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Stimulative Coordination Models for Cooperative and Competitive Enterprise Alliances Based on Token Economy

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ABSTRACT The rapid development of blockchain technology offers new ways for businesses to establish an efficient management system with consensus-based governance. Token economy, however, is a newly born notion that may have great potential in stimulating coordination to be more valuable and efficient. This article classifies enterprise alliances into two categories based on their participation motivations and operating modes. Research has been conducted on ten industries facing the pressure of digitalization to analyze participation motivations and operating modes in enterprise alliances. This research has found that cooperative enterprise alliances tend to have relatively negative attitudes and pursue open and fair coordination. On the contrary, competitive enterprise alliances tend to have relatively positive attitudes and pursue secure and efficient coordination. Therefore, models for cooperative enterprise alliances utilize the blockchain and token economy to encourage open resource sharing and ensure fair benefits. In contrast, models for cooperative enterprise alliances utilize the blockchain and token economy to alleviate unfair advantages and encourage efficient resource sharing. This research has also recognized that the value of tokens lies in obtaining future resources, exchanging for monetary resources, and making rules in DAO. Moreover, the integration of token economy could improve corporate innovation capability and promote sustainable development of enterprise alliances. The main contribution of this article is the design of two stimulative coordination models for cooperative and competitive enterprise alliances based on their differences and the token economy. The significance of this paper is to provide a guideline for corporations to share resources and create value efficiently in enterprise alliances and help enterprise alliances operate and develop more sustainably using blockchain technology.

INDEX TERMS Blockchain applications, coordination, enterprise alliances, smart contracts, token economy.

I. INTRODUCTION

With the rapid development of blockchain technology since 2008 [1], tokenization has gradually become a controversial topic in the realm of Economy and Management. Furlonger and Uzureau [2] propose that tokenization, apart from distribution, encryption, tampering proof and decentralization, is one of the most important characteristics of blockchain. It refers to the representation of an entity's tangible or intangible assets and resources, promoting the circulation of capital in the market. Zhang *et al.* [3] classified tokenization applications into financing, retailing, digital identity, digital copyright, etc. Notwithstanding tokenization may face risks of centralization, trust, privacy, ethics, and monitoring [4], it may have great potential in altering the traditional competition patterns of industrial enterprise alliances by constructing the token economy. The token economy is an economic system established or defined by tokens instead of legal currency. It could be a bridge between the real economy and the fictitious economy, using community or 'Decentralized Autonomous Organization' (DAO) as its carrier [5]. The token economy has already become one of the most famous notions among corporate applications of blockchain technology as it could contribute to the improvement of information sharing, data processing, employee motivation, and the collaboration of different companies and departments.

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Moreover, the token economy could realize value exchange between owners of tokens and contribute to the development of entity and digital economy.

Enterprise alliances have widely existed in today's business environment due to corporations' increasingly fierce competition. Corporations of the same group, industry, supply chain tend to form enterprises alliance to share resources, gain knowledge and reduce costs to market and risks [6]. However, although enterprise alliances could efficiently generate profits for members, issues like information asymmetry, unfair resource allocation, and unstable existence may still exist, preventing enterprise alliances from being even more efficient in operation [7].

A. MOTIVATION

Enterprise alliances are intangible organizations formed by trust and mutual benefits. They should search for feasible coordination models that help maintain their bond, stimulate coordination, and develop sustainably [8]. However, traditional management methods could not solve this problem efficiently due to a lack of efficient coordination mechanisms [9]. Consequently, it may be costly and challenging to build up mutual trust and ensure fairness between corporations of different sizes and commercial purposes while improving the efficiency of coordination between them.

To solve this problem, we have categorized enterprise alliances into two types: competitive enterprise alliances and cooperative enterprise alliances. A competitive enterprise alliance has competitions between alliance members and is reluctant to share complete information and resources with other members. A cooperative enterprise alliance has almost no competition between alliance members and is willing to share complete information and resources with other members. The differences between each type of enterprise alliances lie in their participation motivations and operating modes. Stimulative coordination models should coincide with enterprise alliances' differences and deal with issues unsolved by traditional management methods.

The introduction of blockchain technology seems to provide a feasible solution. Blockchain-based stimulative coordination models could ensure fair and secure coordination regarding resource sharing based on its consensus mechanisms [10]. It also contains encryption algorithms and accurate transmission and authentication methods, focusing on building a transparent and mutually trusted coordination network [11]. Besides, smart contracts used by blockchain could enable secure and efficient resource sharing through automatic operation [12]. Hence, it would be possible to establish mutual trust and make resource sharing secure and beneficial to resource providers and receivers in enterprise alliances.

Following this train of thought, we extend the adoption of blockchain by introducing tokens to drive the coordination in enterprise alliances. In this way, it would be necessary to establish a system formed by tokens, called token economy. The token economy could enhance the willingness for active coordination between corporations by providing valuable rewards to participants [5]. Nevertheless, as it will be discussed in the following sections, blockchain-based coordination models would be the basis of the circulation of tokens in enterprise alliances. The token economy may have the potential to improve corporations' innovation capability and promote the sustainable development of enterprise alliances. Thus, we have designed stimulative coordination models based on the token economy.

B. MAIN CONTRIBUTIONS

We aim to probe the differences between cooperative and competitive enterprise alliances and to design stimulative coordination models for cooperative and competitive enterprise alliances based on the blockchain and token economy. Therefore, this article is trying to solve the following questions:

1) What are the differences between cooperative and competitive enterprise alliances regarding their participation motivations and operating modes?
2) How to stimulate efficient coordination in enterprise alliances based on enterprise alliances' differences, blockchain and token economy?
3) Why is the token economy essential in realizing stimulative coordination models?

By solving these questions, this paper offers a guideline for corporations to share resources and create value more efficiently through efficient coordination in enterprise alliances. Meanwhile, this paper aims to promote the efficient operation and sustainable development of enterprise alliances. As digitalization has already become a necessity for an increasing number of corporations, integrating blockchain technology and token economy into the design of coordination models would help enterprise alliances take the leading positions in the current trend.

C. ORGANIZATION OF THIS WORK

The rest of this paper is organized as follows. In the next section, a literature view has been carried out in terms of enterprise alliances, application of blockchain, and token economy. Then, we present a comparative analysis of cooperative and competitive enterprises on their participation motivations and operating modes. Afterwards, we design stimulative coordination models for cooperative and competitive alliances separately based on the results of comparative analysis and token economy and explain their mechanisms. To emphasize the importance of token economy, another section has been used to discuss the role of token economy in stimulative coordination in enterprise alliances. Finally, the article concludes our contributions and discusses ideas for future work.

II. LITERATURE REVIEW

This paper is related to three streams of research in literature. The first stream focuses on the operation of different types of enterprise alliances. The second stream relates to the application of blockchain in the management field. The third field explores the potential of the token economy in changing the current management system.

Enterprise alliances are widely discussed in corporate governance and corporate strategy. Xian [13] regards enterprise alliances as the groups concentrating on network-based manufacturing. It is common to observe that enterprises tend to cooperate with others to seek various resources, including data, information, product, money, partner, human, PPE, and knowledge. Many studies show that the selection of operating methods would affect enterprises' functions and flexibility, thus affecting their competencies in the competitive market [14], [15]. Consequently, many corporate alliances are now exploring the potentials of technologies (such as cloud computing and AI), and are forming virtual, autonomous, dynamic, participative, multi-level or horizontal enterprise alliances [16]–[18]. However, although the benefits enterprises could gain from alliances are apparent, there may exist quite a lot of challenges. As for enterprises of the same field, the problems would be their uneven product quality, timeliness of satisfying the demand and costs [19], [20]. As for enterprises of different fields, the problems would be their transmission of information, acquisition of resources and alliances' life cycle [21], [22]. Further studies also indicate that the participation motive would be an essential factor for the effective enterprise alliances, which would affect the innovation ability, the harmony, and the overall operating efficiency of alliances [2], [23], [24]. Based on the findings of former research, this paper goes one step beyond by conducting research on ten different industries in terms of financial performance and capability and willingness of digitalization to discuss the participation motivations and operating modes of different enterprise alliances.

Corporate management is one of the application fields of blockchain technology. Blockchain provides solutions to the efficiency of corporate management, which accelerates the corporate digitalization process while enhancing the competitiveness of corporations [25], [26]. A branch of research focuses on the safety characteristics of blockchain. Furlonger and Uzureau [2] indicate that using blockchain distributed ledger technology (DLT) and encryption algorithm could enable corporations to store data and record information safely. Moreover, many studies have designed application models concerning the effective use of blockchain for safe data storage [1], [27], [28]. Another branch of research emphasizes blockchain's potential in the transmission of data and information. As blockchain could build a value transmission network, data and information could be transmitted efficiently and reliably between nodes [30], [31]. These studies are followed by many designs on the data transmission methods based on blockchain, including consensus-based data sharing, private data exchange and secure data processing [32]–[34]. All the findings mentioned above bring about innovations to financial accounting, human resource management and supply chain management [35]–[37]. These innovations could benefit corporations in terms of their financial performance, market competitiveness, and corporate sustainability themes [38], [39]. Like the corporations, enterprise alliances may benefit from blockchain technology in its operating performance and developmental sustainability. Therefore, this paper combines the characteristics of blockchain and the knowledge of corporate management. We explore the application of blockchain technology in enterprise alliances that enables efficient resource sharing and value creation.

