



Artificial Intelligence in Public Procurement: Perceived Challenges, Applications and Value Creation in Early Phases of AI Adoption

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Summary

This paper aims to contribute to knowledge on implementation challenges of AI in public procurement processes and how AI can contribute to public procurement value creation. Research on AI implementation processes and value creation in public procurement is used for the analytical framework. Empirical data consists of semi-structured interviews with 18 persons working with procurement within 10 Swedish authorities. Findings show an overall low level of AI maturity, perceived values of AI are dominated by ideas on improved operative capabilities, certain process effectiveness potentials, and a potential of AI for improved monitoring of sustainability.

Keywords: Public Procurement, Artificial Intelligence (AI), Challenges, Value

Submission category: Academic working paper

Introduction

Public procurement plays a central role in the total economic development of any country (Hakansson and Axelsson, 2020). Every year public authorities in the EU spend around 14% of GDP on public procurement, this amounts to more than EUR 1.9 trillion.¹ It thus plays a large role in the total economic development of countries. Efficient public procurement is crucial for solving many of the key policy challenges that EU and its member countries are facing. Through public procurement there is an opportunity to create economic, environmental and societal value.

In this, Artificial Intelligence (AI) has been identified as having a great potential in transforming procurement operations and affect value creation (Allal-Chérif et al., 2021; Shafie et al., 2022; Andersson et al., 2022). Literature on AI applications within procurement acknowledge these as an important (next) step in the ongoing digitalization of procurement (Batan 2017 Chopra 2019; Kosmol 2019), Kosmol (2019) suggesting that digitalization including AI will provide additional *value* to procurement. Rejeb et al (2018) stated in their technology review that "the combined usage of robotics along with artificial intelligence (AI) and machine learning (ML) clears the way for significant contributions to the field of procurement in supply chain management" (p.79). Following

¹ https://ec.europa.eu/info/sites/default/files/file_import/european-semester_thematic-factsheet_public-procurement_en_0.pdf

in these footsteps, Constant et al., 2022; Shafie et al., 2022; Allal-Chérif et al., 2021, and Cui et al 2022 have from different viewpoints looked at how different AI technologies can bring different values to procurement. In addition to the *generalized view* of AI in procurement and supply chains (e.g. Seyedghorban et al 2020; Spreitzenbarth 2021) there is also ideas presented on *specific applications* of AI in certain specific areas of procurement, for example in forecasting (Kiefer et al 2019) and negotiations (e.g. Schulze-Horn et al 2020). Along with academic research articles, the growing interest in AI in procurement is complemented by a growing number of white papers, future scenario papers, consultancy reports, practical implementation models etc. dealing with the potential of AI in procurement. A common view in both academic and in managerial reports is the fact that AI is expected to create - adding or creating new - forms of *value* in procurement operations.

Previous AI research on implementation processes in organization is dominated by studies with a focus on private business organization (Enholm et al., 2021; Merhi, 2022). One of the most comprehensive research overviews of studies of AI and business value by Enholm et al (2021) has shown some of the major challenges of AI implementation. They conclude that the major enablers and inhibitors can be divided into three main categories: technological, organizational, and environmental. Each of the three can be divided into a more refined set of enablers/inhibitors. Connected to the idea of value, their research overview sums up what is known about the *effects* of AI implementation in private business organizations in terms of first-order effects (like process efficiency, idea generation and business process transformation), and second-order effects (like e.g. financial performance). In line with Enholm et al's study, we argue that there is a similar need in public organizations to consider central enablers and inhibitors, in order to better assess the ability to adopt AI successfully and know which changes to make (p. 22). Merhi (2022) presents a similar study of implementation challenges, dividing them into four types: organization, process, technology and environment.

Looking at public procurement process models and studies (van Weele and Rozemeijer, 2022; Kelly et al., 2021; Patrucco et al., 2017; Patras and Banacu, 2016) and recent literature on value creation in public procurement (Malacina et al., 2022) these deal with the specific values that are created in public procurement processes. Before asking the question what value AI can bring to public procurement, we need to ask the question of what *general* values that public procurement creates. In a preceding study (Andersson et al 2022), Malacina et al's (2022) study of value creation in public procurement was suggested as a starting point. With this study as steppingstone, we ask what general public procurement values that are affected and created when AI is introduced, and in what specific public procurement practices. The study argues for several research gaps to be addressed. Value can and is created in different ways depending on public organization, e.g., municipalities or governmental units, and they may vary in their capabilities to implement various new procurement practices (and technologies). Also between governmental organizations, the differences can be significant. There is a need to investigate how the utilization of different types of new AI based procurement practices, including predictions and views of future potentials, can impact the degree of value created for each organization and differentiate the performance of one governmental buyer from another. With this as starting-point, three research questions are addressed:

1. What are the key challenges when introducing AI technologies in public procurement and what are the practical implications?

