mathematics

Article

Selecting the Fintech Strategy for Supply Chain Finance: A Hybrid Decision Approach for Banks

Yu-Cheng Kao [1], Kao-Yi Shen [2,*], San-Ting Lee [3] and Joseph C. P. Shieh [4]

1 Graduate Institute of Management, National Taiwan University of Science and Technology, Taipei 106, Taiwan; d10216005@mail.ntust.edu.tw
2 Department of Banking & Finance, Chinese Culture University, Taipei 111, Taiwan
3 Department of International Business Administration, Chinese Culture University, Taipei 111, Taiwan; chrise235928@gmail.com
4 Graduate Institute of Finance, National Taiwan University of Science and Technology, Taipei 106, Taiwan; jshieh@mail.ntust.edu.tw
* Correspondence: kyshen@sce.pccu.edu.tw; Tel.: +886-2-2700-5858

Abstract: Many banks are eager to adopt technology solutions to enhance operational efficiency in managing supply chain finance, which involves various participants and complex financial activities. Previous research either focuses on the technology aspect or the optimization of a supply chain; there is little specific guidance on how banks can form a holistic model to evaluate their Fintech strategy for supply chain finance. By using an integrated approach, this study adopted the decision- making trial and evaluation laboratory (DEMATEL) and several analytical methods to construct a hybrid decision model for banks. We concluded four plausible Fintech strategies from previous research and highlighted the advantages of the blockchain-based strategy. We used a domestic bank in Taiwan as a case study during the evaluation phase and implemented crisp and confidence-based fuzzy assessments. The result indicates that the blockchain-based leading strategy would be ideal for this bank. The hybrid decision model also unveils the complicated relationships among those evaluation factors, which sheds light on banks pursuing their innovation in financial services. The findings contribute to banks developing their Fintech-based supply chain financing business, and the supply chain participants may also benefit from securing efficient loans to expedite their operations.

Keywords: supply chain finance; banking; blockchain; Fintech; hybrid multiple criteria decision-making; fuzzy set theory

MSC: 90B50

Citation: Kao, Y.-C.; Shen, K.-Y.; Lee, S.-T.; Shieh, J.C.P. Selecting the Fintech Strategy for Supply Chain Finance: A Hybrid Decision Approach for Banks. *Mathematics* **2022**, *10*, 2393. https://doi.org/10.3390/math10142393

Academic Editor: Gia Sirbiladze

Received: 6 June 2022
Accepted: 6 July 2022
Published: 7 July 2022

1. Introduction

Since early 2020, there has been a rising interest in resolving global supply chain issues during the pandemic, which have caused surging prices and unstable deliveries [1]. Among those issues, supply chain finance (SCF) might be the deciding factor for SMEs (small and medium-sized enterprises) to survive [2]. Compared with giant corporates, many SMEs are vulnerable in securing operation loans, owing to the rising concerns of bad debts or transaction frauds from the banks' perspective. However, the banks' credit crunch might deteriorate the capability of SMEs to fulfill their commitments—even with orders in their hands. As a result, to smooth the operations of global supply chains and alleviate worries about economic growth, SCF for SMEs is a substantial and prosperous business for banks.

Though the potential of SCF is foreseeable, the conventional approach (e.g., letter of credit, LC) in handling SCF is insufficient to deal with information asymmetry between supply chain members and banks promptly [3]. Therefore, embracing advantageous information technology (IT) techniques could be a plausible strategy to facilitate the business developments of SCF for banks. Broadly speaking, the adoption of IT solutions to improve or strengthen financial services could be regarded as a Fintech strategy [4]. Until recently, various technologies, such as cloud computing, artificial intelligence, machine learning, and blockchain technique, have all been adopted by either technology (e.g., Amazon [5] and Alibaba [6]) or financial companies (e.g., JP Morgan [7]) in finance.

The adoption of Fintech solutions seems imperative in a highly competitive environment; however, considering the variety of IT techniques, banks still have to gauge their plausible pros and cons in multiple aspects—to select their Fintech strategy. Unlike the primary banking services (e.g., mortgages or credit loans), SCF is much more complicated, owing to its business nature. Based on previous research [3,8,9] and our discussions with domain experts, SCF has to deal with various supply chain members and cross-border transactions, and three critical factors deserve close attention: (1) information asymmetry, (2) processing time, and (3) coordination among members [2,3] .

