing the challenges or identifying the adverse consequences of the challenges. For example, both transaction cost theory and agency theory make rational actor assumptions and discuss challenges due to lack of information. While transaction cost theory focuses on contractual hazards, agency theory focuses on moral hazards and the adverse selection problems. In either case, the goal is to devise an optimal contract between two parties to minimize opportunistic behavior by the agent (supplier) because of the agent's advantageous position with information. This study, however, goes beyond the rational actor assumptions made by these two theories and focuses on the underlying risk factors to identify the information management challenges. The dimensions of information management challenges developed in this study, therefore, cut across theoretical perspectives used in the B2B literature. When seen from the perspective of information management, the challenges identified in the literature that are spread across theoretical perspectives can be brought under the umbrella of three broad dimensions: deficiency, violation, and anarchy (the new dimension that I developed in this study).

Second, prior literature on RAs had at best identified the risk factors that constitute information management challenges. In this study, however, I built a theoretical abstract view of information management challenges by making progressive contributions through three different levels. At the level of risk factors, this study raised ten new factors that constitute information management challenges unidentified in the existing literature. At the level of information

management challenges, a new information management challenge was identified that, to the best of my knowledge, has not been discussed in the prior literature. The information management challenge of a buyer's failure to protect suppliers' sensitive information is one of the three information management challenges that constitute the dimension of information violation and can result in suppliers' financial and competitive loss and damage to buyer–supplier relationship. At the level of dimensions of information management challenges, in this study, by drawing on the well-established theoretical perspectives of agency theory and garbage can theory, I developed three dimensions that are mutually exclusive and yet collectively exhaustive for capturing information management challenges. Taken together, I identify the theory of the three dimensions of information management challenges with an acronym: DeViAnT (DEficiency, VIolation, and ANarchy Theory).

Third, prior B2B research that has drawn on agency theory, such as Reuer and Ragozzino [45], has shown that goal incongruence can often lead to information violation by suppliers such that they do not put forth the agreed-upon effort and instead project false information to the buyer. Similarly, prior RA research drawing on agency theory has shown that buyers too can create and project false information to suppliers [8, 15, 26]. In either case, the information violation is deliberate and carried out when the financial interests of the two parties are not aligned. This study, however, identified one additional information management challenge in using Ras characterized by information violation that is not a deliberate act (the buyer's failure to protect the suppliers' sensitive information). This study extends the findings of prior research on Ras, such as Jap [27] and Mithas and Jones [38], that investigated the impact of price visibility in Ras on buyer–supplier relationships and buyer surplus by showing that a buyer can inadvertently fail to protect suppliers' sensitive information—a failure that can result in the compromise of suppliers' critical competitive information and damage to buyer–supplier relationships.

Fourth, prior studies on RAs have shown how reliance on RA tools as a mode of communication can deplete suppliers' trust in the buyer and damage buyer–supplier relationships [7, 21]. My findings extend these studies by showing that poor buyer–supplier communication resulting from sole reliance on RA tools can result in suppliers' loss of goodwill toward the buyer, even to the extent that suppliers could be willing to breach the contract and compromise on the quality of products and services. Breach of contract, in turn, can result in loss of suppliers' credibility and reputation with the buyer. Information anarchy resulting from poor buyer–supplier communication can therefore adversely affect both parties.

Finally, this study raised two adverse consequences faced by suppliers that were not identified in the prior literature: (a) suppliers' participation in RAs may be unsuccessful because of unfair actions of other competing suppliers and (b) suppliers' competitive information could be compromised through participation in RAs. The unraveling of these adverse consequences will augment further research on the conditions in which suppliers are exposed to inadvertent consequences despite careful preparatory planning before the RA event.

Implications for Practitioners

This study has some important implications for practitioners. First, the information management challenges can serve as a checklist that buyers and suppliers can use to evaluate the challenges for both parties. For example, the buyer's failure to protect suppliers' sensitive information may not be an issue important enough for a buyer to consider when planning and designing the RAs. However, this study can sensitize buyers to this information management challenge so they can keep suppliers' interests in mind. Second, buyers and suppliers can use the findings of this study to inform themselves and the other party of the potential adverse consequences. This will help each party to understand the other's perspective on information

management challenges, know what the consequences could be, and take corrective action to prevent the information management challenges from arising.

Limitations and Directions for Future Research

Although my research generated important insights about the information management challenges of RAs and their adverse consequences, it does have limitations. First, the data were collected only from the ISM. I cannot know with certainty that the limited sample of this study represents the true population and, as a result, the extent to which the findings can be generalized. Second, I do not yet know what changes the firms need to make in the design of RAs, nor how they should configure the RA process to address the information management challenges. Future researchers can explore whether firms that effectively design RAs and responsibly conduct the RA events are immune to some of the information management challenges identified in this study. Third, future researchers can explore solutions to the information management challenges by identifying business processes and practices that buyers and suppliers can establish to build a strong information management culture. Fourth, additional research can refine and test the proposed relationships between information management challenges and the adverse consequences using methods such as large-scale surveys. Fifth, this study can be added to the literature on theory building because I show how an exploratory data collection methodology such as a Delphi study can be an effective method for building new dimensions that represent theoretical constructs. Finally, I did not theorize the relationships between the adverse consequences. Future researchers can examine whether and how one adverse consequence can influence other adverse consequences.

Conclusion

This study makes important contributions to the literature on RAs and the literature on information management in general by (a) developing three major dimensions of information

management challenges (deficiency, violation, and anarchy), (b) identifying three major dimensions of the adverse consequences (failure of RA use for buyers and suppliers, suppliers' financial and competitive loss, and damage to buyer–supplier relationships), and (c) advancing a theoretical model to expand the current understanding of the relationship between information management challenges and the adverse consequences. Future research related to RAs and IT-enabled B2B relationships can further develop and evaluate the theoretical model and the corresponding propositions. Research on RA configuration and design can also draw on the findings from this study and investigate the role that information management plays in influencing success or failure with RA use.