The token economy refers to a system concerning reinforcement, in which token plays the role of medium of exchange. Although token economy has sometimes been used in education and treatment [40], its full potential has been released by the blockchain technology. The application of blockchain could revolutionize the token economic system to become a peer-to-peer (P2P) network that emphasizes security and trust but is decentralized and transparent to all the participants [41], [42]. Kundu [43] and Reyna *et al.* [44] suppose that the basis of tokens in the economic system is the consensus mechanisms such as proof of work (Pow), proof of stake (PoS), delegated proof of stake (DPoS) and practical Byzantine fault tolerance (PBFT). These consensus mechanisms allow the token economy to become an attractive system that encourages participants to work together and govern the system in order but also keeping the system growing sustainably [45]. Narayan and Tidstrom [46] first proposed that the token economy could offer valuable perspectives for firms involved in 'coopetition' by forming a circular model of value creation and appropriation. Different from the above studies, this paper applies the concept of token economy to the competition and cooperation between enterprise alliances. In this way, we design coordination models based on a similar but more complex and dynamic view through blockchain and token economy.

III. COMPARATIVE ANALYSIS OF COOPERATIVE AND COMPETITIVE ENTERPRISE ALLIANCES

A. PARTICIPATION MOTIVATIONS

Participation motivations for entering an enterprise alliance could differ as every company has unique operating environments and demands. Participation motivation refers to factors that encourage the company to cooperate with others and establish an enterprise alliance [47]. Companies with different participation motivations would benefit from enterprise alliances differentially [2]. This section analyzes the participation motivations of entering enterprise alliances for designing suitable stimulative coordination models.

This research has collected data from enterprise alliances in ten different industries to indicate the differences between cooperative and competitive enterprise alliances in terms of their participation motivations (TABLE 1). These data could show the performance of most enterprise alliances in an industry, manifesting corporations' participation motivations when entering the enterprise alliances. There are two types of indicators being used for comparison: financial performance and capability and willingness of digitalization. As for financial performance, this research adopts the

TABLE 1. Profile of cooperative and competitive enterprise alliances'financial performance, capability, and willingness of digitalization.

Industry[a]	Type of enterprise alliances	Financial performance[b]		Capability and willingness of digitalization	
		Weighted-average Profit margin[c]	Weighted-average R&D investment/ Revenue	Weighted-average number of digitalization-related patents	Digitalization index[d]
Aerospace	Cooperative	3.05%	0.76%	14	0.34
	Competitive	-8.21%	0.65%	67	-0.51
Energy	Cooperative	6.12%	7.73%	393	-0.42
	Competitive	14.51%	1.38%	278	-0.42
Pharmaceutical	Cooperative	-6.15%	62.06%	22	-0.41
	Competitive	9.23%	35.59%	7	-0.51
Automobile	Cooperative	-0.35%	5.08%	995	-0.40
	Competitive	3.67%	3.69%	1251	-0.36
Transportation	Cooperative	5.48%	0.79%	298	3.87
	Competitive	4.81%	1.09%	313	1.14
Retailing	Cooperative	5.15%	0.03%	283	-0.10
	Competitive	5.69%	5.49%	808	1.35
Medical device	Cooperative	9.72%	10.13%	13	-0.3
	Competitive	22.89%	11.29%	210	-0.5
Agriculture	Cooperative	5.45%	1.93%	2	-0.16
	Competitive	19.62%	0.40%	8	-0.47
Construction	Cooperative	2.60%	1.60%	72	-0.49
	Competitive	3.80%	1.57%	304	-0.32
Public utility	Cooperative	34.29%	0.20%	16	-0.44
	Competitive	13.20%	1.47%	4	-0.26
Semiconductor	Cooperative	27.17%	9.64%	402	-0.17
	Competitive	-12.38%	15.46%	309	-0.47

Note:

a. All the data are collected from enterprise alliances that are consists of listed companies with market capitalization more than 20000 million

b. Data relating to financial performance has been collected from 2018-2020 fiscal year

c. Weighted-average value=∑X*company market capitalization/total company market capitalization

d. Standardized Digitalization index=Z-score standardization of (digitalization-related keyword searching index/company market capitalization)

methods used in Iwata and Okada's research [48], which uses weighted-average profit margin and weighted-average proportions of R&D investment. Moreover, according to the recommendations from Simatupang and Widjaja [49] and Jnr and Petersen [50], this research selects a weighted-average number of digitalization-related patents and digitalization index to present the capability and willingness of digitalization. The calculation of digitalization index considers the influence of company size and uses the data bases of Baidu and Google for digitalization-related keyword searching index.

1) COOPERATIVE ENTERPRISE ALLIANCES

As for cooperative enterprise alliances, participation motivations could be classified into three categories: 1. Panic passive motivation, 2. Forced passive motivation, 3. Opportunism motivation (TABLE 2).

TABLE 2. Participation motivations of cooperative enterprise alliances.

Type of participation motivation	Attitude towards changes	Attitude towards enterprise alliance	Main characteristics
Panic passive motivation	Panic	Very Negative	Limitation of budget and technical barriers
Forced passive motivation	Positive	Relatively negative	Technical or monetary advantages
Opportunism motivation	Neutral	Neutral	Share equal status with other companies

Panic passive motivation means that a company has a panic attitude toward new technologies and faces pressure from stakeholders to enter the enterprise alliances. Companies with this type of motivation usually face the trend of digitalization but are generally weak at obtaining cutting-edge technologies [51]. According to the study from Accenture, these companies usually appear in retailing, infrastructure, insurance, and consumer goods [52]. The collected data also shows that the cooperative enterprise alliances in the retailing industry have only 0.03% of their revenue invested in their R&D investment. However, the number of digitalization-related patents has reached 283, and the digitalization index has reached −0.1, suggesting that many enterprise alliances in this industry are panicking in chasing the trend. Similarly, construction and transportation industry have almost the same pattern. Although companies of these enterprise alliances may recognize the importance of new technologies, they may be unwilling to accept them due to the limitation of budget and technical barriers [53]. Therefore, these companies would passively participate in the cooperative enterprise alliances to seek opportunities for future development.

In contrast, forced passive motivation is similar to panic passive motivation except for its attitude towards changes. Companies with this participation motivation are usually forced by parent companies, industrial giants, competitors to enter the enterprise alliances. As they usually have technical or monetary advantages, they may hold a more positive attitude towards changes while still having a relatively negative attitude towards alliances [54]. Cooperative enterprise alliances in the pharmaceutical industry show 62.06% R&D investment but have only 22 digitalization-related patents and a digitalization index of -0.41. The data suggest that enterprise alliances in this industry may usually have panic passive motivation to enter the enterprise alliances. Similar patterns can also be seen in cooperative enterprise alliances in the medical device and agriculture industries.

Opportunism motivation, however, is a balanced type of all the participation motivations. It means that a company has a neutral attitude and has equal status as other companies in the enterprise alliance. Companies of this type would like to create value through trials and search for development opportunities by themselves, therefore cooperating with other corporations [2]. This is possible when companies from a supply chain or complementary industries construct an enterprise alliance [55]. Hence, these enterprise alliances may usually stay in industries like the automobile and semiconductor industry, with medium R&D investment, medium digitalization index and a large number of digitalization-related patents.

2) COMPETITVE ENTERPRISE ALLIANCES

As for competitive enterprise alliances, participation motivations could be classified into three categories: 1. Opportunism motivation, 2. Progressive active motivation, 3. Innovative active motivation (TABLE 3).

TABLE 3. Participation motivations of competitive enterprise alliances.

Type of participation motivation	Attitude towards changes	Attitude towards enterprise alliance	Main characteristics
Opportunism motivation	Neutral	Neutral	Compete for resources or monopolize the market
Progressive active motivation	Progressive	Active	Improve technical and monetary advantages through alliances
Innovative active motivation	Innovative	Very active	Develop themselves rapidly with technical advantages

Opportunism motivation in competitive enterprise alliances is similar to the motivation above, but companies with this type of motivation would compete in the enterprise alliance to gain advantages. They would form voluntary enterprise alliances through contracts to compete for resources or monopolize the market of a particular industry [56]. However, as their primary goals are opportunities, they may still have neutral attitudes and equal status in the alliances. As a result, they would pay more attention to the current trend but perform normally in other aspects. This situation could be manifested by the competitive enterprise alliances in the transportation industry as their digitalization index has reached 1.14 and has 313 digitalization-related patents on average.