As mentioned earlier, SMEs are relatively vulnerable to securing loans. Not only because SMEs lack public financial information and high-quality guarantees but also hard-to-audit transactions and longer account receivables [6] . However, they are indispensable to the competitiveness of a supply chain. The issues mentioned above have caused information asymmetry between SMEs and banks, and the associated due diligence requires a higher time cost. Those two factors are the bottlenecks for banks to resolve in SCF. Besides, the operations of a supply chain require highly integrated cooperation among its members, but those interactions involve sensitive business information and heterogeneous protocols [9]. While selecting a Fintech strategy, banks have to ensure coherent operations among the supply chain members and prevent information leaks, highlighting the importance of coordination under information security.

The three mentioned factors are essential to the success of SCF for banks. And since the operations of SCF are grounded on the collaboration among interorganizational systems (IOS), previous studies take a different perspective on categorizing SCF systems. On one side, Zhu et al. [10] divided the IT systems of SCF into three categories: (1) proprietary system, (2) partially open system (e.g., electronic data interchange, EDI), and (3) open system. On the other side, Steinfield et al. [11] emphasized the information transparency among SCF members and categorized the IT platforms of SCF as (1) point-to-point, (2) private coordination hubs, and (3) shared coordination hubs. Based on the two studies' conceptual frameworks [12,13], we refer to the global developments in this field and identify four plausible Fintech strategies for banks, summarized in Table 1.

Table 1. SCF system categorization and four Fintech strategies.

	Proprietary System	**Partially Open System**	**Open System**	
			Pure-Internet	**Blockchain**
Point-to-Point	LC	EDI	X	X
Private coordination hub	X	X	(a) Internet-based private coordination hub (IPCH)	X
Shared coordination hub	X	X	(b) Internet-based shared coordination hub (ISCH)	(c) Blockchain-based leading operator (BCL) (d) Blockchain-based participant (BCP)

The four SCF Fintech strategies, form (a) to (d), all can incorporate AI techniques to facilitate their operational efficiency.

Table 1 categorizes LC and EDI as the point-to-point approach, which might be insufficient to resolve the three critical factors. To leverage the benefits of Fintech solutions, the bottom layer—either pure-internet or blockchain-based one—should be superior considering the differences among supply chain members. The open system approach may offer higher flexibility and compatibility for banks and SMEs. Since SCF requires the participation of core companies (giant corporates) and numerous SMEs, those SMEs might not be willing to invest enormous IT resources in a proprietary IOS for a single supply chain (most SMEs might be involved in multiple supply chains). Therefore, the following analysis focused on the four (i.e., from (a) to (d)) Fintech strategies that belong to the open system approach.

Unlike the EDI, the prevalence of the internet contributed to the booming of online supply chain management systems (SCMS) in early 2000, either hosted by a core (dominant) company or a third-party software service provider [12,13]. Those SCMS providers are deemed private hubs, and we term it the "Internet-based private coordination hub (IPCH)" strategy. Those SCMS aim to simplify transaction procedures and use open standards to leverage the expansion flexibility for supply chain members. Under this strategy, banks mainly choose to join a private hub to offer SCF service. The required IT investment and resources are relatively small.

The second strategy requires more IT investment. The wave of adopting big data or AI techniques has enabled more key supply chain participants to optimize their operations since 2010. In other words, an SCF IOS is devised to interact with diverse vital players, such as shipping companies (e.g., UPS [14] and DHL [15]), tech giants (e.g., Amazon and Alibaba), and banks, to jointly run a coordinated hub. We term it the "Internet-based shared coordination hub (ISCH)" strategy, excluding blockchain technology. The shared hub strategy enables buyers and suppliers to improve their working capital by extending accounts payable and expediting payments. Banks may play an influential role in optimizing their integration with SCF members and serving as hubs. This strategy requires more IT resources to optimize its existing systems and evolves to a higher level of automation in handling transactions.