Chaitanya Sambhara: Conceptualization, Execution

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Author Biography

CHAITANYA SAMBHARA (chaitanya.sambhara@uta.edu) is an Assistant Professor of Information Systems and Operations Management at the University of Texas Arlington, USA. His research focuses on business value of information technology, risks, controls, and knowledge capital and competence. His research has appeared in the Journal of Management Information Systems, Communication of the Association for Information Systems, Proceedings of the International Conference on Information Systems, America's Conference on Information Systems, and the annual conference of Production and Operations Management Society.

Tables and Figures

Table 1 *Information Management Challenges and Dimensions*

Theoretical Perspective	**Information Management Challenge Dimension**	**Information Management Challenge**	**Selected Prior Studies That Have Previously Identified the Information Challenge**
Agency theory	Information violation	Buyer's failure to protect suppliers' sensitive information	*Not identified in the literature
		Creation of false information by the buyer	Jap [25], Jap [26], Griffiths [22], Carter et al. [5], Emiliani and Stec [19], Charki et al. [8]
		Unfair/unethical exploitation of the other party because of information asymmetry	Beall et al. [2], Griffiths [22], Carter and Kaufmann [4], Charki et al. [8]
Garbage can theory	Information deficiency	Lack of accurate specifications	Beall et al. [2], Smeltzer and Carr [54], Kaufmann and Carter [29]
		Lack of information or assessment of internal market and stakeholders	Griffiths [22]
		Lack of information or assessment of the supply market	Jap [25], Jap [26], Carter et al. [5], Tassabehji et al. [56], Elmaghraby [14]
		Lack of idiosyncratic information about suppliers participating in RAs	Jap [25], Smart and Harrison [53], Charki et al. [8], Fugger et al. [20]
	Information anarchy	Poor buyer–supplier communication	Jap [25], Smart and Harrison [53], Carter et al. [5], Fugger et al. [20]

Table 2 *Adverse Consequences of the Information Management Challenges*

Adverse Consequence Dimension	**Adverse Consequence**	**Selected Prior Studies That Have Also Previously Identified the Adverse Consequence***
Failure of reverse auction use for buyer	Buyer unable to extract RAs' desired benefits	Beall et al. [2], Smeltzer and Carr [54], Kaufmann and Carter [29]
	Buyer unable to enforce outcomes of the RA	Griffiths [22]
Failure of reverse auction use for supplier	Supplier unable to place an optimal bid	Jap [25], Smart and Harrison [53], Charki et al. [8]
	Supplier's unsuccessful participation because of unfair actions of other suppliers	*Not identified in the literature
Suppliers' financial and competitive loss	Increased financial vulnerability of supplier(s)	Beall et al. [2], Smart and Harrison [53]
	Supplier's critical competitive information compromised	*Not identified in the literature
Damage to buyer–supplier relationships	Loss of credibility/reputation among business partners	Charki and Josserand [7], Charki et al. [8]
	Supplier's breach of contract/loss of goodwill for the buyer	Beall et al. [2], Charki, and Josserand [7], Charki et al. [8]

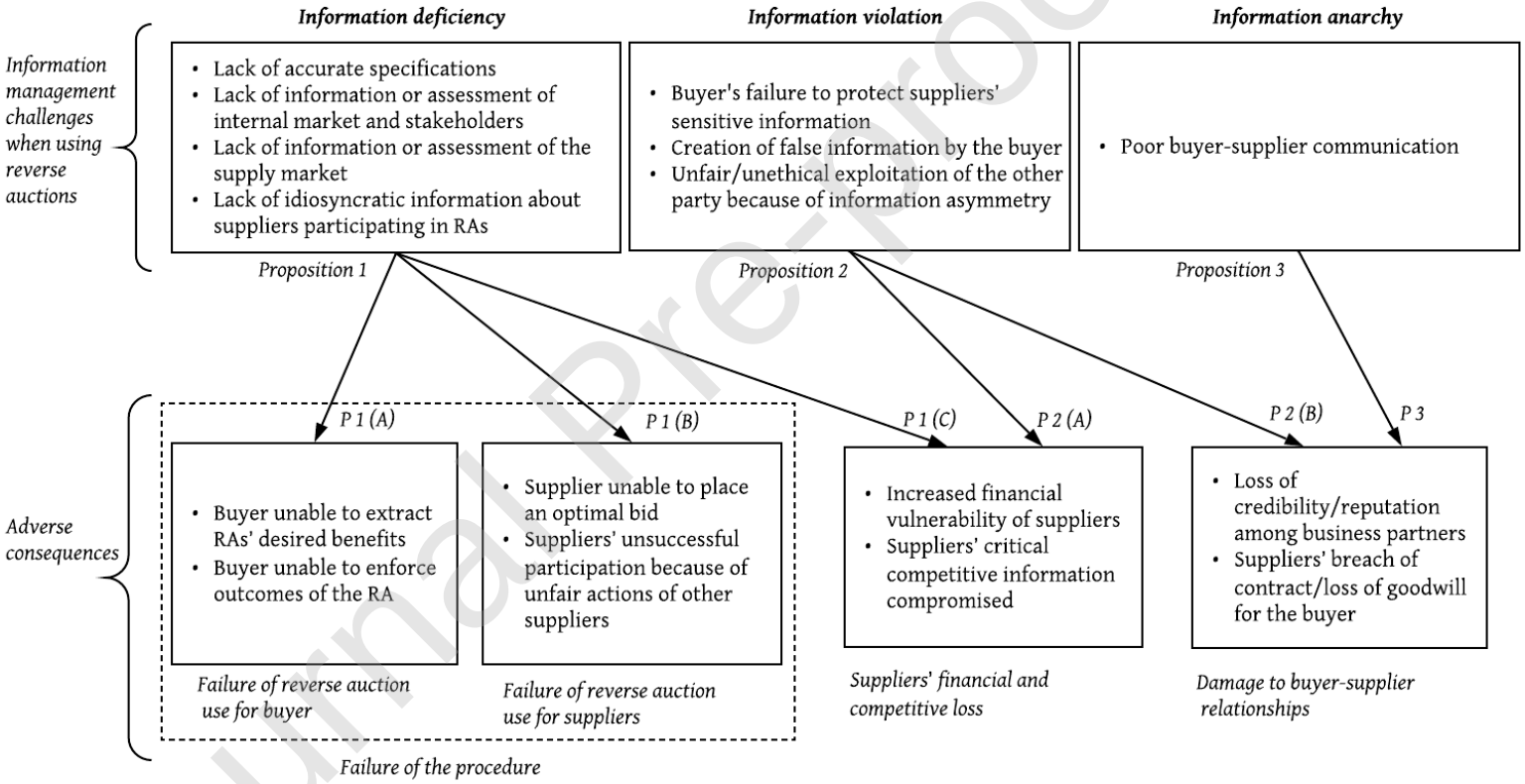


Figure 1. Integrative Model of Information Management Challenges and the Adverse Consequences of Using Reverse Auctions