Progressive active motivation means that a company is progressive in improving operating efficiency and staying active in dealing with internal and external challenges. Companies with progressive active motivation would have successful digitalization attempts and may become leaders of enterprise alliances [57]. Therefore, they would participate in competitive enterprise alliances to further improve technical and monetary advantages through other members. These enterprise alliances may usually exist in retailing and engineering construction industry. Data collected from competitive enterprise alliances in these industries show medium profit margin, R&D investment, digitalization index while having a relatively large number of digitalization-related patents.

On the other hand, innovative active motivation is quite different from others. It means that a company has advanced innovation capability of developing new technologies and can alter the whole industry. Although they may not have enough resources initially, they would be particularly active in forming enterprise alliances with other companies and developing themselves rapidly with technical advantages [58]. Many competitive enterprise alliances in the automobile industry could be classified into this category as they own a large number of digitalization-related patents while having a medium profit margin, R&D investment, and digitalization index.

B. OPERATING MODES

Operating modes have strong relationships with maintaining the enterprise alliance and value co-creation. Owing to the differences in corporations' participation motivations, the cooperative and competitive enterprise alliances will have different operating modes. Operating modes in enterprise alliances could differ in three mechanisms: sharing mechanisms, governing mechanisms, and rewarding mechanisms. Therefore, this part will analyze these types of mechanisms and their differences between cooperative and competitive enterprise alliances.

1) SHARING MECHANISMS

Cooperative enterprise alliances tend to be more open to sharing knowledge, information, money, and other resources (FIGURE 1). The collected data shows high proportions of sharing information, money, human resources, and relatively high proportions of other resources among all the cooperative enterprise alliances (FIGURE 2). In most cases, these enterprises alliances would be willing to share resources in open access through jointly built platforms as the primary aim of cooperative enterprise alliances is to help each other with their resources. Members of cooperative enterprise alliances should first set up the contracts and then access to the sharing platforms [59]. Therefore, this sharing mechanism could allow accurate transmission of information and knowledge and enable better circulation of digital and real resources like money or PPE. However, problems may still exist if members are forced to share or if they tend to conceal something important in the alliance.

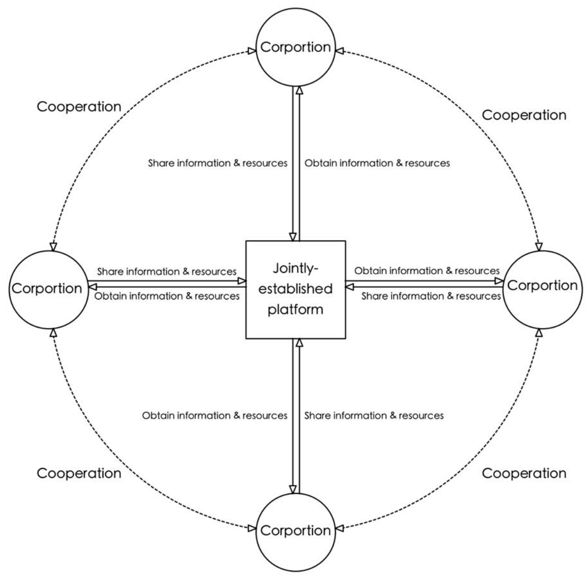

FIGURE 1. Sharing mechanisms of cooperative enterprise alliance.

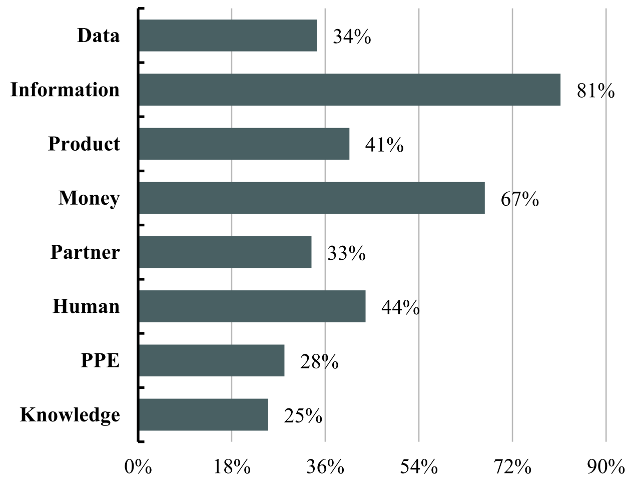

FIGURE 2. Statistics on the sharing resources in cooperative enterprise alliances.

In contrast, competitive enterprise alliances tend to be more cautious about sharing their resources (FIGURE 3). Members of competitive enterprise alliances would be willing to adopt the point-to-point sharing method [60]. This method would prevent essential resources from being utilized by competitors while improving their competitiveness in the alliances. The statistics on the sharing resources indicate that competitive enterprise alliances have lower proportions in the sharing of each resource than cooperative enterprise alliances (FIGURE 4). Moreover, they may intend to share resources with a certain price that is lower than the market to obtain extra profit through enterprise alliance. As a result,

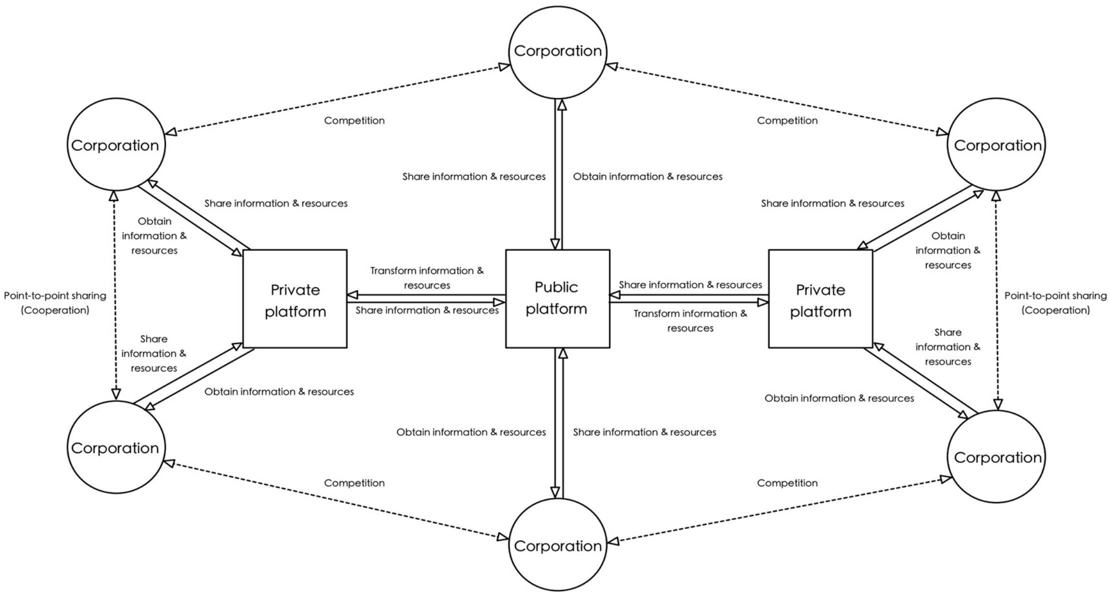

FIGURE 3. Sharing mechanisms of competitive enterprise alliances.

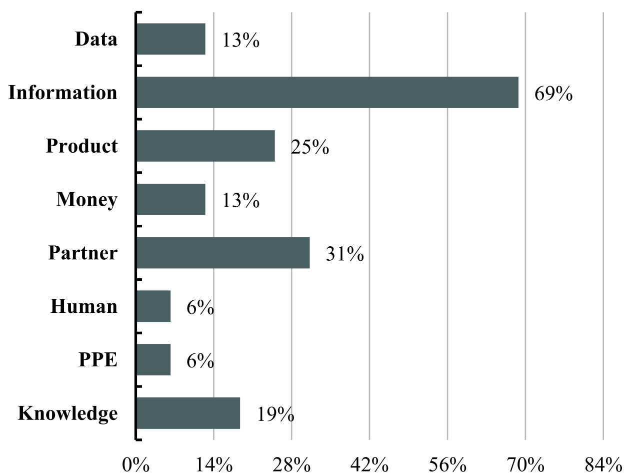

FIGURE 4. Statistics on the sharing resources in competitive enterprise alliances.

competitive enterprise alliances may have problems like asymmetry in information sharing and high costs in cooperation.

