Information Service of a Government Procurement Cloud Platform Based on the Value Chain Model

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Journal of Digital Information Management

ABSTRACT: Purpose: *In the era of knowledge-driven economy, the method of transforming the potential of information resources into actual social and economic values is increasingly becoming significant. As the development of government procurement information continuously deepens, the existing construction, management, and service platform patterns cannot adapt to the development requirements. A method was proposed in this paper to solve the main problems of government procurement information development and the corresponding information service process.*

Design/Methodology/Approach: *This research establishes a collaboration-based model by analyzing and extracting the main features of the value chains in government procurement information service. Such a method was developed by combing the main constituent elements and linking rules of government procurement information chains. Moreover, value curve theory is used to expound on how government procurement intelligent cloud information service adds value to the entire information service chain.*

Findings: *Analysis of the government procurement information service based on the value chain model can effectively explain the continuous information value transfer process among people, organization, and technology in information value chains. Value curve theory can clearly illustrate the effects of government procurement intelligent cloud information service on adding value to the chain. Therefore, the joint elevation of explicit and implicit values should be emphasized to realize the overall escalation of the value curve.*

Originality/Value: *This study proposes a new value chain model-based government procurement information service pattern, which provides a novel idea and method for the innovation of public e-service supply mode and the development of a basic government procurement information platform.*

Subject Categories and Descriptors: J. [Computer Applications]; Government; **H.3.5 [Online Information Services**]; **H [Information Systems];** Value of Information

General Terms: Information Services, Information Value, Cloud-based services, Information Service Pattern

Keywords: Government Procurement, Cloud Platform, Information Service, Value Curve

Received: 11 February 2021, Revised 3 May 2021, Accepted 26 May 2021

Review Metrics: Review Scale: 0-6, Review Score: 5.02, Inter-reviewer consistency: 74.6%

DOI: 10.6025/jdim/2021/19/3/96-105

1. Introduction

Electronic government procurement (EGP) can be regarded as a combination of e-commerce and e-government, which is a good carrier and effective way to plan, control, share, and coordinate fund, business, and information flow among parties that include purchasers, government procurement agents, suppliers, and supervision departments. EGP can effectively optimize and improve the procurement process and reduce costs, make better decisions and get more value (Panayiotou *et al.*, 2004). Moreover, EGP can promote the management and innovation of the corresponding legal and in-

stitutional frameworks (Brun *et al.*, 2004), which has to become a universal way of implementing public procurement behavior in many countries, including China.

Information resource is a key factor for value chain researchers (Yang *et al.*, 2012). According to relevant statistics, the number of information resources collected by the government is approximately 80% of the total social information (Brandis *et al.*, 2014), which forms the basis and bond of the government to exercise social governance functions and carry out administrative works. Potter (1985) highlighted that the use of various links in the value chain requires synergy and optimization between information or information systems. Later, Rayport and Sviokla (1995) studied the flow of information resources as a research object of relatively independent value chain activities and proposed the concept of "virtual value chain" to explain the process whereby enterprises provide users with virtual products and services through information resource processing and the utilization of the Internet. Information resources have deeply influenced and changed the activities of the traditional value chain given the differences and pertinence of targets and objects in the use of information resources. By contrast, users may have different values for information and information flow such that the value-added of information may be gradually expanded or reduced.

The mobile Internet era presents new development opportunities and challenges to government public information service. The transformation of public information service mode matching development of emerging technologies, optimization of supporting information service process, and integration of superior resources guarantee the innovation of government public information service mode and improvement of public service efficiency. The majority of prior studies on government e-procurement have concentrated on system architecture, supply chain, capital saving, and corruption prevention. However, economic analytical research on information utilization and service layer is relatively scarce. Therefore, studying and establishing government procurement information service value chains and their collaborative optimization theory and technology is important to enrich and perfect the relevant theories and methods on information construction and service.