2. *What public procurement practices and what technologies are in focus of present and future, potential application of AI?*

3. *How can value be created in the application of AI in public procurement and value for whom?*

The paper aims at contributing to knowledge on implementation challenges of AI in public procurement processes and how AI can contribute to public procurement value creation. The paper is structured as follows: first theoretical foundation and analytical framework is presented followed by a description of methodology. Thereafter empirical findings are presented. Follow is analysis and discussion. The paper ends with conclusions.

Theoretical foundation and analytical framework

For the analysis of the three research questions we draw mainly on research and conceptualizations in three areas of research: recent procurement research with focus on AI technologies (Cui et al 2022; Allal-Chérif et al 2021), information management research with a focus on AI implementation challenges in business organizations (Kaplan & Haenlein 2020; Enholm et al 2021; Merhi 2023), and on public procurement research with a focus on value creation (Malacina et al (2022).

Introduction: Enablers and inhibitors of AI implementation in public procurement

The first research question asks what the key *challenges* are when introducing AI technologies in public procurement and what the practical implications are. Here, two broad AI research overviews (Enholm et al 2021; Merhi 2022) have listed *enablers/inhibitors & critical factors* associated with AI implementation processes in general. The identified factors largely overlap and the second by Merhi (2022) groups the AI implementation challenges into four different types: (1) *Organization* (Top management support, Ambiguous strategic vision, Organizational culture, Organizational Structure, Lack of visibility on benefits), (2) *Process* (Project champion, Resistance, Lack of technical expertise, Ethics, Responsibility and accountability), (3) *Technology* (Integration complexity, Low data quality, Insufficient quantity of data, IT infrastructure, Security and confidentiality, Data Governance issues, Scalable and flexible system, and (4) *Environment* (Selection of vendors, High cost of AI).

AI technologies in procurement

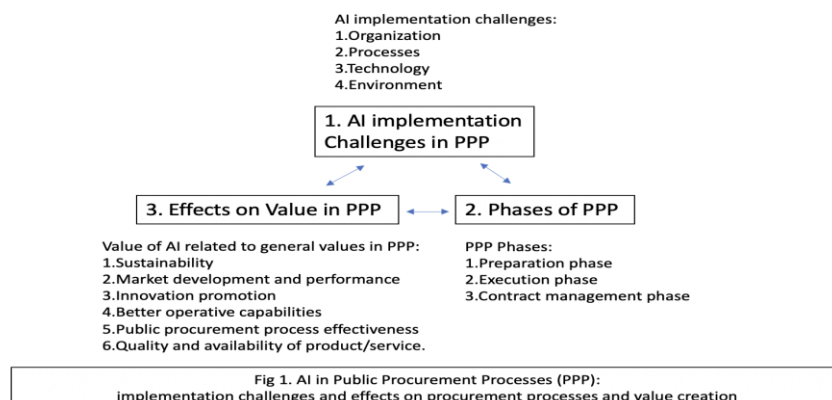
The second research question deals with *what technologies* and what public procurement practices (discussed in the next section) that are in focus of present and future, potential application of AI among public procurement managers. As regards AI technologies, in line with Cui et al's (2022) research, most studies of AI and procurement state that AI delivers value in two main ways: *automation and augmentation/smartness*, enhancing efficiency and/or effectiveness in procurement: "AI has two unique abilities: automation and smartness, which are associated with physical machines or software that enable us to operate more efficiently and effectively" (ibid, p.1). The concept Artificial intelligence is *defined* in different ways. Kaplan and Haenlein (2020) sum it up as: "a system's ability to interpret external data correctly, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation" (p.40). AI also includes different kinds of technologies (see eg. Chopra (2019)

