Research on Service Value Chain Model Based on Technology Service Platform

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Abstract. For the technology service platform, serving users with science and technology resources is the purpose of platform construction, and the quality of the service value chain affects the operation of the technology service platform. Aiming at the immature status of the research on the service value chain model of the technology service platform, this paper proposes a set of construction ideas based on the service value chain model of the technology service platform. The model takes the technology service platform as the central node, and at the same time integrates users, third-party technology service platforms, service resource providers in various fields and other participant nodes, and links the interests of all parties through a dynamic chain with value flow as the core. Each participant node cooperates with each other to form a complex, cross-domain service value chain model. In order to ensure the service quality of the platform, a feedback mechanism that reflects the attitude of users using scientific and technological service resources is introduced into the service value chain model. By taking the manufacturing of vertical elevators as an example, the operation of the service value chain is simulated, and the usability of the service value chain model is verified.

1. Introduction

In today's era of data, information, and resource explosions, technological innovation and development are constantly accelerating the process, and researchers engaged in scientific research are paying more and more attention to the effective use of existing resources. However, the currently available scientific and technological resources show the characteristics of large quantity and wide distribution, which has brought great obstacles to the effective use of scientific and technological resources. The current technology service field also presents the characteristics of individualized user needs, rapid service growth, and platform heterogeneity and diversification. This also exposes a series of outstanding requirements for the use of scientific and technological resources, such as cross-platform resource aggregation, service collaborative realization and improving service value, etc. The technology service platform is committed to providing a service platform that is more convenient for resource search, more efficient resource utilization, and more complete resource sharing for personnel engaged in scientific research. How to optimize the value and interests of all parties on the platform and improve the service quality of the technology service platform is a problem that needs to be solved in the service value chain. Based on this problem, by analyzing the characteristics of each node in the service value chain, this paper proposes a service value chain model that takes into account the value and interests of all parties and promotes the platform to serve users with higher quality.
2. Related work
In the field of service value chain research, many scholars at home and abroad have carried out a lot of research mainly from its practical application scenarios, and have achieved rich scientific research results. He Jianxin[2] put forward a service value chain model based on university libraries around the theme of how to improve service quality and user satisfaction, but the model did not integrate the actual system platform. Feng Yangang[3] studied a mobile value-added service value chain composed of a single mobile device manufacturer, a single mobile network operator and a single service provider, and constructed a cooperative game model among members in the mobile value-added service value chain. Yu Yang[4] and others proposed a bilateral matching model of business resources for multi-service value chains, which integrates the personalized business needs of both the supply and demand parties, and helps the demander to select the most demanding supply and demand from the massive business resources. Li, Wenbo[5] studied the network structure and organizational model of multiple value chains, based on the third-party platform, and analyzed the network structure from the perspective of multi-value chain business collaboration. Caputo, Francesco[6] and others took smart cities as the starting point and proposed a set of smart service value chain models based on the value co-creation between service providers and service users. Anggadwita, G[7] and others aimed to analyze the value chain model of Bandung coffee shop business by mapping the input-output relationship and determining the advantage factors in the value chain. Based on the analysis of the value chain of video service websites, Li Hua[8] and others constructed a profit model, expounding the profit model of existing major video websites. At this stage, the research on the service value chain model of the technology service platform is still relatively limited. This article combines relevant domestic and foreign research to propose a service value chain model based on the technology service platform. After analysis and simulation experiments, this model has practical research significance.

3. Service value chain model of the technology service platform
The technology service platform is a large-scale comprehensive platform that integrates a third-party science and technology service platform. Its service value chain takes the comprehensive technology service collaboration platform (technology service platform) node as the core and central axis, and through the coordinated scheduling of the service value chain various values, guarantees the interests of each node entity in the value chain model. This model mainly includes key nodes such as comprehensive technology service platforms, platform users, technical capability service providers, management and operation service providers, service standard providers, third-party technology service platforms, and resource providers in various fields. Each node in the model is closely linked through the flow of various values, forming a non-linear and complex value network, as shown in Figure 1. Among them, RUV (Resource Use Value) represents resource use value, which is contained in various service resources of the platform. ECV (Economic Value) represents economic value, which runs through the various nodes of the platform. IFV (Information Feedback Value) representing information feedback value is used to provide users with feedback information on the use of scientific and technological service resources to the nodes of the comprehensive scientific and technological service collaboration platform in a timely and accurate manner. TAV (Technical Ability Value) represents the value of technical capabilities, provided by the platform feasibility analysts, needs analysts, designers, developers, and test maintainers to ensure the basic operation of the platform. MOV (Management and Operation Value) means management and operation value, which is the operation strategy of the platform provided by the management and operation personnel of the platform. KSV (Knowledge and Skill Value) represents the value of knowledge and skills, which is generated by the platform service standard maker and research report service provider.
3.1. Internal nodes of the service value chain model

(1) Comprehensive technology service collaboration platform: This node is responsible for service resource scheduling and value transfer, connecting user nodes, technical capability service provider nodes, management operation service provider nodes, service standard provider nodes, and third-party technology service platform nodes, mainly coordinate the internal nodes of the service value chain in the form of ECV.