Appendix A

Table A1 *Themes of Information Management Challenges in the Literature on Reverse Auctions*

Information Management Theme	**Dominant Theoretical Perspective**	**Selected References**	**Reverse Auctions Risk Factors from Literature that Constitute Information Management Challenges**
Over emphasis on the bidding price	Transaction cost theory	Tassabehji et al. [56], Jap [26]	Commoditizing innovative products/services
			Singular focus on price does not factor in total cost of ownership
			Omission of non-price criteria limits buyer's understanding of suppliers' full capabilities.
Suppliers' control over information and unethical behavior	Agency theory	Carter and Kaufmann [4], Charki and Josserand [7]	Supplier collusion
			The risk of other suppliers not adhering to the specifications and underbidding
			A competing supplier may bid low to gain the contract and then raises prices once the buyer is locked in
			Quality of the product could be reduced by suppliers to achieve offered price
			Quality of service and support could be reduced by suppliers to achieve offered price
			Suppliers lose credibility by having to introduce hidden costs in order to maintain profitability
Buyers' control over information and unethical behavior	Not Applicable	Emiliani and Stec [17], Mabert and Skeels [36] Emiliani and Stec [19] , Beall et al. [2], Smart and Harrison [53] Griffiths [22]	Buyers practice favoritism with preferred suppliers
			Inclusion of suppliers who will not be awarded the business
			Buyers create distrust when they use reverse auctions to test the market with no intention of buying
			Buyer not faithful to the auction process
			Failure to honor award terms deters future supplier participation
			The risk of buyer manipulating the auction by introducing artificially low bids
Organizational contingencies	Organization theory	Charki et al. [8] ,Sambhara et al. [47]	Lack of top management support
			Resistance by internal clients within buying organization to reverse auction procedures and outcomes
			Reverse auctions give incumbents unfair advantage
			Lack of technology resources and skills limits participation by suppliers
Buyer–Supplier Communication	Relational theory	Jap [26], Jap [27] Carter and Kaufmann [4] Charki and Josserand [7], Muylle and Standaert [40]	Award terms not clearly communicated prior to auctions
			Communication barriers create ambiguity regarding buyers' requirements
			Lack of post-auction feedback erodes supplier's confidence in the reverse auction process.

Information Management Theme	Dominant Theoretical Perspective	Selected References	Reverse Auctions Risk Factors from Literature that Constitute Information Management Challenges
Preparation for the RAs	Auction theory (process governance)	Jap [26], Jap [27]	Inadequately specified requirements
			Improper lot structuring
			Inadequate supplier qualification
Suppliers' lack of knowledge or access to information	Auction theory (process governance)	Kaufmann and Carter [29], Adomavicius et al. [1]	Suppliers lack adequate knowledge of reverse auction process
			Illusion that supplier needs to offer the lowest price to be awarded the business
Bidding behavior and issues	Auction theory (process governance)	Jap [25], Fugger et al. [20], Setia et al. [50], Drab et al. [11], Duke et al. [12]	Lack of competition in the auction
			Lack of transparency of loading (or weighting) factors placed by buyer on a supplier's bids hampers bidding strategy
			Increasing levels of price visibility can discourage supplier participation

Table A2 *Papers Reviewed for Literature Review, their Goals, Theory Base, Type of Study, Data, and the Examined Outcomes*