2) GOVERNING MECHANISMS

As for cooperative enterprise alliances, the governing mechanism would be 'collective governance', which DAO could realize. As alliance members may intend to maintain the alliance and create value together, they would be willing to make fair governing rules together through DAO [61]. The collected data also show that 66.67% of the cooperative enterprise alliances prefer collective governance (TABLE 4). Therefore, the primary goal of cooperative enterprise alliances would be to accelerate the processing efficiency of issues and information sharing so that they could ameliorate their overall operation efficiency. On the other hand, most corporations in cooperative enterprise alliances would require an automated platform to eliminate their worries about reward distribution and status in cooperation [62], [63]. Their practices would result in a more stable operation of the cooperative enterprise alliance, coinciding with the collected data from enterprise alliances.

TABLE 4. Comparison of governing mechanisms between cooperative and competitive enterprise alliances.

Type of governance[a]	Cooperative enterprise alliance		Competitive enterprise alliance	
	Proportion (%)	Stability[b]	Proportion (%)	Stability
Collective governance	66.67%	81.25%	12.50%	50.00%
Private cooperation (Small alliance)	8.33%	50.00%	31.25%	80.00%
Influence-based governance	25.00%	33.33%	56.25%	77.78%

Note:
a. Source of information: Cooperation frameworks; Agreements; Publicly disclosed information and news
b. Standard of stability: No significant changes in membership within 2 years; Positive profit margin within 2 years

3) REWARDING MECHANISMS

The establishment of rewarding mechanisms in the enterprise alliances should base on sharing mechanisms and governing mechanisms. Even though these two types of enterprise alliances share apparent differences in the above mechanisms, their rewarding mechanisms would be similar, which are determined by the members' contributions to the enterprise alliances. The rewards could be quantified by the time of cooperation, number of shared resources, amount of shared information [64], [65]. These quantified indexes construct a corporation's influence in the enterprise alliance and would be used to reward the corporation based on rules and standards made by alliance members.

The differences between cooperative and competitive corporate alliances lie in the relationship between rewards and contributions (TABLE 5). Cooperative enterprise alliances would be willing to accept an equal reward for every contribution made by members. Moreover, there would be extra rewards for outstanding contributions to encourage cooperation. This reward mechanism would result in relatively strong stimulative effects but ensures equal status and fewer competitions between alliance members [66]. In contrast, competitive enterprise alliances would determine their rewards with unequal standards. In this way, rewards would depend mostly on the value of their contributions. Corporations that have made contributions would desire extra rewards from other members that may benefit from these contributions [67]. As a result, corporations with low influence would have weak stimulative effects while those with great influence would have strong stimulative effects, resulting in fierce competition and unfair competitive advantages in enterprise alliances.

TABLE 5. Comparison of rewarding mechanisms between cooperative and competitive corporate alliances.

	Cooperative enterprise alliance	Competitive enterprise alliance
Rewarding mechanism	Equal reward for every contribution	Reward on the usefulness of their contributions
Rewards for outstanding contributions	Extra rewards	No extra reward (Due to rewarding mechanism)
Status of members	Equal	Unequal
Competitions within alliances	Few	Fierce
Stimulative effects	Relatively strong	Weak (low-influence members)/ Strong (high-influence members)

IV. DESIGN OF STIMULATIVE COORDINATION MODELS

Former sections of this article have already discussed about cooperative enterprise alliance and competitive enterprise regarding their participation motivations, operating modes and rewarding mechanisms. The aim is to explain the basis of designing suitable stimulative coordination models for enterprise alliances to improve their overall efficiency in collaboration. Therefore, this section will explain two types of designs of stimulative coordination models. The design of stimulative coordination models would also be based on the concept of token economy, using blockchain technology as the supporting technology of the whole model. As for each stimulative coordination model, there will be an explanation of its mechanism and critical processes.

A. MODEL DESIGN FOR COOPERATIVE ENTERPRISE ALLIANCES

The idea of designing the stimulative coordination model is 'open and fair sharing'. Cooperative enterprise alliances prefer public sharing as it would be easy to build consensus between members. Moreover, they would like to maximize their profits through this consortium blockchain. Hence, this model could encourage members to share resource openly and ensure the members could gain benefits fairly from the enterprise alliance. The stimulative coordination model for cooperative enterprise alliances is shown in FIGURE 5.

1) SHARING MECHANISMS

This stimulative coordination model enables rapid transmission of sharing requests between alliance members and access to required resources. To seek resource sharing, corporations can send information on required resources through corporation nodes to all the available nodes based on the link first communication tree algorithm (LFT). The LFT could reduce the communication time between corporations by transforming the communication pattern into a binary type [31]. The information will include the resource's type (data, information, product, money, etc.), corporate profile and rewards for sharing. Then, corporation nodes will send information to alliance nodes, which can broadcast information to the whole enterprise alliance. Every corporation node in the cooperative enterprise alliance has an equal status [68]. Corporations that attempt to share the required resources can filter the information using the collaborating filtering (CF) of the recommender system (RS), which allows corporations to filter based on their preferences and can rate some of the items [69]. Their responses will be sent back to the receiver, including a brief description of the owned resources, corporate profile and expected rewards. The receiver will finally decide whether to accept the provider's offer or not according to the information provided by the provider. Hence, a corporation will be able to send a request to many providers of the enterprise alliance at one time in this model, improving the efficiency of matching resources demand and supply.

Blockchain technology plays the role of encrypting and broadcasting information efficiently during this course. It can use Merkle, Hash and other cryptographic techniques in the data layer to encrypt the transmitted information in the blocks to protect the privacy of both providers and receivers [70]. Information can be broadcasted between alliance nodes and corporation nodes automatically based on the LFT, reducing the cumulative communication time significantly. The average communication time in this model is expressed as

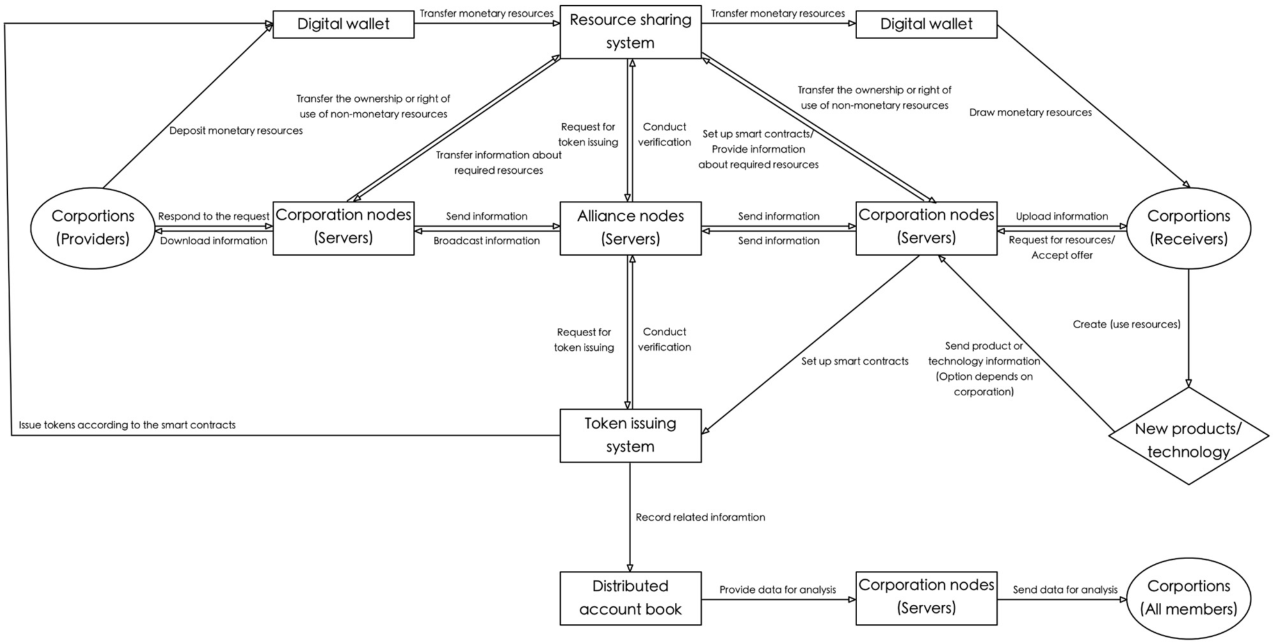

FIGURE 5. Stimulative coordination model for cooperative enterprise alliances.

$f_{ACO}(t)$, in which $f_{CA}(t)$ represents the communication time from corporation nodes to alliance nodes, $f_{AC}(t)$ represents the communication time from alliance nodes to corporation nodes, and N represents the number of possible communication routes:

$$f_{ACO}(t) = \frac{\sum_{i=1}^{N} [f_{CA}(t) + f_{AC}(t)]}{N}. \tag{1}$$

This mechanism provides members a large amount of information, thus allowing providers to filter the information to search for expected information. Moreover, it would be difficult for a corporation to gain unfair advantages in sending information as more than 51% of the nodes should be tampered with due to the distribution character of the blockchain [71]. Therefore, corporations could ensure the accuracy of the information and the fairness of requesting sharing in the cooperative enterprise alliance.