2. Literature Review

The e-Government information platform construction and public information services have constantly attracted substantial attention from international academic circles. Arduini and Zanfei (2014) claimed that the widespread modern information technology provides various users (e.g., ordinary citizens, companies, and organizations) with high-quality, real-time, and practical economic life value-added services. Public and administrative organizations have applied these new technologies to improve the effectiveness of work organization and information exchange, while providing users with the necessary and supplementary public e-services. Jansen and Ølnes (2016) proposed that "e-services" comprise service description, interface, or expression. These researchers also hypothesized that the understanding of different public services can be improved by conducting a systematic analysis of various government tasks and responsibilities. The modeling function of online public services and benchmark service quality indexes should be combined to improve the basis for the benchmark framework. Seri *et al.* (2014) suggested the use of online tools to facilitate the interaction between the citizens and the government. The following three-layer analysis is considered for the interest of all participants: the government provides citizens with information ("e-information sharing"), stakeholders-related interaction ("e-consulting"), and involvement in the decision-making process ("e-decision making"). Breur (2011) divided government information services into four phases: information scheduling and classification, online processing, vertical integration, and horizontal integration. He believed that government information could realize a "one-stop" service, which can be accepted and used by the public through scientific and reasonable integration. Kohlborn (2014) introduced the concept of "service binding," which means gathering services into the behaviors of product packaging that conform to the demands of users and may contribute to the related detailing and grouping functions. E-government construction has facilitated the openness and transparency of public management information, as well as relatively improved the convenience and efficiency of public information acquisition and affairs handling. However, a real interactive platform between the government and the public is not completely implemented. Fakhoury and Aubert (2015) believed that information and communication technology could improve public management. However, the extent of use of e-government systems by end-users was substantially lower than expected, thereby necessitating a continuous effort. Active citizenship and trust may affect the behavior intention of e-government services.

Lin *et al.* (2010) expounded on the details of the overall technology, level of e-procurement application, and the existing problems of constructing China's government procurement information system. They proposed an e-government procurement framework based on procurement business components and established a working flow model based on authority and user participation. Vaidya and Campbell (2016) studied the efficiency and service problems of the e-government procurement from multiple angles, such as information system and supply chain management.

Leviäkangas (2011) determined that information flow-targeted value chains in the area of information service value chain had different utilization and processing qualities. Moreover, the stakeholders or operators in different chains had various perceptions of values. The same information has different values and attributes of critical set values. The advancement of value chains may not

consistently increase value but may reduce unless value accumulation is elaborately sustained. Subbiah and Ibrahim (2011) analyzed the obstacles encountered by public users from different countries when participating in e-government service process and the different methods adopted to facilitate a benign public–government relationship. The aforementioned authors also explained that the participation of the public in the co-creation of e-government service value could improve the government service level in Malaysia. Zhou (2009) explained that e-government information service is a special public service and its economic characteristics include non-exclusiveness, exclusiveness, incomplete competitiveness, externality, and low marginal cost. However, this service belonged to special economic behavior. Accordingly, they analyzed the measures to improve the efficiency of e-government information services.

Guan *et al.* (2016) conducted an in-depth analysis of the good attributes of government public information services and explained its non-exclusiveness in consumption and non-competitiveness in supply. They identified the limitations of government public information services in realizing market balance and effective resource allocation. They also studied its supply-demand curve and analyzed the unbalanced problem of government public information services. Lastly, he proposed that a demand expression mechanism should be established at the demand end. Moreover, buyers had more requests and asked for high-quality goods but also at low prices (Centobelli *et al.*, 2016). A competitive mechanism must be applied at the supply end to remodel the market, thereby reconstructing the supply-demand balance of the government public information service and realizing effective resource allocation. Wang *et al.* (2015) suggested the concept of enterprise collaborative value chain based on a cloud environment. They established a collaborative management framework of value chains and proposed a graded network coordinating plan by compiling techniques for value chain control. Chen *et al.* (2016) proposed a grey correlation analysis-based value chain benefit distribution model under a cloud environment based on the following features of collaborative value chains: dynamic property of construction and operation process, form networking, emphasis on customer value, openness and transparency of internal operation, and collaborative agility and intelligence of the value chains.