Phases in public procurement processes

The second part of the second research question concerns *what* public procurement processes that are in focus of attention for AI. For this we need a purchasing process model, and one that fits with the specific characteristics of public procurement processes. Procurement research entails several studies and recurrent discussions on how public and private procurement differ (e.g Larson 2009). Comparisons are made from the point of view of established procurement process models like e.g. van Weele's & Rozemeijer's (2022) established model with six core phases. Instead of adapting each of the six phases to the public procurement situation, we present the official procurement process model as presented by the Swedish Competition Authority (2016), dividing the process into three phases: (1) *preparation phase* (demand and need analysis, supply market research and analysis, strategy development) (2) *execution phase*, (tendering and supplier selection), and (3) *the contract management phase* (expediting and evaluation, follow-up and evaluation).

Value and value shaping in public procurement

The third research question draws attention to *the value* associated with the use of AI in public procurement process steps. We approach this value from two types of research: procurement research and AI focused IT management research. Firstly, in a preceding study (Andersson et al 2022), we built on Malacina et al (2022) and how they extract and distinguish between six key public purchasing and supply chain (PSM) practices; four *internal* (vertically aligned PSM practices, enabling PSM practices, within PSM practices, cross-functional PSM practices, and two *external* (relational PSM practices, non-relational practices). Secondly, in a matrix these six can be seen to be linked - to different degrees - to six general value components in public procurement: (1) sustainability, (2) market development and performance, (3) innovation promotion, (4) better operative capabilities, (5) public procurement process effectiveness, and (6) quality and availability of product/service. Another way in which we can approach the question of perceived value from AI in procurement is to compare with what IT management research has shown concerning of real *first-order* and *second-order effects* of AI implementation *in general* (Enholm et al 2021). First-order effects are then the effects on focal *processes* (here: procurement, while the second-order effects of AI implementation are the effects on the overall *organization*. To the first category belong Process efficiency, Insight generation and Business Process transformation. The second order effects concern overall Operational performance, Financial performance, Market-based performance, Sustainability performance, and also Unintended consequences. Summing up, our three research questions will be discussed and analyzed with the help of our three analytical frameworks in three parts:



Methodology

A qualitative approach

A qualitative approach was chosen for data collection. By using a qualitative method, it enables a deeper understanding of reasoning from the interviewees regarding the public sector, public procurement processes, and AI solutions. AI in public procurement is a relatively new field of subject and this study is one of the first attempts in collecting empirical data about the use of AI in public procurement, challenges, applications used and value contribution.

The choice of Sweden and Swedish authorities

Sweden is interesting due to its relatively high level of public procurement in relation to its GDP. In Sweden, public procurement amount to more than EUR 80 billion each year, this corresponds to almost one fifth of Sweden's GDP (20 percent of GDP).² This compared to 12 percent of GDP that is the average amount spent in OECD countries on public procurement.³ Public procurement in Sweden thus has great impact on the economic development of the country and a great potential to contribute to societal value through using technologies such as AI.

The pre-study

In order to find the most suitable authorities to interview, i.e. authorities that are in the forefront in procurement and that might use AI applications to create value in the procurement process, a pre-study was conducted. The pre-study consisted of four interviews. Persons interviewed were board member of the Swedish association of public purchasers, the General Director at the national agency for public procurement, project manager at the national agency for public procurement and project manager for Afori (arena for public procurement innovative solutions) (see Table 1 below).

Table 1. *Persons interviewed in the pre-study*

Organization	Role	Date	Time	Type of interview
Organization 1 pre-study	Board member	June 27, 2022	1 hour	Zoom
Organization 2 pre-study	General Director	Sept 9, 2022	1 hour	Teams
Organization 2 pre-study	Project Manager 1	Sept 20, 2022	1 hour	Teams
Organization 2 pre-study	Project Manager 2	Sept 20, 2022	1 hour	Teams

In Sweden there are approximately 340 authorities and through the pre-study the authors found out which of these authorities that were relevant and interesting to include in the study. The authorities included and interviewed were thus all chosen because they were viewed as being in the forefront within procurement and might use AI applications. At all interviews the authors asked if the respondent knew about an authority that used AI applications in their procurement work. The suggestions given were then included in the study.

Semi-structured interviews

Semi-structured interviews were carried out with persons working with procurement at the chosen authorities from June 2022 to December 2022. Altogether 15 persons have

² <https://www.upphandlingsmyndigheten.se/om-offentlig-upphandling/>

³ <https://www.oecd.org/gov/public-procurement/>

been interviewed in the main study. 10 Authorities included in the study. See table 2 below for more information about roles interviewed, and date of interview.