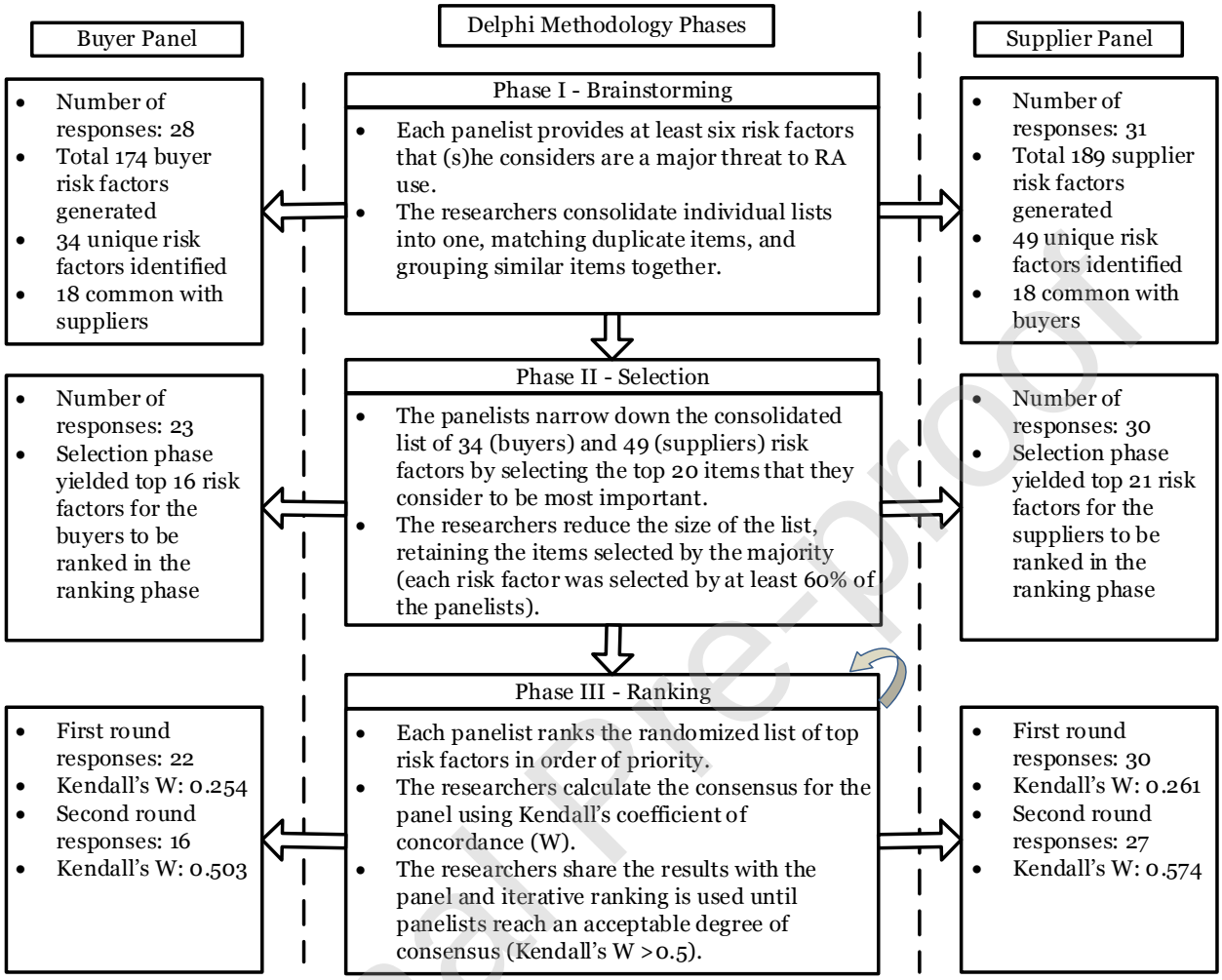
Study	Goal of the Study	Theory Base (If Any)	Type of Study	Data	Examined Outcome
Drab et al. 2018 [11]	Examine the impact of bid visibility on RA transparency and cost savings	Auction theory (process governance)	Empirical	Archival data of 5000 RAs	Cost savings for the buyer and RA transparency
Sambhara et al. 2017 [47]	Identify the risks factors of reverse auctions, examine how buyers and suppliers differ in their perceptions of the risk factors, and identify the controls to mitigate key risk factors	Agency theory, transaction cost theory, organizational contingency theory, relational view, and process governance	Empirical	Two Delphi studies with 59 professionals (buyers and suppliers) followed by semi-structured interviews	NA
Duke et al. 2017 [12]	Examine the efficiency of uniform price and discriminatory price RAs on the cost of conducting RAs	Auction theory (process governance)	Empirical	Laboratory experiment with 180 participants	Cost of conducting RAs
Muylle and Standert 2016 [40]	Examine the impact of RA procedural fairness on the relationship quality	Auction theory (process governance)	Empirical	Survey of 179 buyers and 31 suppliers	Buyer–supplier relationship

Study	Goal of the Study	Theory Base (If Any)	Type of Study	Data	Examined Outcome
Fugger et al. 2016 [20]	Whether and how bidding format in RAs can lead to supplier collusion	Behavioral game theory (process governance)	Empirical	Laboratory experiment with 372 participants	Total cost incurred by the buyer
Setia and Speir-Pero 2015 [50]	How the bid price visibility in RAs can impact suppliers' profit margins	Auction theory (process governance)	Empirical	Laboratory experiment with 255 participants	Suppliers' profit margin
Adomavicius et al. 2012 [1]	Examine how information feedback mechanisms in multi-attribute RAs affect suppliers' bidding behavior and profits	Auction theory (process governance)	Empirical	Laboratory experiment on 37 auctions with 169 participants	Probability of supplier winning an action
Charki et al. 2011 [8]	Examine the ethical concerns pertaining to the use of RAs and the consequent likelihood of RA use in future	Organization theory	Empirical	Semi-structured interviews of 18 RA service providers, 20 buyers, and 32 suppliers	Likelihood of RA use in future
Mithas et al. 2008 [39]	Examine the factors that may prevent the use of RAs by the buyer	Transaction cost theory, relational theory	Empirical	Survey of 152 professionals	Likelihood of RA use in future
Charki and Josserand 2008 [7]	Study the impact of RAs as a mode of communication on buyer–supplier trust	Transaction cost theory, relational theory	Empirical	70 semi-structured interviews of suppliers	Trust between buyers and suppliers
Jap 2007 [27]	Study the impact of auction design parameters on buyer–supplier relationships	Auction theory (process governance), agency theory, relational theory	Empirical	25 quasi experiments with 125 suppliers	Buyer–supplier relationship
Mithas and Jones 2007 [38]	Examine how the auction design parameters affect buyer surplus	Auction theory (process governance), agency theory	Empirical	700 auction lots	Extent of savings achieved by a buyer
Losch and Lambert 2007 [34]	Examine the impact of information behavior between buyer and suppliers on buyer–supplier relationship	Grounded theory approach	Empirical	9 interviews with buyers and suppliers who use RAs, and 15 interviews with buyers an suppliers who do not use RAs	Buyer–supplier relationship
Losch and Lambert 2007 [33]	Study the general context of RAs, information behavior and buyer–supplier relationships	Grounded theory approach	Empirical	Survey of 54 suppliers and 89 buyers	Buyer–supplier relationship