Among the open system approach, the impact brought by the blockchain technique has transformed centralized financial services into decentralized ones [16]. According to a previous study, a blockchain-based system has the benefits of creating "trust" among multiple business participants [17], which is essential to the success of SCF. Its encrypted transaction data may be synchronized on all nodes, where only authorized players may access and decode sensitive business information. Moreover, the blockchain's automation process supported by "smart contracts [3]" may speed up the procedures and lower the operating costs. Those advantages position the blockchain-based SCMS as an appealing solution for SCF.

Therefore, the third and fourth strategies are both based on the blockchain technique [18]; the former (i.e., blockchain-based leading operator (BCL)) has to devise and maintain a blockchain-based supply chain ecosystem, and the latter (i.e., the blockchain-based participant (BCP)) merely joins an existing blockchain SCMS and maintains a node. Though the blockchain technique also uses the internet to connect and deliver information, it has unique characteristics that make it distinguishable to serve as a trustworthy bottom-layer solution. Giant banks, such as JP Morgan [7], made significant progress. The following section discusses adopting the blockchain-based technique for SCF.

The previous discussions show that the four plausible Fintech strategies are different in their resource requirements and the associated benefits. A bank would have to consider multiple aspects to choose a suitable path to fulfill its goal. Considering the complexity in making such a decision and the differences between banks, we proposed a hybrid multiple criteria decision-making (HMCDM) approach [19] to explore this problem. Since choosing a strategy needs to clarify the interrelationship among the critical factors (criteria), we adopted the decision-making trial and evaluation laboratory (DEMATEL) [20] to meet this aim. In addition, the DEMATEL extended DANP (DEMATEL-based analytic network process) [21,22] would support the identification of the relative influence of each factor while choosing an SCF Fintech strategy. Finally, we used a Taiwan-based domestic bank as a case study, which considers the domestic bank's resource constraints, to illustrate the proposed HMCDM approach.

The purpose and plausible contributions of this study are as follows: (1) clarify the interrelationship among the factors that would decide a bank's Fintech strategy for SCF, (2) identify the relative influence of each factor from banks' perspective, and (3) invite domain experts to apply the proposed HMCDM model for a domestic bank in Taiwan as a case study. Since SCF has attracted growing attention during this pandemic, grabbing this business opportunity would be an essential and practical topic for banks to address. Additionally, this study could be regarded as an empirical case in the field of Fintech.

The remaining sections are as follows: Section 2 introduces the current developments of SCF in a business environment. Moreover, it discusses the background and benefits of the blockchain technique to serve an SCF system. Section 3 explains the proposed HMCDM approach, including the DEMATEL, DANP, and confidence-based fuzzy evaluations. Section 4 uses a domestic bank in Taiwan as a case study. Section 5 discusses the results with a sensitivity analysis, and Section 6 concludes this work.

2. Literature Review and Recent Developments

In business practice [23], the primary purpose of SCF is to optimize the operating capital in logistics, supply chain management, distribution, and sales. The technology providers connect all participants to improve account reconciliation, exchange purchase orders, invoices, credit bills, payments, and relevant operating information.

In the academic field [24], the study of SCF may be divided into finance and supply chain management. The SCF financial research mainly puts forward solutions to dispose of accounts payable and accounts receivable, while the study of supply chain management aims to optimize the operating capital efficiency. This section manages to cover both the recent developments. Since blockchain technology has been widely embraced by the financial sector recently, the following Section 2.1 discusses its potential to serve as an SCF platform. Section 2.2 takes a holistic view to categorize several aspects of banks while evaluating an SCF Fintech strategy.

2.1. Blockchain Technique as a Financial Service Platform

Blockchain is one of the most influential Fintech technologies. It may assist in promoting the security and service level in the supply chain, reduce maintenance costs, and ensure the authenticity of the information, which has attracted growing attention in the financial sector. The smart contract [25] of blockchain technology may match and verify the transaction data from approval to payment and automatically trigger relevant transactions. The blockchain technology architecture [26] provides a safe, irreversible, and transparent storage method for the supply chain data, whose database is distributed and termed decentralization. Its benefits in devising an SCF platform are apparent. However, despite many advantages, the development of blockchain-based SCF is still in the early stage [27,28]. Hofmann [29] identified several main obstacles to the blockchain-based SCF, such as compliance requirements and the need to generate safe transaction records. Therefore, though blockchain technology would be an appealing candidate, banks still need in-depth analyses to evaluate its attractiveness as an SCF platform.