In the last three years, big data value chains have become the new trend in research on information service value chain. Addo and Helo (2016) claimed that big data was becoming an important power-organizing enterprise in this era of various global industrial scales. They explained that big data is a tendency-oriented new enterprise system or platform, in which value-adding can be achieved by adding features to acquire, save, and analyze large quantities of data from various sources. Moreover, big data could be beneficial only for analysis and value adding. Saggi and Jain (2018) further claimed that big data would become a technology-driven ecosystem and improve decision-making, which would contribute to knowledge extraction inexplainable and proper forms. Opresnik and Taisch (2015) proposed the fifth feature (i.e., "V"-value) of big data (the other four "V" features are volume, variety, velocity, and verification). A third-layer-added value (i.e., "information') was added based on existing product and service layers. They inferred that servitization could become a process, where data is the essence. New revenue flow and value-adding could be created by reusing and reselling big data. Kim and Lee (2018) proposed that big data has different uses on various scenes to increase social value. For example, the public sector utilizes big data to improve transparency, facilitate citizen participation in public life, prevent crimes, improve national security, and support social welfare through education and health care management. Hardy and Maurushat (2016) used the Australian government's data movement on web portals as an example. These data were not only released to provide the public with information, but also to promote innovation through "big data" analysis, as well as enhance government transparency and accountability system. The Australian government believed that enterprises, the academe, and the public could learn new opinions from data sets released by the government and identify innovative solutions to complicated policy problems. Günther *et al.* (2017) explained that big data were considered the source of innovative products, services, and business opportunities. Big data could likewise improve operational efficiency and effectiveness, such as optimizing supply chain flow, improving business performance, predicting the market and consumer trends, customizing personalized products, innovating products or services (Chen *et al.*, 2012), determining the most profitable price for products and services, selecting the most suitable personnel for certain tasks and work, reducing errors and quality problems, improving client relations (Mcafee and Brynjolfsson, 2012), elevating decision-making level (Sharma *et al.*, 2014), improving advisable strategic planning (Constantiou and Kallinikos, 2015), and implementing active transparency and immediate feedback. Vecchio *et al.* (2017) believed that value creation through big data requires concrete technology and analytical method to transform such data into information assets. Accordingly, such assets would contribute to the recognition of hidden patterns and profound understanding of client experiences. Thus, the created value would be the result of management information and knowledge assets. Information resource integration and sharing had been led to a profound transformation of the related personnel, organization technology, flow, and behavioral pattern. Emphasis is provided on the manual control and management of depressive, isolated, and sealed social information resources through cooperation and coordination among social organizations. The objective of this process is to realize the sufficient use of information resources and their maximum value-adding.

The organizational layout of the remainder of this study is as follows. Section 3 primarily expounds on the main

features of the government procurement information service value chains in five aspects and a value chain model during the value-adding process. Section 4 closely links procurement service and client information demand based on the cloud platform and big data analysis to facilitate the optimization and upgrade of the government procurement information value chains. Section 5 uses value curve theory to explain the value-adding process and final result of the government procurement information service value chains. Section 6 draws the research conclusions based on the previous analyses.

3. Value Chain Model of Government Procurement Information Services

3.1 Characteristics of the value chain of government procurement information services

The value chain of government procurement information resources includes sharing and processing. Information sharing mainly refers to the active or passive disclosure of original basic information resources, and information processing refers to information provided to the public. The value-added content of information resources come after analyzing and processing from the original information resources.

The value chain of government procurement information has the following characteristics:

(I) Government procurement information resources have internal and external sources. Internal information sources refer to government office process information, policies, regulations, documents, and information from the procurement department. External information sources, mainly include information from suppliers, purchasers, purchasing agencies, bid experts, and the public.

(II) The most important goal of government procurement information value chain activities is to maximize social effects. The original intention of government procurement is to balance fiscal expenditure by reducing expenses and improving public welfare. Instead of earning profits, the aim is to optimize government procurement funds.

(III) The value-added process of the value chain of government procurement includes direct and indirect forms. Government procurement agencies can “direct” the release of the original information to suppliers, purchasers, and other relevant public entities. “Indirect form” means that the management department of government procurement is inspired by the processing of information resources and is constantly improving its information services or use by other government procurement-related parties. This process comprised auxiliary activities in the traditional value chain.

(IV) The entire value chain is constructed on the basis of customer or market demands. The chain should be constantly pushing the value of information by constantly transferring information value and forming a flexible service system, coordinating management, and integrating the various functions of upstream and downstream of the government procurement process. The process should provide personalized service solutions for different government procurement stakeholders and satisfy their personal requirements.

(V) The information value chain focuses on the entire life cycle of commodities and projects. We can use the information technology and technology platform to support the design, analysis, operation, and management of the information service, value chain; eliminate information asymmetry; improve the efficiency, quality and performance of information services; and promote the innovation of the service system and the predictability of technological risks.