2) STANDARDIZED SETTING UP OF SMART CONTRACTS

Smart contracts are the core of the stimulative coordination model as they could accelerate the process of resource sharing while ensuring the interests of both provider and receiver. Smart contracts could be standardized as corporations in the cooperative enterprise alliances trust other members and are willing to accept equal rewards for every contribution. Corporations that intend to set up smart contracts need to provide the information of 'who is the provider?', 'who is the receiver', 'what kind of resource will be shared?', 'how long does it take to complete resource sharing?', 'how many tokens should be awarded?', 'what are the rules of sharing?' and 'what is the remedy if sharing being cancelled?'. Smart contracts should be set up in both the system of resource sharing and token issuing for the automatic operating purpose. As a result, small contracts could make the process less complex and time-wasting, thus improving the overall efficiency of sharing resources in the enterprise alliance. The example of a standardized smart contract is shown in Listing 1.

Smart contracts are formed by codes, aiming to realize automatic operation in the resource-sharing process. Besides, smart contracts are essential to the integration of decentralized resources, matching the supply and demand to meet the goal [72]. They would be difficult to tamper as every operation is recorded and encrypted automatically [73]. The implementation of smart contracts in the whole system is also automatic. It will execute when preconditions are met [1]. Hence, smart contracts could ensure the efficiency and fairness of resource sharing in the cooperative enterprise alliance.

In addition, smart contracts would be essential to forming the token economy as it correlates with token issuing. Although the token issuing system will ultimately determine the proportion of issued tokens, smart contracts will plan the distribution routes, including the total amount of tokens distributed and when the token will be distributed [75]. Under some circumstances, tokens will be issued several times instead of at one time as the resource sharing will last for a period. In this way, smart contracts would save the time of verification and diminish the possibilities of errors and delays [76]. Therefore, setting up standardized smart contracts would be beneficial for both providers and receivers in the cooperative enterprise alliance.

3) OPEN RESOURCE SHARING

The resource sharing process can be open in the cooperative enterprise alliance as members trust each other and competitions are uncommon to be seen between members.

```
<smart_contract tag_name ="resources_sharing" contract_id ="0001" changeable ="false" monetary = "false">
     <state> enabled </state>
    <parties>
        <beneficiary> Provider_1 (address_1) </beneficiary>
        <beneficiary> Provider_2 (address_2) </beneficiary>
        <obligor> Receiver (address_3) </obligor>
        <third_party> nil </third_party>
    </parties>
    <obligation_type>
        <member_obligation> to-do </member_obligation>
    </obligation_type>
    <precondition>
        act1 (signed) & resources (transferred)
    </precondition>
    <precondition>
        act2 (signed) & resources (transferred)
    </precondition>
    <performance_type>
        payment (address_1, address_2, share)
    </performance_type>
    <performance_object>
        token (share, amount)
    <performance_object>
    <rule_conditions>
        date (starting_date, ending_date)
    </rule_conditions>
    <remedy>
        cancellation_fee (amount, address_1, address_2)
    </remedy>
    </smart_contract>
```

LISTING 1. Example of a standardized smart contract.

In other words, there can be fewer limits and steps in completing the process of resource sharing. FIGURE 6 shows the sharing mechanism in cooperative enterprise alliances. As for sharing resources, there are two ordinary circumstances: monetary resource sharing and non-monetary resource sharing (data, information, product, partner, human, PPE, knowledge). Monetary resources will be shared through digital wallets and the resource sharing system. Providers need to deposit money into their digital wallets and transfer money into the resource sharing system. The system will automatically transfer the monetary resources to the digital wallet of receivers based on smart contracts and the transaction data will be stored in nodes [77]. On the other hand, non-monetary resource sharing requires providers first to upload the information of resources to corporation nodes. Then, corporation nodes will automatically communicate with the resource sharing system and send the information to the system to accomplish the sharing process.

4) AUTOMATIC TOKEN REWARDING

Token rewarding is the key to the sustainable operation of the stimulative coordination model, making it an essential part of the token economy. The token issuing system will operate based on the ‘Token Consensus Algorithm’ (TCA) and the content of smart contracts. The system can control the time of issuing and the number of issued tokens. The TCA is an efficient algorithm that can collect and process transaction data based on the consensus [10]. FIGURE 7 shows the logical diagram of the automatic token rewarding in this model. Before issuing tokens, a verification process will first be carried out to ensure that resource sharing has been accomplished. Then, the system will issue tokens to the addresses of the digital wallets of providers as rewards for resource sharing. As for those who are active in sharing resources in the enterprise alliance, bonuses will be given by the system automatically. Both the rewards and the bonuses will be determined by DAO so that members in the enterprise alliance may have a higher acceptance level of rewarding [78]. Tokens play an important role in the DAO of this model, which is based on two types of consensus mechanisms: Proof of work (PoW) and Proof of stake (PoS). PoW is to prove the number of resources a member has shared with others, while PoS is to witness the status of a member in voting [79]. Corporations can use tokens to earn future profits from the receiver’s new products and vote in DAO to formulate reward rules.

Automatic token rewarding is based on blockchain technology, ensuring safety and fairness, and enhancing the effects of stimulation. When the system issues tokens, relevant information will be automatically recorded in the distributed account book for further analysis. The token issuing system will also encrypt the private information that relates to resources and corporations to protect corporations’ privacy. Furthermore, the token issuing system will broadcast the number of tokens that have been issued to corporation nodes. This process would improve fairness as it may increase the difficulty of tampering [80]. Moreover, corporations would be encouraged to share their resources more actively to maintain their status if the number of tokens could be accessible. Therefore, this mechanism may stimulate corporations to be ready to share resources, thus making the development of enterprise alliances more sustainable.

5) SUPPORT FOR A CONTINUOUS AMELIORATION

Support for continuous amelioration should be of necessity owing to its importance in continuously improving operating efficiency and fairness. Distributed account books will send data for analysis to the corporation nodes regularly. This process will allow members of the cooperative enterprise alliance to analyze whether there are abnormal resource sharing or defects in the codes of smart contracts. The primary aim of this mechanism is to make continuous amelioration to match the actual environments and needs of enterprise alliances. Despite the model being designed using blockchain technology, there may still exist some defects that need to be improved [2]. In addition, this design is based on the token economy in that tokens would be utilized as an essential tool to stimulate coordination between corporations. In other words, it may be more complex than designing a simple

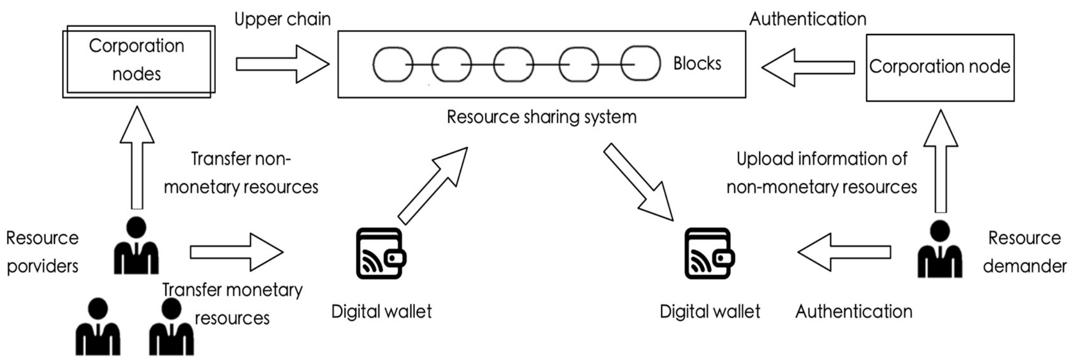

FIGURE 6. **The sharing mechanism in cooperative enterprise alliances.**

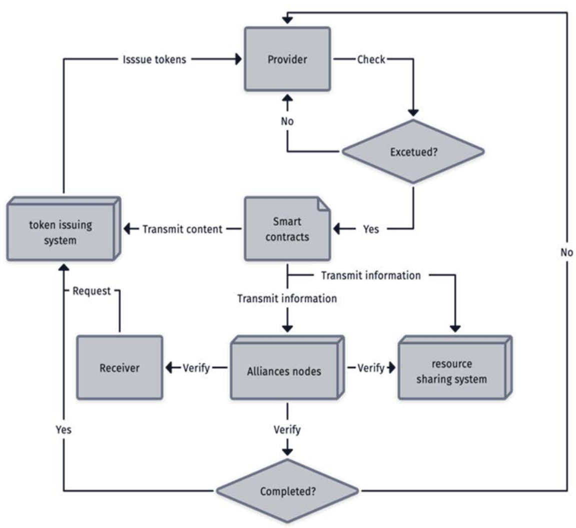

FIGURE 7. **Logical diagram of automatic token rewarding.**

blockchain-based platform [5]. Therefore, support for continuous amelioration would improve the stimulative coordination model's efficiency and make it more feasible and suitable in the real environment.