2.2. Key Aspects for Selecting the Fintech Strategy for Supply Chain Finance

The main objective of SCF is to optimize the capital flow among business processes through solutions provided by financial institutions, technology providers, and other participants. Banks reply on adopting innovative Fintech techniques to meet this goal. However, due to the strict financial supervision of financial institutions, Legal Compliance is inevitable for banks to consider. The other critical aspects include technology, organization, operation management, and finance [4,30,31]. The following sections briefly probe into these four aspects.

2.2.1. Legal Compliance

Due to various Fintech innovations, consumers may enjoy more convenient financial services at lower costs [32,33]. However, without adequate supervision, Fintech innovations might also destroy financial systems and cause severe economic downturns, negatively impacting society [34].

In the practice of international financial supervision, some international supervision institutions, such as the Financial Stability Board (FSB), European Central Bank (ECB), and European Commission (EC), have paid great attention to the risks of Fintech innovation and put forward a series of relevant policies and regulations to balance and control those risks [35]. Therefore, while selecting a Fintech strategy for SCF, banks have to take financial regulations and international laws into essential consideration. Until recently, several mechanisms have been adopted to ensure compliance with innovative financial services that require stringent financial supervision. For instance, the supervision sandbox and regulatory technology (RegTech) fostered specific Fintech innovations.

Although the financial authority policy may maintain a stable and prosperous financial market, it may also cause a major obstacle for banks or Fintech start-ups to adopt new technologies [36]. The financial authority should flexibly regulate and properly relax the licensing restrictions so as to promote mutual growth [37]. For instance, if the authority may declare its industrial policy for blockchain technology [38] and provide clear guidance, it would increase the willingness of financial institutions to adopt or devise blockchain-based ecosystems. As mentioned earlier, blockchain-based systems are decentralized databases that might distribute their data outside a country. To some authorities, this might be prohibited under its domestic regulations. Therefore, clear policy guidance may help banks clarify the requirements to implement such a cross-border platform.

2.2.2. Organization and Operation Management

While facing market competition, businesses mainly have three options: reduce costs, improve efficiency, and increase the value of products (services). Adopting new technology solutions gives the chance to obtain the aforementioned options [39]. In the case of building an SCF platform, banks need to observe their competitors' movements before making decisions. Some banks incline to be conservative, and others attempt to seize the business opportunity and become market leaders. Aggressive banks may enjoy the first-mover advantage, but they also have to endure uncertainty and additional risks. Thus, a bank needs to consider its competitors' movement and risk-tolerance preference to select an SCF Fintech strategy.

Support from the top management of banks is crucial to adopting new technologies. Several studies highlight its critical importance in diverse industries [40–43]. Our interviews with domain experts found that high-level management support often influences banks to consider new technologies. Especially for the blockchain-based SCF strategy, without the top management support, the budget, personnel training, and R&D investment will be subject to many resistances and constraints.

While selecting an SCF Fintech strategy, banks want to keep their current customers and look for new business opportunities. Take the blockchain-based platform, for instance; it may construct a new ecosystem for its participants. The blockchain technology market report [44] released by Statista in October 2021 pointed out that the global blockchain market will grow exponentially in government, health care, banking, insurance, payment, and others. It is estimated that the market size will reach USD 162.84 billion by 2027. In other words, banks may build an SCF platform and extend it to more businesses once they can identify suitable partners and business models [45]. Compared with centralized solutions, decentralized blockchain platforms may build trust among participants, a critical factor in the boom of new businesses.