3.2. Government procurement information value chain model

Government procurement information forms mobile and complete information value chain, which is collected, stored, aggregated, and processed for secondary use. From the beginning to the end of the chain, the above mentioned processes have been passed to achieve the value-added of information. We can similarly divide the value chain activities of government procurement information into basic and auxiliary activities compared with Potter’s definition of the value chain model, including the basic and auxiliary activities of creating value. These activities lead to promoting the final realization of the public value of government procurement. Figure 1 shows the value-added process of the government procurement information service value chain.

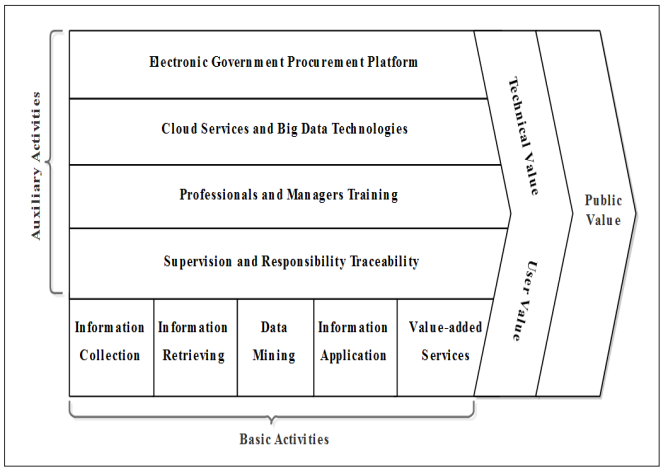

Figure 1. Government procurement information value chain model

The basic activities in the model of the value chain of government procurement information are necessary and indispensable. These activities include the collection of original information, information retrieval, data mining, information utilization, and value-added services of information. The collection of raw information, such as purchasers, suppliers, commodity prices, and other basic information resources, cannot directly create value-added

for users. However, these factors are necessary and serve as a starting point for subsequent information resource utilization and information value increment. The scale benefit and information increment would not be realized without the accumulation of massive raw data and information. The purpose of information retrieval is to make the participants of government procurement find and discover valuable information resources accurately and quickly, whose precondition is standardized reading and writing of government procurement information. Data mining is the key activity to information appreciation. Only through data mining can reflect the value of information, which is not simply stacking information, but doing clustering analysis and systematization and carrying out the potential value of information for users' corresponding demands. Finally, information value-added services can provide high-level professional services for government regulators, suppliers, purchasers, and other users.

The government procurement information value chain includes a series of necessary auxiliary activities, which include the electronic government procurement platform, cloud services and big data technologies, professional and managerial training, supervision, and responsibility traceability. Building a unified e-government procurement platform can help in the convergence and the collection of original information from different levels and parts. The development and application of cloud computing and big data technology enhance technological capabilities in information retrieval and data mining. Technical and professional training and the enhancement of the professional level of the government procurement information service should be done continuously. For the prevention of gaining profits from the use of monopoly information for value-added development in the process of government procurement, strengthening the supervision and the tracing of responsibility of the entire procurement process is important. Although different, these "basic activities" will directly affect value chain value-added activities and still play an important complementary and auxiliary role for the entire value chain of government procurement information services, such as systems, technology, and talents. The entire value chain of government procurement information services is a complete entirety. The "basic activities" and "auxiliary activities" involved are interrelated and interact with one another. The process of increment of the entire information value chain is a process of information elements acting together and proceeding step by step.

4. Innovation Model of Government Procurement inFormation Services

The intelligent cloud platform (Wang *et al.*, 2015) for government procurement is an upgraded version of e-government procurement, which is similar to the traditional procurement information chain in terms of elements and linking principles. The data flow of users and suppliers can be bridged and related to one another through the supply chain. However, given the lack of integration and support of the cloud system, information on the previous e-government procurement system always indicates fragility and vulnerability. These features result in the formation of information islands. Hence, fragmented information can hinder the realization of interconnected sharing and statistical inquiry and the development and application of big data technology for the supply and demand system. Moreover, the efficiency of government procurement is difficult to improve effectiveness.

Under the background of today's big data era, there is a massive exchange of information, while the communication has drastically changed as more and more people using the networks (Kanakaris *et al.*, 2018). What's more, the demands, such as query, application, and the feedback of purchase information have been greatly increased for various government procurement users. Therefore, information resource management and development in government procurement is necessary to the make corresponding adjustments promptly. The intelligent cloud platform can play a significant role, which can effectively improve the management and application capabilities of the government procurement, supply and information chain, link user information requirements and services, optimize and upgrade the government procurement supply chain by the high-quality and efficient supply chain information management (Song and Liu, 2014) and create the significant value of government procurement information services. Figure 2 simplifies the above process.