B. MODEL DESIGN FOR COMPETITIVE ENTERPRISE ALLIANCES

The idea of designing the stimulative coordination model is 'secure and efficient sharing'. Competitive enterprise alliances tend to share their resources privately to compete with others. The rewards for sharing would vary depending on the value of resources. Consequently, it would be difficult to maintain the enterprise while meeting every member's requirement. The design of this model, however, will focus on alleviating unfair advantages in the enterprise alliance and taking advantage of the token economy to encourage efficient resource sharing. The stimulative coordination model for competitive enterprise alliance is shown as follows (FIGURE 8).

1) POINT-TO-POINT RESOURCE SHARING REQUEST

This stimulative coordination model adopts the method of point-to-point resource sharing requests based on the trust first communication tree algorithm (TFT). The TFT considers the security and stability of communication, allowing corporations to choose their receivers [31]. Corporations, as the receiver, will be able to provide information on their requests through corporation nodes to their trusted alliance members. To select trusted members, a weighted-average method can be used to evaluate the trustworthiness of members [81]. In formula (2), $T_{i,j}$ represents the trust value of subject I for j, R_d is the direct trust value based on former transactions, R_r is the by subject I based on corporation profile, R_i is the risk value of sharing, and α, β, γ are different coefficients.

$$T_{i,j} = \alpha \cdot (\beta \cdot R_d + (1 - \beta) R_r) - \gamma R_i \tag{2}$$

If the trust value $T_{i,j}$ is high enough to be accepted, the receiver would choose that provider as the resource sharing object. The broadcasting and the responding processes are quite similar to these of the cooperative enterprise alliance. The information offered in the request will include the resource type, corporate profile, rewards for sharing and corporate options on broadcasting. However, the receiver usually wants to own more options in this process due to 'small alliances' in enterprise alliances. Therefore, this model also includes the establishment of private alliance nodes, aiming to facilitate peer-to-peer transmission [82]. In this way, the receiver can opt to send information to the corporation privately or send it to the alliance node for broadcasting purposes. In contrast, corporations that do not have any private alliance node will have no choice but to broadcast their requests through the alliance node. Equation (3), as shown at the bottom of the next page.

Point-to-point resource sharing request offers a higher level of security regarding corporate privacy, resources, and overall efficiency. Private alliance nodes could ensure the safe transmission of requests between corporations by verifying and broadcasting the request to every corporation node affiliated using the TFT [83]. The average communication time in this

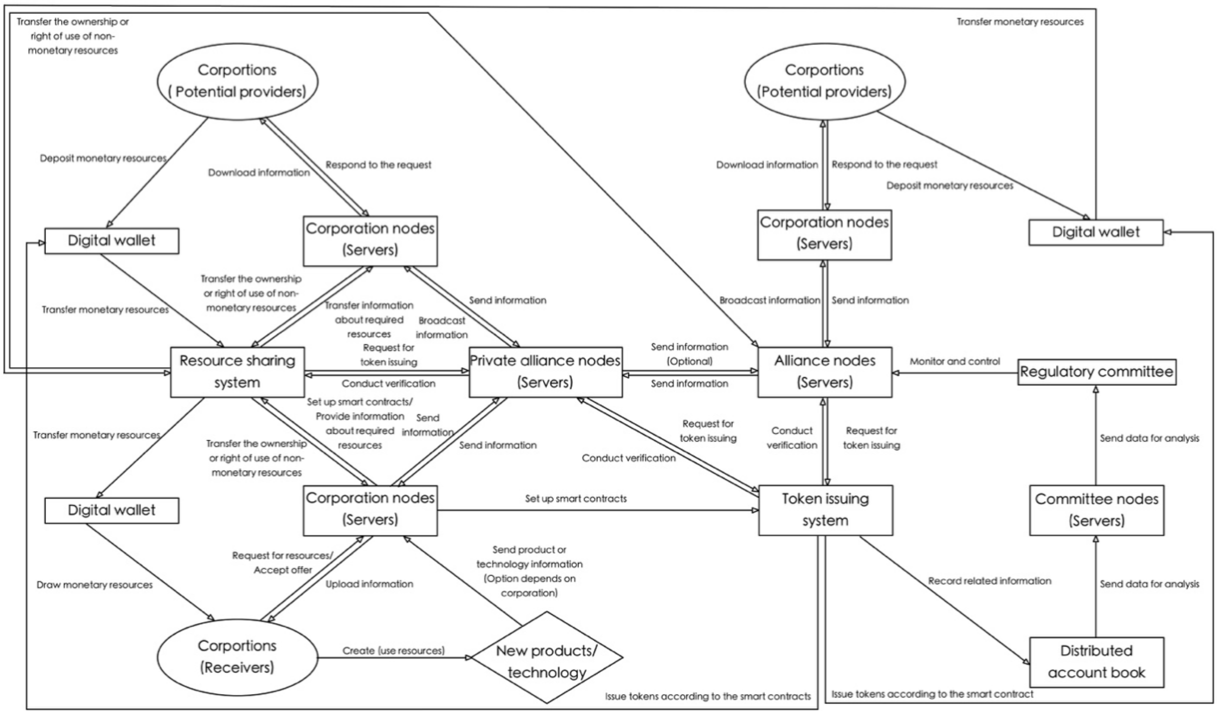

FIGURE 8. Stimulative coordination model for competitive enterprise alliances.

model is expressed as $f_{ACM}(t)$, in which $f_{AC}(t)$ and $f_{CA}(t)$ represent the communication time between alliance nodes and corporation nodes, $f_{CP}(t)$ represents the communication time from corporation nodes to private alliance nodes, $f_{PA}(t)$ represents the communication time from the communication time from private alliances nodes to alliance nodes, and N_P and N_{NP} represent the possible communication routes of corporations with and without private alliance nodes:

It is obvious that this type of transmission would take a longer time on average as corporations need to choose receivers until proper providers have been found. However, the TFT could be an optimal solution to the sustainability of the competitive enterprise alliance as it helps corporation maintain their competitiveness in the alliance [84]. Moreover, if members' initial sharing requests cannot be fulfilled, other corporations in the alliance will have opportunities to respond to sharing requests. In this way, corporations would have more opportunities of seeking required resources in a competitive environment. Although corporations out of small alliances may not use this way of transmission, they could utilize alliance nodes to seek potential providers, which may also be efficient.

2) DIVERSIFIED SETTING UP OF SMART CONTRACTS

The smart contracts in the competitive enterprise alliance will be diversified as corporations require unequal rewards and higher quality resources. Corporations, as receivers, should provide the information of 'who is the provider?', 'who is the receiver?', 'which type of resource will be shared?' and 'how long does it take to complete resource sharing?', 'how many tokens should be awarded?', 'what are the rules of sharing?' and 'what is the remedy if sharing is cancelled?'. Apart from the above information, they should specify the quality of resources such as the amount of money, the collecting time of information, the book and market value of assets, the potential value of patents, etc. to ensure the quality of resources. Therefore, it would take more time in setting up the smart contracts as the requirements are different from one to another, which may affect the overall efficiency of sharing [85]. Furthermore, if the standard is difficult to execute automatically, corporations should check required resources in advance to avoid unnecessary wasting of time in altering the content of smart contracts.

The setting up process is similar to that of the cooperative enterprise alliance, which is to set up smart contracts with

$$f_{ACM}(t) = \frac{\sum_{i=1}^{N_P}\left[f_{CP}(t) + f_{AC}(t) + f_{PA}(t)\right] + \sum_{i=1}^{N_{NP}}\left[f_{CA}(t) + f_{AC}(t)\right]}{N_P + N_{NP}} \quad (3)$$

```
<smart_contract tag_name ="resources_sharing" contract_id ="0001" changeable ="false" monetary = "false">
    <state> enabled </state>
   <parties>
       <beneficiary> Provider (address_1) </beneficiary>
       <obligor> Receiver (address_2) </obligor>
       <third_party> nil </third_party>
   </parties>
   <obligation_type>
       <legal_obligation> to-do </legal_obligation>
   </obligation_type>
   <precondition>
       act_1 (signed) & resources (transferred)
   </precondition>
   <precondition>
       act_2 (signed) & resources (transferred)
   </precondition>
   <performance_type>
       payment (address_1, share)
   </performance_type>
   <performance_object>
       token (share, amount)
   <performance_object>
   <rule_conditions>
       date (starting_date, ending_date)
       money_amount (above_amount)
       patent_value (above_amount)
       …
       information_collection (before_time)
   </rule_conditions>
   <bonus_rules>

       money_amount (above_amount) & resources (transferred)
       patent_value (above_amount) & resources (transferred)
       …
       information_collection (before_time) & resources (transferred)
   </bonus_rules>
   <bonus_payment>
       token (amount, address_1)
   </bonus_payment>
   <remedy>
       cancellation_fee (amount, address_1, address_2)
   </remedy>
   </smart_contract>
```

LISTING 2. Example of a diversified smart contract.

the resource sharing system and the token issuing system. An example of a diversified smart contract is shown in Listing 2.