2.2.3. Technology

Along with the broader application of Fintech, the threats have become higher for the banks to face hacker attacks and data damage [46]. Several recent reports revealed that the losses from hackers ranged from USD 100 to 600 million in a single incident [47–49]. Thus, internet security might be the most crucial factor to consider in technology. An SCF platform hosted by banks should provide reliable data storage and traceable transaction records and be immune to hackers' attacks. Moreover, it needs to protect sensitive transaction data among the SCF participants and prevent information leaks [2]. Since an ISO platform requires intensive collaboration among its participants, how to secure the whole system's security would be a challenging task. Compared with conventional pure-internet-based architecture, the blockchain-based one should be more reliable, given its decentralized and synchronized network structure.

In recent years, along with the continuous development of Fintech applications, various innovative scenarios have become more feasible in the financial field. However, due to the complexity of integrating new platforms, banks need to gauge their maintenance capability to deal with intensive communications and troubleshooting issues between their legacy and newly developed systems [50–52]. Though banks may outsource their platform to a third party, its internal technicians still need to handle the system's maintenance, given the sensitive information involved in an SCF platform. Therefore, while selecting SCF strategies, banks should consider their technical capability in maintaining new platforms.

The timeliness of information in the conventional SCF [53] is constrained to manual processes, which often causes unwanted delays in approving loans. How to authenticate transaction data efficiently is another critical concern for banks. Take the blockchain-based ISO, for instance; it may combine the IoTs technology [54,55] to trace the real-time logistics of goods and authenticate their status in a supply chain. Pure-internet-based solutions require additional authentications, which might delay the operations of an SCF system.

SCF takes the factoring of accounts receivable as its core [56]. It integrates orders, inspections, invoices, and payment notices traded by manufacturers into order financing, post-inspection financing, advance payment financing, and accounts receivable financing.

While undertaking order financing, most financial institutions require clients to apply for "accounts receivable financing" at the same time and repay the "accounts receivable financing" funds allocated to the former loan of "order financing" in advance. This process may offer additional operating capital to SMEs [57]. However, banks might also increase unsecured loans. Thus, how to enhance debt guarantees while running an SCF platform would be a concern.

The blockchain-based SCF platform [58] has advantages in tracking various transaction activities and performing automatic information audits. This feature is attractive to banks while devising an SCF platform.

The primary purpose of SCF is to support a supply chain to optimize its operational efficiency by offering its participants associated loads promptly [59]. However, the various participants of a supply chain might yield different businesses. From a bank's perspective, if it expands the application scenarios by leveraging the infrastructure of its SCF platform, it may bring additional business opportunities and revenues. For instance, a blockchain-based platform could be extended to cross-border payment or insurance-related business [18]. Banks should consider the potential of additional application scenarios in advance.

2.2.4. Finance

Before launching innovative Fintech services, banks often need to increase extra system construction costs of hardware equipment, operating software, newly hired technicians, and training. These construction costs must be well planned to avoid an excessive financial burden on banks [60]. The BCL strategy mentioned above must especially design and maintain an SCF ecosystem based on blockchain and construct multiple SCMS nodes, requiring high system construction costs.

Compared with the centralized system, the maintenance cost of the decentralized system is much higher [61,62]. The main reason is that the decentralized system has more different application scenarios and higher security than the existing centralized system. It represents a variety of financing businesses to be developed [63]. These increased application scenarios and security correspond to different costs, which are not considered in the centralized system. Therefore, the construction and maintenance costs should be considered while selecting an SCF Fintech strategy.

Though banks are inclined to leverage new Fintech solutions to increase or enhance their services, the ultimate motive is driven by reaching higher profitability or market share. Therefore, while adopting an innovative Fintech strategy, banks have to cover the interests of their existing customers while exploring new business opportunities [64].

An SCF can be regarded as a financial ecosystem that involves various participants. Banks may choose to join an alliance or lead an SCF; those diverse approaches would yield different outcomes [65]. On one side, to lead an SCF, a bank may dominate the ecosystem and plan for extended businesses. However, the associated costs will be higher. On the other side, banks may save high costs by joining an alliance, but the prospect of gaining more market share would be confined.

The above discussions summarize the considerations for banks to select their SCF strategy and the benefits of blockchain. In Section 4, this study invited experts to conduct the Delphi survey based on the literature review to form an evaluation framework.