Information resources can be obtained and analyzed in time and effectively through information combing and information aggregation to meet the needs of the personalized information service of the government procurement stakeholders. The objective of the government procurement information service is to promote the collection, combing, aggregation, mining, and utilization of information. Moreover, the service should reduce the negative impact of noise and uncertainty information on the supply chain. Various stakeholders would then obtain highly effective information service and information value-added in the new government procurement intelligent cloud platform.

Information aggregation is a process of information generalization and pooling in the cloud system of government procurement. This process demands specific information service requirements in extracting and aggregating abundant fragmented information coming from the sorting, analyzing, and accumulating big data. The process transforms semi-structured and unstructured information into classified and ordered collection value information resources for integration, optimization, and preparation for reuse.

Behavior overtime in complex systems depends on the dominant feedback process of the system (Moon *et al.*, 2018). The data mining of the government procurement cloud platform information resource pool through large

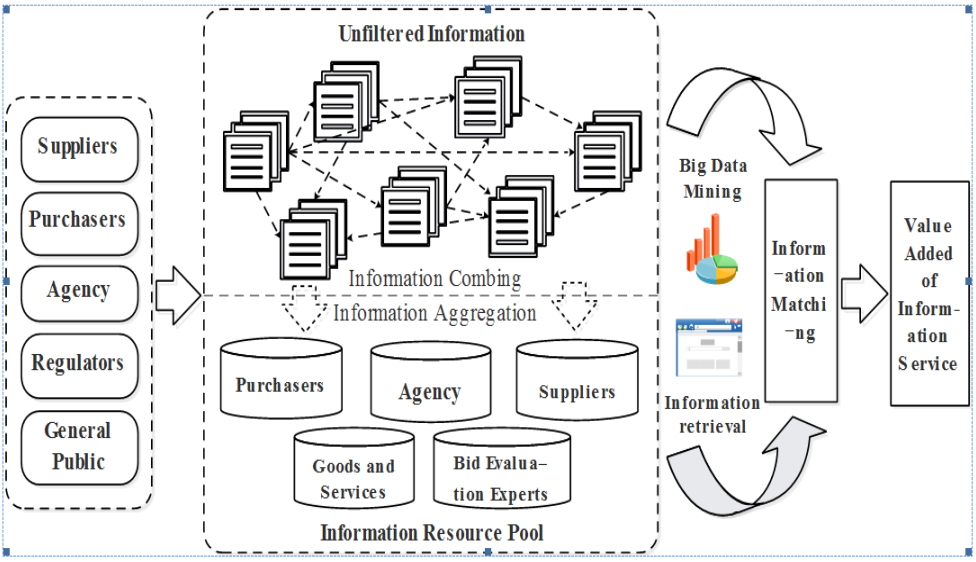

Figure 2. Information service process of the government procurement intelligent cloud platform

data technology can effectively meet information service needs of the users of government procurement effectively. On the condition of conserving business secrets and open market rules, the process fully uses the big data generated by the information aggregation process on the cloud platform and maximizes its utilization. Furthermore, the process promotes the value increment of information in the government procurement supply chain and improves the corresponding information service ability.

The government procurement supply chain, which is connected by the cloud platform, can profoundly demonstrate the integration link process and state of each organization node of the information value chain; promote the overall utilization of information flow in the supply chain; enhance the government procurement service agencies' ability to collect, extract, integrate, and excavate information resources in the entire procurement process; and improve the ability of prediction, judgement, and decision-making for subsequent procurement. What's more, the supply chain can change the work and service mode of government procurement stakeholders, such as the awareness, inquiry, and feedback of government procurement information. The characteristics of government procurement and supply chain are clearly shown under the background big data era, such as high quality, high efficiency, multi-share, precision, and diversified information services. The process can fully meet the needs of personalized information services for different users, reduce the negative effects caused by information asymmetry, find, utilize valuable information resources in the execution and management of government procurement (Lin and Ng, 2011), and improve the management efficiency and diversification decision level (Roy, 2013). Finally, the supply chain will bring highly significant value-added effects of information services and ultimately improve the economic and social benefits of the entire government procurement.