Study	Goal of the Study	Theory Base (If Any)	Type of Study	Data	Examined Outcome
Carter and Kauffman 2007 [4]	Examine the impact of supplier opportunism as a consequence of RA use on supplier's non-price performance	Agency theory, relational theory	Empirical	Survey of 343 buyers/purchasing professionals	Suppliers' non-price performance or commitment towards buyers
Elmaghraby 2007 [14]	How RAs can be effectively configured to derive maximum benefit from their use	Auction theory (process governance)	Empirical	Interview of 10 auction service providers	NA
Gattiker et al. 2007 [21]	Examine the effectiveness of RAs as a mode of communication on buyer–supplier trust	Information richness theory	Empirical	Simulation experiment with 177 subjects	Trust between buyers and suppliers
Hur et al. 2006 [24]	Examine how firms can successfully integrate the use of RAs in their purchasing process	None	Empirical	Case study of 5 firms	NA
Tassabehji et al. 2006 [56]	Examine the impact of RA use on price reduction and buyer–supplier relationship	Transaction cost theory, relational theory	Empirical	Case study of 5 RAs participated by one supplier, semi-structured interviews of 16 other suppliers	Savings achieved by a buyer and buyer–supplier relationship
Emiliani 2005 [16]	Examine the efficacy of ethical guidelines and code of conduct in the use or RAs	None	Conceptual	None	NA
Emiliani and Stec 2005 [19]	Examine the impact of RA use on suppliers' business policies and practices	None	Empirical	Survey of 30 suppliers	Business policies and practices of suppliers
Carter et al. 2004 [5]	Investigate the factors that can prevent the use of RAs and the factors that lead to successful use of RAs	Negotiation theory, auction theory (process governance)	Empirical	Interviews of 15 RA service providers, 16 buyers, and 15 suppliers	NA
Kauffman and Carter 2004[29]	Identify the conditions under which RAs are more/less effective as compared to face-to-face negotiations	Negotiation theory, auction theory (process governance)	Empirical	Interviews of 15 RA service providers, 16 buyers, and 15 suppliers	NA
Talluri and Ragatz 2004 [55]	Develop a framework for designing and implementing multi-attribute RAs	Process governance	Conceptual	None	NA

Study	Goal of the Study	Theory Base (If Any)	Type of Study	Data	Examined Outcome
Beall et al. 2003 [2]	Evaluate the advantages and disadvantages of RA use	None	Empirical	Survey of managers in two large firms	NA
Griffiths 2003 [22]	Investigate the impact of RAs on buyer–supplier relationship	None	Conceptual	None	Buyer–supplier relationship
Jap 2003 [26]	Examine the process governance of RAs and the impact of RAs on buyer–supplier relationship	Transaction cost theory, process governance, relational theory	Empirical	Interviews and a quasi-experiment with 68 suppliers	Buyer–supplier relationship
Smart and Harrison 2003 [53]	Examine the impact of RA use on price reduction and buyer–supplier relationship	None	Empirical	Case study of 6 RAs	Savings achieved by a buyer and buyer–supplier relationship
Smeltzer and Carr 2003 [54]	Identify risks of RA use and the conditions for successful use of the RAs	None	Empirical	Interviews of 41 buyers	NA
Emiliani and Stec 2002 [17]	Examine how RA use can extract savings for a buyer	None	Conceptual	None	NA
Emiliani and Stec 2002 [18]	Examine the extent to which use of RAs is consistent with Caux Round Table principles for business	None	Conceptual	None	NA
Mabert and Skeels 2002 [36]	Examine how RAs should be conducted	None	Empirical	Case study with a fortune 100 company and US Navy	NA
Jap 2002 [25]	Give an overview of how RAs are governed and how	Process governance	Empirical	Survey of 38 buyers in four firms	NA

Figure A1. Delphi Methodology



Appendix B: Demographic Information for Delphi Study Panels and the Interview Panel

Table B1. Demographic Profile of Delphi Study Panels

Demographic Variable		Buyer Panel	Supplier Panel
Panel size		28	31
Average overall work experience: Years [Range]		19 [4-45]	20 [4-40]
Average experience in sourcing (buyers), sales/business development (suppliers): Years [Range]		15 [3-45]	15[4-40]
Number of RAs participated in (Buyer panel range 4-550) (Supplier panel range (5-4500)	0-5	14%	29%
	6-10	0%	29%
	11-20	18%	0%
	21-50	21%	32%
	51-100	11%	0%
	101+	36%	10%
Will participate in reverse auctions in future?		Yes (96%), No (4%)	Yes (79%), No (21%)
Average number of years their firm has been using RAs		5.4 years	6 years
Average number of employees in their sourcing/procurement department (buyers), sales/business development department (suppliers)		75	58
Average fraction of procurement spending done using RAs (buyers), Average fraction of revenue through RAs (suppliers)		18%	18%
Average percentage of participating organizations' procurement projects that use RAs		86%	NA
Geographical locations of panelists		Argentina (4%), France (7%), UK (11%), India (18%), USA (61%)	Philippines (4%), Azerbaijan (4%), Argentina (4%), UK (4%), China (4%), Australia (8%), India (25%), USA (58%)
Industries Represented			
Industrial Manufacturing		39%	48%
Real Estate		-	7%
Oil and Gas		-	4%
Electronic Media		-	4%
Pharmaceuticals		11%	4%
Utility Services		14%	19%
Information Technology		25%	15%
Financial Services		11%	-

Table B2. Demographic Profile of the Interviewees

Demographic Variable		Buyer Panel	Supplier Panel
Number of interviewees		7	7
Average overall work experience		26 years [range 12–40]	28 years [range 18–43]
Average experience in sourcing (buyers), sales/business development (suppliers)		20 years [range 9–40]	20.5 years [range 15–30]
Average number of RAs participated in		193 [range 50–550]	1030 [range 10–5000]
Countries represented	India	1	2
	United States	3	2
	United Kingdom	2	2
	France	1	0
	Australia	0	1
Education	Bachelor's degree	3	3
	Master's degree	3	2
	Doctoral degree	1	1
	No answer	0	1
Average percentage of participating organizations' procurement projects that use RAs		86%	Not applicable
Formal process established to review and learn from RAs?	Yes	6	3
	No	1	4
Industries represented	Industrial manufacturing	3	3
	Pharmaceuticals	2	1
	Real estate development	1	1
	Information technology	1	2

Appendix C: Details of Risk Factors That Constitute Information Management Challenges