3. Hybrid Multiple Criteria Decision-Making (HMCDM) Approach

This section introduces the proposed HMCDM approach that comprises the DEMATEL technique [20], DANP [21,22], and confidence-based fuzzy evaluations. The involved factors (criteria) are collected by conducting the Delphi survey. We explained the investigation process in Section 4. Although various MCDM methods may be adopted to analyze this problem, the DEMATEL technique might be ideal for exploring the interrelationship among the key factors (criteria). Moreover, its extended ANP (i.e., DANP) method may identify the relative influence of each factor, which could support a bank in selecting its Fintech strategy for SCF. Finally, during the evaluation phase, this study invited domain experts to gauge the attractiveness of each strategy on each criterion for a bank, using the confidence-based fuzzy technique and modified VIKOR to aggregate the final performance. The confidence-based fuzzy assessment has the benefits to reveal the confidence level of experts while using lin-guistic expression. The modified VIKOR method may serve as an aggregator to high-light the performance gaps. The analytical result may thus contribute to selecting the Fintech strategy of SCF for a bank. The adopted methods are briefly explained in the following subsections, illustrated in Figure 1.

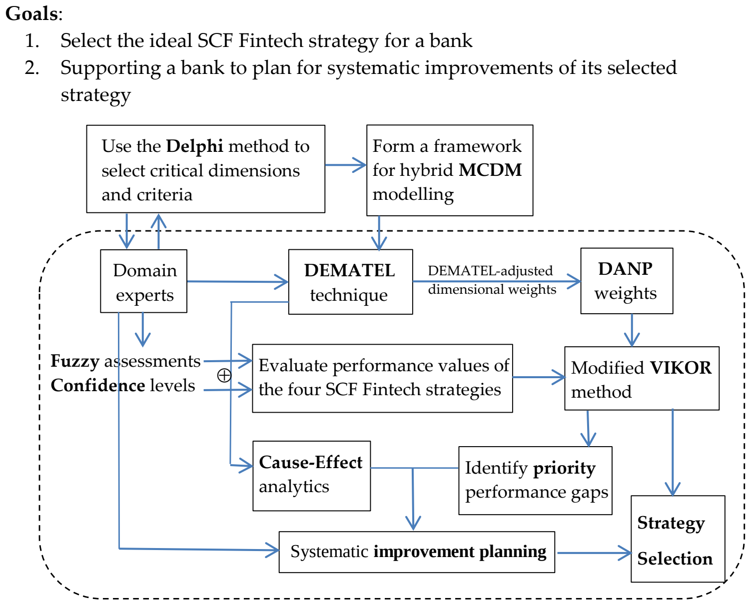

Figure 1. Conceptual flow of the research framework.

In Figure 1, the modified VIKOR can identify a strategy's highest weighted performance gap, which supports clarifying the priority for a bank to plan for improvements. With the cause-effect analysis from the DEMATEL technique, a bank may have a holistic view to identify the source dimension(s)/factor(s). The integrated approach supports a bank's ranking choice and serves as guidance to improve the selected strategy. The details of each method are explained in the following.

3.1. Decision-Making Trial and Evaluation Laboratory (DEMATEL) Technique

The DEMATEL technique presumes that each criterion has an influence on the other criteria of a system (or model), which is commonly observed in a social problem. The required computational steps are as follows [20].

Step 1: Form an initial influence matrix $\boldsymbol{A}$.

The initial influence matrix $\boldsymbol{A}$ could be reached by collecting opinions from domain experts. The questions of a DEMATEL questionnaire would be similar to: "What is the direct influence of criterion *i* on criterion *j*?" The typical scale ranges from 4 (very high) to 0 (no influence), and the averaged influence of criterion *i* on criterion *j* can be denoted as a_{ij}. It should be made aware that the elements located in the upper-right (i.e., among a_{12}, a_{n1} and a_{nn-1}) and lower-left triangular (i.e., the region among a_{21}, a_{1n} and a_{n-1n}) regions might not be symmetrical. If the total number of criteria was *n*, the initial influence matrix $\boldsymbol{A}$ could be shown in Equation (1):

$$\boldsymbol{A} = \begin{bmatrix} a_{11} & \cdots & a_{1j} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ a_{i1} & \cdots & a_{ij} & \cdots & a_{in} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ a_{n1} & \cdots & a_{nj} & \cdots & a_{nn} \end{bmatrix}_{n\times n}, \quad 1 \le i, j \le n. \tag{1}$$

Step 2: Normalize the matrix $\boldsymbol{A}$ to become $\boldsymbol{A}^{\mathrm{N}}$.