5. Value added of Government Procurement information Service

Government procurement information services need active participation and effective interaction of suppliers, purchasers, the public, and other users. By constructing the government procurement cloud platform, all parties can participate in the process of the design and improvement of the government procurement information services. This open mechanism will be widely used, well established, continuously improved, and innovatively developed, which not only overwhelmingly shows the characteristics of inclusiveness and service generalization on the cloud platform, but also profoundly exhibits the interaction between the government and the public. Only through this way can all forces achieve the value of government procurement, improve the quality of government decision-making, and improve public satisfaction and acceptance.

The government procurement cloud platform can integrate various working modes and flexible systems to work together; make full use of the large amount of potential data resources accumulated by the government procurement, and make a precise division, accurate positioning, and recommendation for buyers' needs. The introduction of the big data analysis technology will integrate data resources and classify and analyze the value and potential value of the purchaser demands by historical transaction records. Moreover, the records will take account of generality and personality and provide targeted products and service information services to different user groups. The technology will enhance the intelligence level of the government procurement cloud platform and improve purchaser satisfaction with good quality and cheap products.

The intelligent cloud platform can promote all participants

of government procurement in creating service value. On the one hand, the platform can promote government procurement departments to provide different users with personalized information service requirements by data mining and clustering analysis. On the other hand, purchasers, suppliers and public users can supervise the entire process of government procurement through the cloud platform and provide or receive timely feedback on expectations and suggestions for the improvement of government procurement. The convenience of the information interaction mechanism can provide a guarantee for the value creation of all participants in government procurement.

The platform can use the "value curve" to describe the development trend of the government procurement value and the path of value-added. In view of the value chain, we will focus on the process of value creation and the participation of government procurement stakeholders. The part that exceeds its value in the process of government procurement services is regarded as "value-added."

Figure 3 shows "curve 1" representing the traditional model. The value-added is low because that value is only limited to the bidding process of government procurement. "Curve 2" represents most of the electronic government procurement model, which not only is concerned about the promotion of its own value, showing as the value curve's vertical increase, but also pays attention to the promotion of the value of upstream suppliers and downstream purchasers. The curve extends to both ends and forms a "smiling face." "Curve 3" represents the government procurement intelligent cloud model. Compared with "curve 2," curve 3 goes upward and extends even further because it pays considerable attention to the promotion of the value of suppliers and purchasers. This step ultimately improves the comprehensive value of the entire government procurement value chain, and the smile of the curve will be brilliant.

The intelligent cloud platform must meet the following essential conditions that achieve the overall shift of the value curve and enhance the added value of the government procurement service.

(I) Ensuring that each link of the information chain is open and transparent

Government procurement agencies can fully use the new channel of the intelligent cloud platform to promote the disclosure and transparency of the government procurement chain and break information asymmetry between government agencies and their service providers. Changing the top-down and one-way mode of the traditional information service process is highly profitable and pays considerable attention to feedback mechanisms and the interaction process of information disclosure.

(II) Interaction awareness among stakeholders in government procurement

Government procurement management must consider the interests of all sides of stakeholders and form pluralistic and unified interest expressions. Given the relationship among stakeholders in the government procurement value chain, the government represents the public interest, the supplier represents the interests of the private, and the practice of government procurement is the bridge between the main and object of the realization of the public value-added.

(III) Incentive mechanism of government procurement service, value collaborative creation

The cloud of government procurement has a special channel system for government procurement to participate in interactions, which includes online consultation