(2) User: The most fundamental guarantee of economic benefits of this platform, using the scientific and technological service resources provided by the platform in various fields and providing economic value and feedback information to the comprehensive technology service collaboration platform.

(3) Technical capability service provider: Following the entire life cycle of the platform from feasibility analysis to putting it into use, it provides technical support for the design, development, testing, and maintenance of the platform.

(4) Management and operation service provider: It formulates the operation strategy of the platform, determines the operation mode of the platform, processes the feedback information of users in a timely and gives the next operation plan.

(5) Service standard provider: A set of feasible platform service standards are formulated through research on existing national standards to ensure the applicability of scientific and technological service resources.

(6) Research report service provider: It receives user demand reports delivered by third-party technology service platforms, investigates the field of relevant technology service resources and their distribution in various fields based on the content of the demand, and returns the survey results to the third-party technology service Platform.

(7) Third-party technology service platform: This platform is based on user needs and guided by the research report returned by the research report service provider, solicits scientific and technological
service resources in various fields, and transfers the well-organized resources to comprehensive technological service collaboration platform.

(8) Domain resource providers: They respond to the requests of third-party technology service platforms and provide them with corresponding technology service resources in a certain field.

(9) Field entities: They provide existing scientific and technological service resources to resource providers in various fields.

3.2. The value flow of the service value chain model
The service value chain model of the technology service platform takes various value flows as the core, and its value flows are shown in Figure 1. The node of the comprehensive technology service collaboration platform is not only the center of the value chain model, but also the core hub of the value flow in the value chain. This node is connected with the user node to deliver the use value of scientific and technological service resources to users and receive the economic value and information feedback value of user feedback, delivers economic value to technical capability service providers and obtain the value of technical capability provided by them, delivers economic value and feedback information value to management and operation service providers, and accepts the returned management and operation value, provides economic value to service standard providers and obtains knowledge and skill value, delivers economic value to third-party technology service platforms and obtains the use value of scientific and technological service resources collected and integrated by it. As a small and medium-sized hub node in the service value chain, the third-party technology service platform also carries the task of transferring value flow. This node delivers economic value to research report service providers and resource providers in various fields, obtains knowledge and skills value from research report service providers, and receives value of use of science and technology service resources in various fields from the field resource providers. Resource providers in specific fields and field subjects realize the flow of value through the exchange of economic value and use value of scientific and technological service resources.

3.3. Service value chain model feedback mechanism
The comprehensive technology service collaboration platform node provides users with science and technology service resources and receive feedback information submitted by users for user text evaluations. The evaluation text is submitted to the platform in the form of a message. The platform collects user text comment information and uses the sentiment analysis model to determine the sentiment trend, and obtains the analysis result of the text evaluation information. The comprehensive technology service collaboration platform node transmits the analysis results of the text evaluation information to the management operation service provider node in the form of a report file for reference by the platform management operator, so that it can understand the current user’s attitude towards a certain science and technology service resource in a timely manner. And they can provide corresponding operation management strategies. This process can be described in Figure 2.

![Figure 2. Service value chain feedback mechanism.](image)

Text sentiment analysis, also called sentiment orientation analysis, is the process of analyzing, processing, inducing and reasoning about subjective text with sentiment orientation[9]. The platform uses a sentiment analysis module based on the pytorch framework and LSTM (Long-Short Term
Memory) neural network, and the usability of the module is verified through experiments. This article introduces the final negative rate to measure the user's attitude towards the use of technology service resources after sentiment analysis.

Since the model's effect will fluctuate slightly during the training data process, the average negative review rate method is used to estimate the user's negative review rate. The calculation formula of the average negative rate \( anr \) (Average Negative Rate) is:

\[
\text{anr} = \frac{\sum_{k=1}^{n} \frac{\sum_{i=1}^{m} s_{ni}}{\text{total_test}}}{n}
\]  

In formula (1), \( anr \) represents the average negative review rate; \( n \) represents the number of training sessions; \( m \) represents the number of batches per training; \( s_{ni} \) represents the number of negative reviews in each batch of training; \( \text{total_test} \) represents the total number of samples in the test set.

From the accuracy of the model, the final negative rate of user reviews can be calculated. The final negative rate \( fnr \) (Final Negative Rate) calculation formula is:

\[
\text{fnr} = anr \times acc + \frac{p_{ns}}{100}(1 - acc)
\]

In formula (2), \( fnr \) represents the final negative review rate of user reviews; \( acc \) represents the accuracy rate of sentiment classification by the model; \( p_{ns} \) represents the number of manually reviewed negative reviews in 100 randomly selected data in the data set.

4. Simulation operation of service value chain

4.1 Service value chain model to be constructed

Taking the simulated manufacturing of vertical elevators as an example, this article simulates the construction scenario of the scientific and technological service value chain of vertical elevators from user requirements to the actual manufacturing process, and the formed vertical elevator value chain model is shown in Figure 3. Figure 3 contains the task description and value flow of each node in the service value chain, including the following processes.