Dimensions of Information Management Challenges	Information Management Challenges	Risk Factors That Constitute Information Management Challenges	Descriptions of Risk Factors	Selected Prior Studies That Have Previously Identified the Information Challenge	Buyer Panel Rank	Supplier Panel Rank
Information deficiency	Lack of accurate specifications	Inadequately specified requirements	It is imperative that everyone is bidding on the same requirements and those specifications are accurate and complete. Otherwise, you are comparing "apples & oranges".	Beall et al. [2], Smeltzer and Carr [54], Kaufmann and Carter [29]	1	5
Information deficiency	Lack of information or assessment of internal market and stakeholders	Lack of top management support	The lack of top management support and commitment can limit the use of auctions and enforcement of outcomes.	Griffiths [22], Smeltzer and Carr [54],	7	NR
Information deficiency	Lack of information or assessment of internal market and stakeholders	Resistance by internal clients within buying organization to reverse auction procedures and outcomes	Lack of support from internal clients due to loss of control on supplier selection, and concerns about quality, service and incumbent relationships. Internal clients can either block the auction upfront or block the award.	Griffiths [22]	3	NA
Information deficiency	Lack of information or assessment of the supply market	Lack of awareness of who you are competing with and their cost structures	As the supplier is unaware of his/her competitors in the bidding process, he/she is also not knowledgeable of the competition's cost structures.	*Not identified in the literature	NA	19
Information deficiency	Lack of information or assessment of the supply market	Inadequate supplier qualification	Buyers face the risk of inadequately screening suppliers that participate in reverse auctions. This may lead to an incompetent supplier winning the auction.	Jap [25, 26], Carter et al. [5], Tassabehji et al. [56] Elmaghraby [14]	5	6
NR: Not Ranked, NA: Not Applicable i.e., the risk factor was not identified by the panel						

Dimensions of Information Management Challenges	Information Management Challenges	Risk Factors That Constitute Information Management Challenges	Descriptions of Risk Factors	Selected Prior Studies That Have Previously Identified the Information Challenge	Buyer Panel Rank	Supplier Panel Rank
Information deficiency	Lack of information or assessment of the supply market	Improper lot structuring	Buyers face the risk of segmenting the requirements into improper lots. This can lead to lower competition by excluding suppliers and making bidding more complex. For example, small suppliers may not have the capacity to bid on large lots; some suppliers may be interested only in a portion of the lot.	Smeltzer and Carr [54], Carter, Kaufmannet al. [5]	9	NA
Information deficiency	Lack of information or assessment of the supply market	Too high or too low starting bids	If starting bid price is low, there may be no bids in the auction. Conversely if the starting bid is high, best price may not be obtained.	*Not identified in the literature	NR	NA
Information deficiency	Lack of information or assessment of the supply market	Lack of competition in the auction	Insufficient number of suppliers or lack of bid activity limits competition. Without adequate competition, the buyer may not obtain the lowest price the supplier would otherwise be willing to offer.	Beall, Carteret al. [2], Kaufmann and Carter [29]	4	NA
Information deficiency	Lack of information or assessment of the supply market	Lack of technology resources and skills limits participation by suppliers	Small suppliers may not have the resources (e.g., internet access and knowledge of e-sourcing tools) to participate in reverse auctions.	Jap [25], Beall, Carteret al. [2]	NR	NR
Information deficiency	Lack of information or assessment of the supply market	Supplier collusion	Suppliers may collude or form a cartel in order to control pricing.	Emiliani and Stec [18], Carter, Kaufmannet al. [5], Talluri and Ragatz [55] Emiliani [16], Charki, Josserandet al. [8], Fugger,	NR	NR

Dimensions of Information Management Challenges	Information Management Challenges	Risk Factors That Constitute Information Management Challenges	Descriptions of Risk Factors	Selected Prior Studies That Have Previously Identified the Information Challenge	Buyer Panel Rank	Supplier Panel Rank
				Katoket al. [20]		
Information deficiency	Lack of information or assessment of the supply market	Market conditions not conducive for reverse auctions	Unfavourable market conditions for auctions can include high market volatility, a pure commodity product with known price (e.g. metals, crude), or a niche product with limited supply.	Smeltzer and Carr [54]	13	NA
Information deficiency	Lack of information or assessment of the supply market	Risk of price increase if pre-bids are not used	When buyers do not use pre-bids, they risk a price increase if the pricing obtained from the auction is higher than their current pricing.	*Not identified in the literature	NR	NA
Information deficiency	Lack of information or assessment of the supply market	Lack of flexibility in payment terms disadvantage some suppliers during bidding process	A supplier is not always aware of a buyer's payment terms. Additionally, a supplier can be more competitive if given the incentive of full payment at delivery.	Smart and Harrison [53]	NA	NR
Information deficiency	Lack of idiosyncratic information about suppliers participating in RAs	Lack of transparency of loading (or weighting) factors placed by buyer on a supplier's bids hampers bidding strategy	A buyer may employ a loading (or weighting) factor to a supplier's bid which increases or decreases his/her bid value by a certain amount. This lack of transparency of loading factor hampers the supplier's bidding strategy in rank-only auctions.	Charki, Josserandet al. [8]	NA	NR
Information deficiency	Lack of idiosyncratic information about suppliers participating in RAs	Reverse auctions give incumbents unfair advantage	An incumbent supplier has an unfair advantage in the bidding process as he/she knows how low to bid because of his/her knowledge of the costs associated with meeting the Buyer's requirements.	Jap [25], Griffiths [22], Carter, Kaufmannet al. [5]	NA	NR