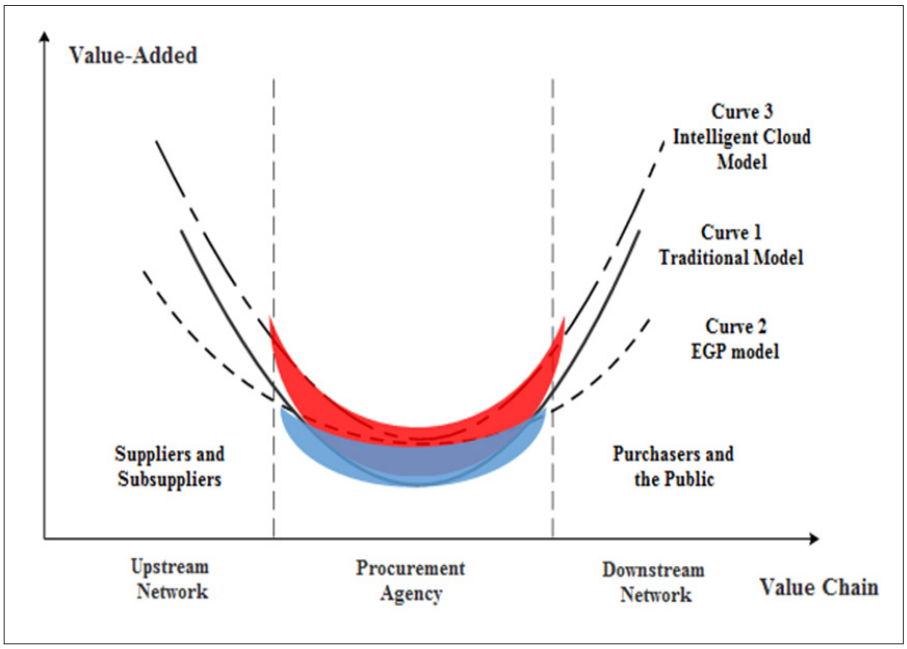

Figure 3. Value curve of the government procurement intelligent cloud platform

of purchasers; supplier advice; after-service satisfaction surveys; procurement queries and complaints; and government procurement of micro-blogs, WeChat, and other real-time online interactive modes. Moreover, due to encouraging all parties into the service value creation process of government procurement, the cloud platform sets up incentives and mechanisms to mobilize public participation fully. All parties are encouraged to offer suggestions. For instance, the scores obtained from the questionnaire can be used to exchange for physical rewards and regular publishing of excellent feedback.

(IV) Common improvement of the dominant and recessive values

The dominant value of government procurement includes the market of the behavior of government consumption and the promotion of the development of small and medium enterprises, domestic demand and growth of enterprises, and industrial upgrading and consumption and green development, among others. Conversely, the implicit value includes standardizing fiscal expenditure, improving the efficiency of capital use, reducing corruption, and improving government services and macro regulations, among others. Given the core position, the relevant government procurement departments can be helped with the accurate implementation of policies and regulations, the improvement of the pertinence and availability of services, and the reduction of the risk of service innovations on the cloud platform. For other government procurement stakeholders, information gathering and effective feedback on the government procurement cloud can make their real needs and ideas, timely in understanding and processing, solving various problems and difficulties encountered in the process of government procurement, and obtaining good personalized service experiences. Hence, government procurement online business processes and rules can be optimized, and the service efficiency can be improved through the government procurement intelligent cloud platform.

6. Conclusions

The reconstruction and optimization of the government procurement information value chains are an arduous system project. The supply contents and service parts of the government procurement information service must be adjusted to improve the operating efficiency of the overall government procurement information value chains.

Accordingly, such an adjustment will promote active exploration and trial. The role identification of stakeholders related to government procurement is also experiencing enormous change along with the establishment of a government procurement intelligent cloud platform. This change includes suppliers, purchasers, and the public, who are information receivers and providers. They are also supervisors who jointly participate in government procurement information services to realize information sharing and value co-creation. The study on the value chains of the government procurement information services leads to the following conclusions. (I) The government procurement information value chain model, which was developed by combing the main features of the procurement information service value chains, can effectively clarify the continuous information value transfer process among personnel, organizations, and technologies. This model contributes to the establishment of a flexible service system network for collaborative management, thereby resulting in continuous value-adding to the social effect. (II) The entire value-adding process of the e-government procurement information resources was analyzed starting from satisfying the personalized information service demand of the stakeholders involved in government procurement. A new information service pattern of e-government procurement platforms based on cloud computing and big data technology was proposed. (III) Value curve theory was used to expound on the value-adding process of the government procurement intelligent cloud information service. To elevate the overall elevation of the value curve (i.e., effective elevation of government procurement service, value adding), the emphasis should particularly be provided to the joint elevation of the explicit and implicit values.

Overall, a value chain model was utilized to realize the systematic combing and effect display of the e-government procurement information service and the entire value-adding process. The utilization of this model is immensely important to the economic study on e-government procurement. Nevertheless, the main limitation of the present study lies in the theoretical aspects of the management and operation mechanism of the government procurement information value chain model. A lack of practical study on the application of big data technology was observed and will be the emphasis of follow-up research.

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