The structure of Listing 2 is similar to that of Listing 1, except it has extra content in rule conditions, bonus rules and bonus payment. The use of blockchain technology in setting up smart contracts would be particularly important. As smart contracts become more diversified, encrypting key information would be necessary to protect privacy and fair competition [76]. Moreover, smart contracts could enable the automatic operation of resource sharing and token issuing, ensuring fairness in competitive enterprise alliances. However, diversified smart contracts may become a challenge for automatic operation as it would increase the possibility of errors [75]. Hence, the costs of realizing the stimulative coordination model would also be higher than that of the cooperative enterprise alliance.

3) PRIVATE RESOURCE SHARING

Private resource sharing will be the coordination trend in the competitive enterprise alliance. After setting up the smart contracts, corporations will be able to share their resources through the resource sharing system. The types of resource that will be shared would be quite similar to that of the cooperative enterprise alliance. The method of sharing is also quite similar, except the resource sharing will be limited to point-to-point sharing (FIGURE 9). In this way, the receiver would obtain the required resources in a shorter time and safer way, ensuring the corporate competitive advantages in the alliance. However, this mechanism may become a challenge for monitoring the unfair resource sharing in the enterprise alliance as 'giant enterprise' may charge higher prices for resource sharing in competitive enterprise alliances [86].

Private resource sharing would be necessary for stimulating coordination between corporations in the enterprise alliance. The use of blockchain technology could preserve the private information of both provider and receiver effectively. Their digital wallets' addresses and profiles will be encrypted through Merkle and Hash to ensure safety [70]. The resources will also be encrypted through cryptography to prevent disclosure and tampering. Consequently, the resource sharing would take a shorter time to accomplish due to point-to-point transmission. Moreover, private resource sharing would be welcomed by corporations in the circumstance of fierce competition, sustaining the development of competitive enterprise alliances.

4) SEMI-AUTOMATIC TOKEN REWARDING

Semi-automatic token rewarding can be more suitable than automatic token rewarding for the competitive enterprise alliance. As mentioned before, smart contracts will be diversified due to corporate requirements of unequal rewards. This process will require a fair judgement of shared resources' quality while the resource sharing system cannot perform well. Hence, a regulatory committee will be required to evaluate the quality of shared information to determine the amount of token reward. Normally, rewards will correlate with the difficulty of providing the required resources. Resources that are huge in amount and are valuable would require more tokens as rewards. Hence, the resource sharing system will determine the quality of required resources according to the smart contracts and the resources transmitted to the system. If the system cannot decide by itself, the regulatory committee will aid it in determining the quality of resources. The results will be transferred into codes, which can regularly

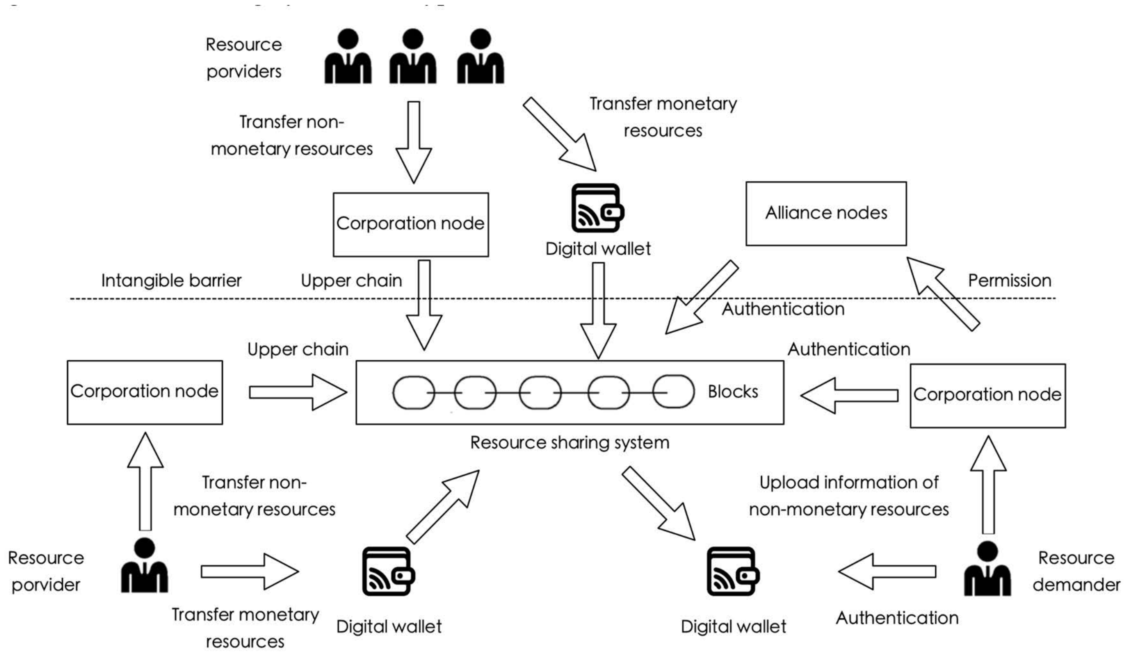

FIGURE 9. **The sharing mechanism in competitive enterprise alliances.**

update the resource sharing system. The logical diagram of semi-automatic token rewarding is shown in FIGURE 10.

Semi-automatic token rewarding provides a feasible solution to alliance maintenance and coordination stimulation. With the use of diversified smart contracts, it is likely to meet the requirements of members of the enterprise alliance. The rewards of sharing resources will be determined by the system or the regulatory committee, thus making it acceptable for alliance members. The continuous updates in the resource sharing system would enable the system to deal with more conditions automatically and accurately.

Moreover, as representatives from each alliance member form the regulatory committee, it could ensure procedural fairness and decrease unfair competitions in the alliances, thus improving the satisfactory level of members [87]. Additionally, rewards depending on the quality of shared resources would be stimulative for most members in the competitive enterprise alliance [88].

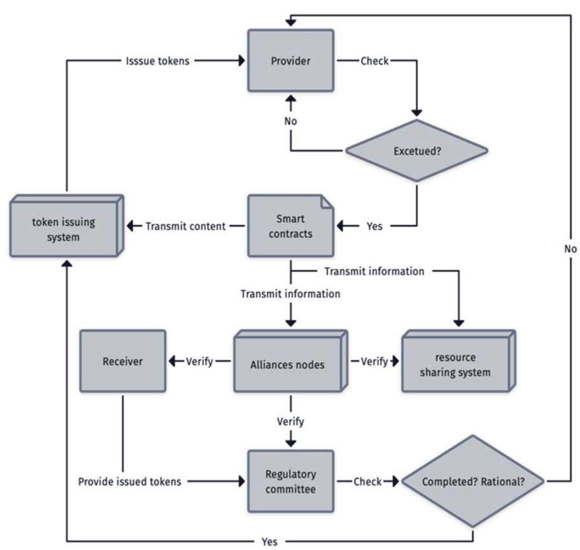

FIGURE 10. **Logical diagram of semi-automatic token rewarding.**

5) REGULATORY SUPPORT

The regulatory committee can provide support for determining token rewards and dealing with the problems in the alliance. As mentioned before, the regulatory committee is formed by the representatives of every corps to ensure procedural fairness. It can monitor the daily operation of the whole system and determine the quality of shared resources in case of need. Hence, it may solve the problem of giant enterprises charging higher prices for resource sharing.

Another function of the regulatory committee is to cope with the issues met by the member. The regulatory committee can deal with problems concerning token rewards, unfair competitions and tampering and report to the alliance members if necessary. The interference of the regulatory committee should follow the inference rules to ensure timely and necessary support for members. An example of an inference rule dealing with the token issuing problem is as follows:

IF smart contract has been executed

AND tokens have not been issued

AND resource sharing system has verified the resource sharing

AND the receiver OR the provider has requested for support

OR the token issuing system reports the inability to identify the content of smart contracts

THEN the regulatory committee provide support

Therefore, the regulatory committee could improve the satisfactory level of members and the efficiency of daily operation of competitive enterprise alliances. On the other hand, the regulatory committee will monitor the operation of DAO. When members make rules and standards in DAO, the regulatory committee will monitor its operation to ensure its efficiency. Hence, the regulatory committee would be of necessity to sustain the operation of the stimulative coordination model in competitive enterprise alliances.