Table 2. *Persons interviewed in main study*

Organization	Role	Date
Organization 1	Procurement Manager	June 27, 2022
Organization 2	Procurement Manager	Oct 27, 2022
Organization 3	Manager Procurement and Business Law	Nov 9, 2022
Organization 4	Procurement Manager	Nov 17, 2022
Organization 5	Procurement Manager	Nov 18, 2022
Organization 6	Manager Processes Procurement	Nov 24, 2022
Organization 6	Expert Procurement Systems Consultant	Nov 24, 2022
Organization 6	Purchaser	Nov 24, 2022
Organization 7	Deputy Procurement Manager	Nov 25, 2022
Organization 8	Innovation Strategist	Dec 2, 2022
Organization 8	Project Manager Procurement Development	Dec 2, 2022
Organization 8	Procurement and Logistics Strategist	Dec 2, 2022
Organization 8	Procurement Controller	Dec 2, 2022
Organization 9	Purchaser	Dec 9, 2022
Organization 10	Head of Section Procurement	Dec 15, 2022

Questions were guided by the research questions and the analytical framework. All interviews were recorded and transcribed. The transcribed interviews were coded and analyzed in a three-step procedure: *Firstly*, the empirical material was coded according to usage or potential usage of AI applications and stage in the procurement process. *Secondly*, the empirical material was coded according to six central values from public procurement from literature. *Thirdly*, and following the second step an analytical task was to connect these categories to the overarching theoretical framework. After coding and conducting the first and second analysis steps, it became clear that “challenges” were brought up and discussed to a large extent, much larger than the authors had expected. The actual use of AI technology in the procurement process was limited, but at the same time all respondents could see potential areas of use for AI in which AI might be able to contribute to value. Next, we present some of the empirical findings.

Empirical findings

Looking at the empirical data both from pre-study and main study interviews it can be concluded that there is an interest in AI and procurement within the public procurement organizations. Managers working with procurement within these organizations view AI technologies as potential solutions to use in procurement processes. Respondents brought up and discussed various values in relation to using AI in the procurement work; e.g. value related to sustainability, market development, innovation, better operative capabilities and through an increase in procurement process effectiveness. To achieve these values however several challenges were brought up for discussion. Of the 10 organizations included in the study only two currently use AI technology/solution/application related to procurement. However, most of respondents could see potential uses of AI in procurement and one organization had a project initiated to investigate if and how AI can be used to add value in the procurement work. Next, our empirical findings are presented as follows; first challenges are presented, followed by a section on usage of AI in the procurement process and value this use can or does create and contribute to.

Challenges

Challenges brought up and discussed were lack of resources, low level of knowledge both in terms of AI and in terms of procurement, poor or limited system support, a lack of management's understanding and support, the consideration of laws and regulations, high level of IT security demand, problems with using external suppliers of IT solutions, lack of knowledge of the market (suppliers of AI solutions) and working in silos. All respondents brought up lack of resources as a challenge, both for increasing level of maturity in the procurement work overall and for starting initiatives for the use of AI in procurement. Also lack of support from management and the organization were brought up by respondents.

“One challenge or barrier is that we are relatively immature, we have poor system support I would say, we do not have the business systems in place in the same way as in the private sector. So it requires quite a large investment in system support and how to manage it. We need training, we who work with procurement need to develop and step up, the same goes for the authority management. I think about the potential of finding really good suppliers all over the world, and that within the public sector you are often satisfied with a good enough supplier...”

(Organization 1, Procurement Manager)

The consideration of laws and regulations was also brought up and so was also the demand for high level of IT security and problems with using external suppliers of IT solutions. The challenge, or barrier with the demand for high level IT security was brought up by five of the ten organizations. The authorities that brought this up for discussion were authorities within security and authorities which manages large amount of personal data. Another challenge is that authorities are not allowed to share information with each other. This was brought up when discussing the possibility to use AI both in the preparation phase and the contract management phase: to find suppliers with a good track record regarding both environmental and social sustainability, in the preparation phase to avoid potentially criminal suppliers, and in the preparation phase, to be able to monitor suppliers and make sure they comply with what they have promised in the contract during the monitoring phase.