Dimensions of Information Management Challenges	Information Management Challenges	Risk Factors That Constitute Information Management Challenges	Descriptions of Risk Factors	Selected Prior Studies That Have Previously Identified the Information Challenge	Buyer Panel Rank	Supplier Panel Rank
Information deficiency	Lack of idiosyncratic information about suppliers participating in RAs	Omission of non-price criteria limits Buyer's understanding of suppliers' full capabilities.	Auction process may not evaluate suppliers' full capabilities (e.g., non-price value adds, alternative products, synergies, and bundled bids).	Smeltzer and Carr [54], Carter and Kaufmann [4]	11	16
Information deficiency	Lack of idiosyncratic information about suppliers participating in RAs	Lose an auction to a supplier who subcontracts to a lower quality foreign supplier	Competing suppliers may win the auction by bidding low and outsourcing to lower quality foreign suppliers.	*Not identified in the literature	NA	NR
Information deficiency	Lack of idiosyncratic information about suppliers participating in RAs	Suppliers unable to bid strategically when last submitted bid price is not revealed	In rank-only auctions when bid prices are not visible, suppliers lack information to bid strategically.	*Not identified in the literature	NA	NR
Information deficiency	Lack of idiosyncratic information about suppliers participating in RAs	Illusion that supplier needs to offer the lowest price to be awarded the business	Reverse auctions condition suppliers to believe that the lowest bidder wins. Even if you are the lowest bidder, however, you may not be awarded the business because transition costs favour the incumbent.	Fugger, Katoket al. [20]	NA	14
Information deficiency	Lack of idiosyncratic information about suppliers participating in RAs	Commoditizing innovative products/services	Reverse auctions focus primarily on price and do not allow opportunity for innovative products and services.	Smart and Harrison [52], Smart and Harrison [53]	NA	10
Information deficiency	Lack of idiosyncratic information about suppliers participating in RAs	Suppliers lack adequate knowledge of reverse auction process	Suppliers may lack adequate understanding and knowledge of reverse auction process and procedures.	Carter, Kaufmannet al. [5]	16	NR

Dimensions of Information Management Challenges	Information Management Challenges	Risk Factors That Constitute Information Management Challenges	Descriptions of Risk Factors	Selected Prior Studies That Have Previously Identified the Information Challenge	Buyer Panel Rank	Supplier Panel Rank
Information deficiency	Lack of idiosyncratic information about suppliers participating in RAs	Singular focus on price does not factor in total cost of ownership	Total cost of ownership includes factors other than price such as transportation, insurance, and inventory costs. While it is possible to construct auctions that take into account the total cost of ownership, this is often not done because it is more complicated to do so or because it is more time consuming.	Emiliani and Stec [18], Smart and Harrison [53], Emiliani and Stec [19], Hur, Hartleyet al. [24]	2	19
Information deficiency	Lack of idiosyncratic information about suppliers participating in RAs	Suppliers withholding their best price for post auction negotiation	Suppliers may hold back their best price during an auction because they don't want to reveal this information to their competition.	*Not identified in the literature	NR	NR
Information violation	Buyer's failure to protect supplier(s)' sensitive information	Unreliable technology	Auction software/system malfunctions can interrupt the auction or require that it be re-run, thus exposing the initial bid strategies of suppliers.	*Not identified in the literature	NR	NR
Information violation	Buyer's failure to protect supplier(s)' sensitive information	Increasing levels of price visibility can discourage supplier participation	Choosing the wrong level of price visibility (e.g., rank, bid amount) can be counterproductive if it discourages suppliers from participating for fear of revealing sensitive information to competition.	Jap [25], Carter, Kaufmannet al. [5]	NR	NR

Dimensions of Information Management Challenges	Information Management Challenges	Risk Factors That Constitute Information Management Challenges	Descriptions of Risk Factors	Selected Prior Studies That Have Previously Identified the Information Challenge	Buyer Panel Rank	Supplier Panel Rank
Information violation	Buyer's failure to protect supplier(s)' sensitive information	Suppliers are forced to disclose sensitive information (e.g., pricing structure, manufacturing processes)	The suppliers are often required to disclose information about their cost structures and manufacturing processes in order to participate in auctions.	*Not identified in the literature	NA	NR
Information violation	Buyer's failure to protect supplier(s)' sensitive information	Security of suppliers' bid compromised	The confidentiality of a suppliers bid is threatened in reverse auctions if a competitor gets access to his bid by hacking, bribery or coercion.	*Not identified in the literature	NA	NR
Information violation	Creation of false information by the buyer	The risk of buyer manipulating the auction by introducing artificially low bids	Buyer can artificially drive the prices down by having their own personnel bid in the auction. Reverse auctions do not have the traditional eye-to-eye contact that would prevent such manipulation.	Jap [25, 26], Griffiths [22], Carter, Kaufmannet al. [5], Emiliani [16], Elmaghraby [14], Charki, Josserandet al. [8]	NA	7
Information violation	Creation of false information by the buyer	Inclusion of suppliers who will not be awarded the business	Buyers may intentionally include suppliers who will not be awarded the business in order to drive down prices.	Carter, Kaufmannet al. [5]	15	NA
Information violation	Unfair/unethical exploitation of the other party due to information asymmetry	Buyers create distrust when they use reverse auctions to test the market with no intention of buying	A buyer may use reverse auctions only to test the market with no intention of awarding the business to the participants. This may lead to deterioration in the buyer–supplier relationships in the long-run.	Jap [25, 26], Charki and Josserand [7], Charki, Josserandet al. [8]	NA	20

Dimensions of Information Management Challenges	Information Management Challenges	Risk Factors That Constitute Information Management Challenges	Descriptions of Risk Factors	Selected Prior Studies That Have Previously Identified the Information Challenge	Buyer Panel Rank	Supplier Panel Rank
Information violation	Unfair/unethical exploitation of the other party due to information asymmetry	Suppliers lose credibility by having to introduce hidden costs in order to maintain profitability	A supplier reduces the price to win the auction. However, to maintain profits, the supplier then introduces hidden costs. This in turn leads to loss of his credibility in the long-run.	Charki and Josserand [7], Charki, Josserandet al. [8]	NA	NR
Information violation	Unfair/unethical exploitation of the other party due to information asymmetry	Buyer not faithful to the auction process	Buyer accepts quote outside the eSourcing event or starts discussion/negotiation with supplier outside the online event. This results in the supplier not being motivated to provide his best bid online.	Beall, Carteret al. [2], Griffiths [22], Tassabehji, Tayloret al. [56], Carter and Kaufmann [4], Gattiker, Huanget al. [21], Emiliani and Stec [18], Emiliani [16]	10	NR
Information violation	Unfair/unethical exploitation of the other party due to information asymmetry	Failure to honour award terms deters future supplier participation	Buyers not honouring award terms can result in suppliers not participating in future auctions.	Carter, Kaufmannet al. [5], Emiliani [16], Charki, Josserandet al. [8]	14	NA
Information violation	Unfair/unethical exploitation of the other party due to information asymmetry	Buyers practice favouritism with preferred suppliers	Buyers often award business to their preferred suppliers even if they were not very competitive in the auction.	Smeltzer and Carr [54]	NA	NR
Information violation	Unfair/unethical exploitation of the other party due to information asymmetry	The risk of other suppliers not adhering to the specifications and underbidding	Competing suppliers may bid lower and win the auction by not strictly adhering to the buyers' specifications. Such underbidding creates a cost difference that may not be a true "apples to apples" price.	Carter, Kaufmannet al. [5], Emiliani [16]	NA	2