V. DISCUSSION ON THE ROLE OF TOKEN ECONOMY

Token economy has been regarded as the driving force in the efficient operation of the stimulative coordination model. With the help of token economy, coordination in the enterprise alliances would be reinforced to become more sustainable and active, creating value for both the alliance and the alliance members. In this section, the role of token economy in the stimulative coordination model will be discussed in terms of three aspects.

A. THE VALUE OF TOKENS

The value of tokens lies in their functions in the stimulative coordination model. There are three functions: 1. obtaining future resources, 2. exchanging for monetary resources and 3. making rules in DAO.

The first function of tokens focuses on realizing value co-creation in the enterprise alliances. Corporations that share resources with others would gain tokens as Proof of work (Pow) and Proof of stake (Pos) in return. When receivers realize the idea of products and earn profits from them, tokens could be used as a guarantee for allocating the potential profits. This method would allow corporations to obtain monetary resources and patents from new products. However, the distribution proportions would depend on the number of shared resources and the time of holding the tokens to encourage active resource sharing [89]. Xu and Yu [63] proposed that the value of tokens would depend mainly on the future benefits they could bring to the corporations. Therefore, this function would be the basis of the value of tokens.

The second function of tokens is to provide corporations with alternatives when facing the problem of liquidity. Normally, corporations could transform tokens into monetary resources through digital wallets. If the corporation intends to obtain benefits earlier, they could opt to exchange their tokens with others. The exchange process could be accomplished through digital wallets of corporations over the counter, requiring two corporations to reach an agreement in advance [90]. This function would provide corporations with flexible options in terms of resources sharing, thus increasing enterprise alliance attractiveness. Notwithstanding the risks of insider trading may increase, the value of this function would be of significance to the token economy.

Moreover, tokens could be used to make rules in DAO and may influence the operation of the stimulative coordination model. As tokens could be the proof of contribution to the enterprise alliance, those who own tokens would have the right to vote in the enterprise alliance to establish rules. The changeable rules would include the standard of rewards, the requirements of sharing resources, the functions of tokens, etc. This function aims to protect the rights of SMEs in the alliance and stimulate corporations to share resources. Hence, the function of establishing rules in DAO would be an essential part of token value.

B. IMPROVEMENT OF CORPORATE INNOVATION CAPABILITY

The token economy may have the potential to improve the innovation capability of corporations as it encourages cooperation and increases liquidity. As mentioned before, tokens could be used to award corporations that share resources in the enterprise alliance. In a study of several profitable projects, it is said that tokens could become effective incentives for investors and entrepreneurs [91]. In this way, tokens would reinforce the connections between different corporations in that they would coordinate with others by sharing resources to have token rewards. Xie and Tu [92] propose that solid connections between corporations would lead to the construction of collaborative innovation networks, which guarantees the realization of collaborative innovation. Therefore, the innovation capability of corporations would correlate with the use of tokens as rewards for coordination. On the other hand, Chen [93] has proved that tokens may have great potential to reshape the forms of entrepreneurship and innovation. Tokens, however, could become the substitute for money, which may increase the liquidity of corporations in return. As a result, corporations may have more monetary resources to invest in the innovation of technology and products, enhancing their innovation capability.

Another point is that corporations utilizing tokens in operation would do better in digitalization, thus leading to better innovation capability. Zhao *et al.* [94]supposed that the token economy would become a new form of the digital economy. The utilization of tokens could accelerate the transformation of digital financial assets [95] and facilitate the innovation of supply chain transactions [96]. Hence, the application of the token economy could improve the level of corporate digitalization. Moreover, the study from Simatupang and Widjaja [97] verifies that success rate factors, innovation investment return, and innovation sustainability have positive relationships with corporate digitalization. Therefore, the token economy would be the key to the amelioration of corporate innovation capability.

C. PROMOTION OF ENTERPRISE ALLIANCES' SUSTAINABLE DEVELOPMENT

The token economy could promote the sustainable development of enterprise alliances as it enables collaborative value creation between members. FIGURE 11 shows how

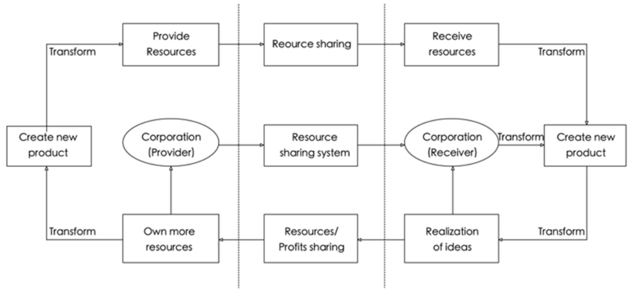

FIGURE 11. Logical diagram of collaborative value creation.

corporations create value collaboratively through sharing resources. In the stimulative coordination model, corporations that receive resources from others could create new products to realize their ideas and generate profits. Meanwhile, corporations that receive tokens for sharing could obtain future profits and products or patents in return. Then, they would be able to create value by utilizing these new resources to create new products and transform them into new resources. New resources would be added into the resource sharing system, and receivers would be able to transform resources into new products again. The advantages of using tokens are that receivers could have more free resources to create new products while the future profits of providers could be guaranteed. The whole process is based on token economy and could realize collaborative value creation, promoting the sustainable development of enterprise alliances.

Furthermore, the method of collaborative value creation would enhance the attractiveness of enterprise alliances. To develop sustainably, enterprise alliances should keep themselves attractive to attract new members for more resources. Suh [98] found that inter-firm cooperation and experienced cooperation would positively affect the attractiveness of enterprise alliances as the success rate of producing new products would increase. As for SMEs, the access to various resources would be attractive as realizing ideas of new products could bring huge benefits and technological advantages to corporations [99]. The use of tokens, however, would be able to facilitate inter-firm cooperation on resources sharing, making collaborative value creation becomes easier. As a result, enterprise alliances would become more competitive and sustainable by engaging more corporations in the alliances.

VI. CONCLUSION

In this paper, we have conducted a comparative analysis of cooperative and competitive enterprise alliances firstly. The analysis has shown that corporations in cooperative enterprise alliances may tend to have panic passive motivation, forced passive motivation and opportunism motivation. They hold relatively negative attitudes towards changes and enterprise alliances even though they have advantages in monetary and technical aspects. On the contrary, corporations in competitive enterprise alliances may have opportunism motivation, progressive active motivation, innovative active motivation. They hold relatively positive attitudes towards changes and enterprise alliances and intend to gain advantages through enterprise alliances. As for sharing mechanism, cooperative enterprise alliances may adopt open sharing while competitive enterprise alliances may utilize point-to-point private sharing. Moreover, the governing mechanisms would be 'collective governance' for cooperative enterprise alliances and 'influence-based governance' for competitive enterprise alliances. In addition, cooperative enterprise alliances may expect equal rewards, while competitive enterprise alliances may desire rewards based on the usefulness of contributions.

The main contribution of this paper is the design of stimulative coordination models using the blockchain technology. Stimulative coordination models have considered the differences of cooperative and competitive enterprise alliances and have utilized token economy as the designing basis. The idea for designing the stimulative coordination model for cooperative enterprise alliances is 'open and fair sharing'. It contains one-to-many resource sharing requests, standardized setting up of smart contracts, open resource sharing, automatic token issuing, and support for continuous amelioration. In contrast, the stimulative coordination model for competitive enterprise alliances uses 'secure and efficient sharing'. It entails point-to-point resource sharing request, diversified setting up of smart contracts, private resource sharing, semi-automatic token rewarding, and regulatory support. On the other hand, the blockchain technology plays an essential role in realizing the stimulative coordination models. It could ensure the accuracy of shared resources and the privacy of corporations and enable continuous amelioration of models through DAO. In addition, blockchain could facilitate token issuing and guarantee the future benefits of token receivers through smart contracts.

This paper has also discussed the role of token economy in detail as it correlates with the sustainable development of corporations and enterprise alliances. The discussion includes three parts: the value of tokens, improvement of corporate innovation capability, and promotion of enterprise alliances' sustainable development. Firstly, the value of tokens is manifested by their functions in the stimulative coordination models, including obtaining future resources, exchanging monetary resources, and making rules in DAO. Then, the analysis supports the functions of token economy in helping corporations improve their innovation capabilities as it could facilitate the digitalization of corporate operations. Additionally, the token economy could promote the sustainable development of enterprise alliances as it could facilitate collaborative value creation.

The design of stimulative coordination models for cooperative and competitive enterprise alliances contributes to the efficient coordination in enterprise alliances. The combination of management, blockchain and token economy is innovative. However, the model design does not consider the characteristics of different industries. Moreover, its actual impacts may be difficult to evaluate due to the lack of data and policies. Therefore, the future research will focus on two main aspects. Firstly, we will further explore different stimulative coordination models for different industries by analyzing the operating environment and characteristics of industries. Then, we will conduct experiments in enterprise alliances to evaluate the actual stimulative effects of models and make improvements to them.

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