“It is interesting to be able to share information among authorities. In my opinion there are many challenges if we talk about sharing information about the citizens. It is a big problem, I think, something that should be changed. This is important in order to fight financial- and welfare crime.”

(Organization 5, Procurement Manager)

To reach this kind of solution however, a database that is fed by all authorities and also other data sources need to be created and managed over time. To achieve this, authorities however need to collaborate and not work in silos.

AI in the procurement process and value

Looking at the three phases; 1) the preparation phase, 2) the execution phase and 3) the contract management phase, AI is viewed as being able to be used and contribute to value in all three phases. In the first phase, *the preparation phase*, the respondents brought up potential use of AI in supply market research and analysis. The use of AI technology to find out about and reach new and a more potential suppliers, and the use of AI technology to get information about suppliers' performance (including sustainability performance).

“It would be very interesting if you could find solutions, we are interested in finding new suppliers, that is for sure. Then we must get them interested in submitting a public tender in Sweden which is the strictest market in Europe following the European laws and regulations. It is a bigger challenge, but certainly we could imagine working to open new markets, find new markets, find market data and work with it in a different way as well.”
(Organization 10, Head of Section Procurement)

It is in the *execution phase* we find the two actual examples on how to use AI in procurement related activities and value it generates. The first example is from the organization providing procurement business support to public organizations. They are using (not clear to what extent, but the tool is used by the respondent) a contractual tool that can ensure quality based on best practice and legislation.

“It is a contractual tool that can ensure quality based on best practice and legislation. I think it’s a great addition. Here I can check that I haven’t missed anything. I can focus on the most important things and see the structure. Through this tool I get a heads up that this part is missing for example. The tool works well for consultancy agreements and confidentiality agreements. I submit my text and then it only takes a few minutes and I get highlights showing what in my text deviates from standard. Like here text is missing, you need to fill in something. I think this tool is a good complement.”
(Organization 3, Manager Procurement and Business Law)

This area of use was also brought up by respondents in six other organizations as a potential area in which AI could add value.

“AI is very suitable for going through texts and comparing. If I’m done with my request documentation and run it through an AI, like a giant library of previous judgments in the administrative court, for example, and it goes really, really fast. All these judgments that no one can bear to read, it’s practically impossible. You can probably pick out a few and compare, but to get a direct answer after being reviewed against 180 000 previous administrative law judgements, and that there is, for example, a 96 percent probability that the request documents are correct according to legislation, that would be something very good, I think. Like a good decision support system.”
(Organization 7, Procurement Manger)

In the *contract management phase* suggested use of AI was brought up by respondents in six of the organizations. This within the area of following up and evaluation of suppliers. Following up and evaluation regarding pricing and costs, but also regarding social and environmental demands that the supplier has agreed to through signing the contract. Currently few public organizations (authorities and municipalities) follow up that suppliers deliver what is agreed, both regarding product and services, and costs, but also regarding social and environmental sustainability. The largest public procurement organization said that public procurement should contribute to development of supplier markets to become more innovative and sustainable. It is thus important not only to include innovation and sustainability in the preparation and execution phase, it is also of importance to follow up supplier behavior, and if they deliver what has been agreed. Here AI according to the respondents might play a role and could contribute.

“I think that contract management can be an area to use some form of automation like AI. Automation that allows you to log in at all times and see how the supplier is doing. If they

meet the requirements they have agreed to. It can be anything from sustainability requirements to having a certain rating or checking if and how they pay their employer fees and so on. Here we could become more efficient in ensuring that we actually get what we want from the agreement and the supplier. That the supplier delivers on the requirements we have set.....we don't have time for contract management.”

(Organization 2, Procurement Manager)

Analysis and Discussion: AI in public procurement

Next, we connect the key results from the empirical study with our analytical framework presented above. Our discussion is divided in three parts. We start our analyses with two broad themes related to the overall situation and impressions from the interview study: The first concerns the *overall* low level of AI maturity in all the interviewed government agencies and perceptions of potential reasons behind this. Secondly, we focus on our first research question and the various challenges associated with AI implementation in the public procurement processes. The third theme concerns the perceived potentials of AI in the public procurement processes. We comment on emerging findings from the empirical study on the perceptions of AI implementation challenges and potential value in public procurement processes.