① The user proposes to the technology service platform to purchase technology service requirements for manufacturing vertical elevators. On the basis of the technical capability service provider providing the web system to receive text and send text functions, the platform will submit it to the third-party technology service platform after obtaining the requirement. ② The third-party technology service platform obtains the research report of user needs with the assistance of the research report provider. ③ Taking the survey report as a reference, the third-party technology service platform requests the list of materials required for elevator manufacturing and technical resources for elevator appearance production from resource providers in the material supply field, and requests for tractors and traction machines from resource providers in the mechanical power field. Technical resources for door machine installation and debugging, requesting technical resources for installation and debugging of contactors, relays, and speed limiters from resource providers in the field of integrated circuits, and requesting technical resources for installation and debugging of control systems from resource providers in the field of computer technology. ④ The third-party technology service platform submits the above-mentioned technology service resources to the comprehensive technology service collaboration platform, and provides services in compliance with service standards. Under the premise of providing national standards and mechanical manufacturing service standards, the comprehensive technology service collaboration platform will finally transfer resources to the user nodes. ⑤ The service value chain model relies on the feedback mechanism to analyze the user's evaluation of the use of vertical elevator manufacturing technology service resources, and transmits the analysis results to the management operation service provider node, and the node personnel feedback the operation strategy to the technology service platform based on the analysis result.
4.2 Service value chain feedback mechanism

The user can obtain the technical service resources related to the demand through the vertical elevator manufacturing service value chain model constructed by simulation, and these technical service resources will be applied by the user to the actual manufacturing of the elevator. The user experience will be fed back to the technology service platform in the form of text evaluation, and the platform will analyze the use of this science and technology service resource based on this, and provide the analysis result to the platform management operator for reference.

4.2.1 User feedback evaluation data. Since the platform has not yet been formally put into use, the feedback evaluation data after simulating users' use of the vertical elevator technology service resources are used to experiment with the feedback mechanism in the service value chain. In the simulation data, 9,548 pieces of user text evaluation data are included.

4.2.2 User text evaluation data analysis. The platform uses the pytorch deep learning framework and the LSTM neural network model to perform sentiment analysis on user text comment data. After preprocessing the user text evaluation data in the simulation data set, such as deduplication, deleting misuse information, we can obtain a "csv" file of the processed user evaluation data. It contains 9548 pieces of short text sample data of user reviews, and each piece of text data was attached with a separate classification label to represent different emotions of users. Among them, there are 2 types of labels, as shown in Table 1.

Table 1. Partial sample of data set.

| label / type | Text content |
|--------------|--------------|
| 1 / positive | The service is very good, the quality is good and meets expectations. |
| 1 / positive | good! Praise! Must like one! |
| 0 / negative | The service needs to be improved, and there is still a gap with the imagination. |
| 0 / negative | Not easy to use for me! |
According to the pytorch deep learning framework, the user evaluation short text data was segmented, of which 7,161 pieces of data were used as the data for the training set, and 2387 pieces of data were used as the data for the test set. A total of 4 layers of neural networks were set up in the program, which were Embedding (word embedding layer), LSTM (long and short-term memory network layer), and two Linear (linear layers), and finally the two classification results were obtained. In the experiment, the data set was processed in batches. Each batch processed 512 pieces of data, and the length of each piece of data was 20 units. After passing through the word embedding layer, each word in each piece of data was mapped to a tensor of length 100, and finally a 3-dimensional tensor was obtained and passed to the LSTM layer. The data passing through the LSTM layer returned a one-dimensional data tensor as the input of the first linear layer, and the second linear layer output the result of the two classifications.

The experiment carried out 30 training on the data, and the accuracy rate of the test set and the negative evaluation rate curve of user reviews were shown in Figure 4. After 30 rounds of data training, a stable accuracy rate was finally obtained, and the accuracy rate of this model reached about 86%.

![Figure 4. Sentiment classification accuracy and negative evaluation rate.](image)

100 pieces of text data were simulated manually, and 17 pieces of negative emotion text were manually reviewed. The model classification accuracy rate was 86%, and the average negative feedback rate of users in this data set was 14.31% calculated by formula (1). From formula (2), the final negative rate of sentiment analysis can be calculated to be 14.7%.

5. Summarize
This paper proposes a set of service value chain models for the technology service platforms. The service value chain model includes users, comprehensive technology service platforms, third-party technology service platforms and other nodes, including economic, resource use, knowledge and skills and other value forms. The model uses value flow as a link to closely link the nodes in the value chain. Each node in the value chain performs its own duties to ensure the normal operation of the platform in the form of receiving value, generating value, and delivering value. In order to fully consider the emotional trend of users in using scientific and technological services, a feedback mechanism from user nodes to management and operation service provider nodes is introduced to ensure the service quality and user satisfaction of the platform as much as possible. The experiment takes the manufacture of vertical elevator as an example to simulate the working conditions of each node in the value chain after the platform is put into use, and verifies the usability of the model.

There are still shortcomings in this model research at this stage. For example, the model failed to be verified on a formal platform, and the possible problems and risks at this stage are unknown. The accuracy of the sentiment analysis model in the feedback mechanism of the value chain needs to be further improved. These are what needs to be done in the next step and the focus of future work.

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