Dimensions of Information Management Challenges	Information Management Challenges	Risk Factors That Constitute Information Management Challenges	Descriptions of Risk Factors	Selected Prior Studies That Have Previously Identified the Information Challenge	Buyer Panel Rank	Supplier Panel Rank
Information violation	Unfair/unethical exploitation of the other party due to information asymmetry	A competing supplier may bid low to gain the contract and then raises prices once the buyer is locked in	Supplier loses business because another opportunistic supplier may bid low to gain the contract and then raise prices once the buyer is locked in.	Carter, Kaufmannet al. [5], Emiliani [16], Charki, Josserandet al. [8]	NA	21
Information violation	Unfair/unethical exploitation of the other party due to information asymmetry	Quality of the product could be reduced by suppliers to achieve offered price	Suppliers may compromise on the quality of the products in order to honour the price they bid in the auction.	Charki and Josserand [7], Charki, Josserandet al. [8]	NR	1
Information violation	Unfair/unethical exploitation of the other party due to information asymmetry	Quality of service and support could be reduced by suppliers to achieve offered price	Suppliers may lower quality of service and customer support in order to honour the price they bid in the auction.	Beall, Carteret al. [2], Charki, Josserandet al. [8]	12	3
Information anarchy	Buyer–supplier communication	Award terms not clearly communicated prior to auctions	Failure to clearly communicate award terms can create resentment among suppliers and suppress competitive pricing.	Jap [25], Carter, Kaufmannet al. [5]	6	NR
Information anarchy	Buyer–supplier communication	Communication barriers create ambiguity regarding buyers' requirements	If the only conduit of communication is through the reverse auction system, there are serious issues of clarity of specifications and deliverables. Oftentimes it is difficult to receive answers to questions.	Jap [25], Smart and Harrison [53]	NA	9
Information anarchy	Buyer–supplier communication	Lack of post-auction feedback erodes supplier's confidence in the reverse auction process.	Lack of feedback after the auction makes suppliers suspicious and hurts their confidence in the process.	Emiliani [16]	NA	NR

Dimensions of Information Management Challenges	Information Management Challenges	Risk Factors That Constitute Information Management Challenges	Descriptions of Risk Factors	Selected Prior Studies That Have Previously Identified the Information Challenge	Buyer Panel Rank	Supplier Panel Rank
Information anarchy	Buyer–supplier communication	Award volume not guaranteed making it difficult to price	Suppliers often reduce price with the hope of being awarded a large volume by which they can recover their profit margin. The volume of the award, however, is not guaranteed which makes it difficult to price.	*Not identified in the literature	NA	NR

Appendix D: Additional Quotes from Interviews

#	Proposition	Additional (Verbatim) Quotes from Interviews
1	An increase in information deficiency when using RAs can result in, (A): an increased likelihood of failure of the procedure (failure of RA use for buyer and suppliers), (B): an increased likelihood of suppliers' financial and competitive loss.	*1. We have had such situations where we achieved huge savings (20% resulting in savings of millions of dollars) on polyethylene bags and the central unit was not able to convince individual units with in to implement the awards. It all depends on the corporate culture within the company. The other side of it to make sure you got upper management on board; someone at high enough level who can influence the decision process. The challenge is that at some organizations the culture is such that upper management will not do that.* *2. If you don't have the top management on your side, you have to stop your program and work on getting that support. You should do whatever you need to do to get it. If not done, it will destroy your program. You will give wrong message to your suppliers.*
2	An increase in information violation when using RAs can result in (A): an increased likelihood of suppliers' financial and competitive loss, (B): a greater damage to buyer–supplier relationships.	*1. I have couple of examples where I participated in an auction where incumbent had a certain piece of business and we were participating as a potential supplier. Incumbent supplier knew what we did not and therefore the prices went too low. We were being used only to drive the prices down.* *2. We have had several unsuccessful auctions where our competitors have severely underbid to a point it could not possibly be profitable for them to take that work at that cost.* *3. I have been a part of auctions where some information is left out from suppliers that should have been shared. It happens quite often when a buyer is not faithful to the auction process. I have seen a buyer bending rules when it was not happy with the outcome of the auctions.* *4. It is fairly common where buyers feel empowered to deviate from the process that they may or may not have communicated with suppliers. It happens because it is not legally binding process. Seller cannot sue the buyer when the buyer does not follow the rules.*
3	An increase in information anarchy when using RAs can result in a greater damage to buyer–supplier relationships.	*1. We told suppliers that it is a sealed bid and it may be a first step of a process that may lead to reverse auctions. However, we may go ahead and award the business based on sealed bid. It is very unfair to say one thing and do another particularly when you say nothing about reverse auctions, get sealed bids and later run reverse auctions. It hurts buyer's credibility in the market.* *2. We routinely did not have good communication channel with suppliers. It is very destructive to your sourcing program. You keep receiving this feedback from the suppliers that you did not communicate properly. Therefore, if you are using reverse auctions to just screen say 15 down to 5 suppliers so you can do some offline negotiation, you should tell your suppliers that.*