Low level of AI maturity in governmental procurement

The first and foremost observation is that of the ten interviewed governmental agencies only one had actually implemented an AI solution (Swedish Public Employment Service). The low maturity in public procurement in the Swedish governmental agencies was coupled with what appeared to be a high level of general interest in what AI could do but also with a fairly low level of AI preparedness in terms of data management, AI technologies and more widely spread internal AI knowledge and capabilities.

Perceived AI implementation challenges

Following Merhi's (2022) study and categorization of AI implementation challenges, four different types of challenges were forwarded among the public procurement managers. From the point of view of the procurement managers and their units in the ten governmental agencies some perceived AI challenges stood out as central for procurement: 1) *Organization*: Top management support within the governmental agencies was mentioned as an issue, often in combination with an old, established silo based organization structure. The internal culture within the organizations (and within procurement units) did not support a status level for procurement that allowed a more progressive view on digitalization, AI and new technologies in procurement. The awareness of AI's potential existed in parts of the procurement organizations but the general visibility of the benefits of AI in procurement was perceived as fairly low 2) *Process*: As the implementation of AI, with one exception, not taken off the experiences of concrete implementation process challenges were very limited. However, there were ideas in procurement that there would likely be process resistance and inertia due e.g. to lack of AI capabilities technical expertise, and clear responsibilities and accountability, if and when implementation started 3) *Technology*: Some of the public procurement managers mirrored the concerns about data, as indicated by Merhi (2022) as one of the central implementation challenges: low data quality, insufficient quantity of data, data security and confidentiality, and other data governance issues were mentioned as central, initial challenges if and when AI was to be implemented in procurement. The scalability and flexibility of the new systems, and integration complexity (public management rules)

were also mentioned 4) *Environment*: The identification and selection of vendors of AI solutions was not considered a central issue and challenge at this stage.

The potentials of AI in public procurement phases

The perceived potentials of AI in public procurement phases were associated with all three major phases of public procurement, but in different degrees by the different governmental agencies: *Preparation phase*: AI in demand and need analysis, supply market research and analysis, and AI in support of procurement strategy development. *Execution phase*: AI for support in tendering and supplier selection. *Contract management phase*: Value of AI in expediting and supplier follow-up and evaluation.

The potentials of AI in public procurement value creation

As regards the value of AI in public, governmental procurement some were directly related to the six general values generated by public procurement (Malacina et al 2022): *Sustainability*: AI in procurement for improved sustainable performance was perceived not only to be connected to monitoring green public procurement, low carbon footprints etc but included also social sustainability monitoring in execution phases of the public procurement process. *Market development and performance*: Some of the larger governmental agencies with much buying power forwarded ideas of AI as a potential support in driving supply market competition, growth and development. *Innovation promotion*: Based on more advanced data management and AI it was anticipated that public procurement would be able to sense, seize and thereby trigger innovation in supplier networks. *Better operative capabilities*: In general, increased public procurement efficiency - in all parts of the procurement process chain of activities - were frequently forwarded as one of the most significant advantages of AI. Better use of time and existing internal resources was expected to be a central result of AI implementation. *Public procurement process effectiveness*: In addition to efficiency effects, effectiveness gains in the form of supplier compliance, fewer errors, control of corruption and more were mentioned. *Quality and availability of product/service*: Ideas of how AI implementation could have potential quality effects differed between the type of governmental agency. The large powerful agencies responsible for large building construction projects emphasized indirect *secondary, societal* effects of increased efficiency and effectiveness in their large scale, long-term infrastructure projects.

Conclusions

The aim of this paper is to contribute to knowledge on implementation challenges of AI in public procurement processes and how AI can contribute to public procurement value creation. Initial findings show an overall low level of AI maturity. As regards the value of AI in public, governmental procurement some were directly related to all the six general values generated by public procurement (Malacina et al 2022). But the perceived values of AI were dominated by ideas on improved operative capabilities, certain process effectiveness potentials, and a potential of AI for improved monitoring of sustainability. Three categories of challenges were forwarded among the public procurement managers: organizational challenges due to a silobased organization structure, process challenges related to uncertain responsibilities and accountability, and technological challenges related to data management issues. The large powerful agencies responsible for large building construction projects emphasized higher values and, societal effects of increased efficiency and effectiveness, while smaller agencies tended to emphasize procurement process efficiency effects.

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