The second step sums up each row and column of $\boldsymbol{A}$ and identifies the maximal figures among them. Then, the initial influence matrix $\boldsymbol{A}$ can be transformed by multiplying π with $\boldsymbol{A}$ and shown as: $\pi \times \boldsymbol{A} = \boldsymbol{A}^{\mathrm{N}}$, where π can be obtained by Equation (2).

$$\pi = \min\left\{ \frac{1}{\max_i \sum_{j=1}^{n} a_{ij}}, \frac{1}{\max_j \sum_{j=1}^{n} a_{ij}} \right\} \tag{2}$$

Step 3: Transform $\boldsymbol{A}^{\mathrm{N}}$ into a total influence matrix $\boldsymbol{T}$.

The normalized $\boldsymbol{A}^{\mathrm{N}}$ serves as the initial state, which could be extended to ascending power (i.e., $\boldsymbol{A}^{\mathrm{N}}, \left(\boldsymbol{A}^{\mathrm{N}}\right)^2, \left(\boldsymbol{A}^{\mathrm{N}}\right)^3, \cdots$) to obtain the total influence matrix, in Equation (3). This process is similar to the Markov Chain, also termed the rippling process in the DEMATEL.

$$\boldsymbol{T} = \boldsymbol{A}^{\mathrm{N}} + \left(\boldsymbol{A}^{\mathrm{N}}\right)^2 + \left(\boldsymbol{A}^{\mathrm{N}}\right)^3 + \cdots + \left(\boldsymbol{A}^{\mathrm{N}}\right)^{\alpha} = \boldsymbol{A}^{\mathrm{N}} \times \left(\boldsymbol{I} - \left(\boldsymbol{A}^{\mathrm{N}}\right)^{\alpha}\right) \times \left(\boldsymbol{I} - \boldsymbol{A}^{\mathrm{N}}\right)^{-1} \tag{3}$$

While $\alpha \to \infty$, $\left(\boldsymbol{A}^{\mathrm{N}}\right)^{\alpha}$ would approach a null matrix with $n \times n$ zero elements. Thus, the total influence matrix can be written as: $\boldsymbol{T} = \boldsymbol{A}^{\mathrm{N}} \times \left(\boldsymbol{I} - \boldsymbol{A}^{\mathrm{N}}\right)^{-1} = \left[t_{ij}\right]_{n \times n}$, where $\boldsymbol{T}$ will be a $n \times n$ matrix and $1 \le i, j \le n$. The summation of each row and column can form two vectors: $\mathbb{R} = \left[r_1, \cdots, r_n\right]$ and $\mathbb{C} = \left[c_1, \cdots, c_n\right]'$. By conducting $\mathbb{R} + \mathbb{C}$ and $\mathbb{R} - \mathbb{C}$, the cause–effect influential relationship among the criteria can be identified. If $r_i - c_i > 0$, then criterion *i* belong to the cause group, $r_i - c_i < 0$ the effect group.

3.2. DEMATEL-Based ANP (DANP)

After conducting the initial DEMATEL analysis, the total influence matrix $\boldsymbol{T}$ can be extended to calculate the DEMATEL-based ANP (DANP) weights. The required steps are as follows.

Step 4: Calculate the dimensional matrix $\boldsymbol{T}^D$.

A typical AHP/ANP problem often comprises two layers: dimensions and the associated criteria. Therefore, to obtain the DANP weights of criteria, the next step is to restructure $\boldsymbol{T}$ using dimension-grouped sub-matrices. Thus, $\boldsymbol{T}$ may be denoted as $\boldsymbol{T}_G^D$, shown in Equation (4), assuming that there are *o* dimensions and *n* criteria.

$$\boldsymbol{T}_G^D = \begin{array}{c} \\ \boldsymbol{D}_1 \begin{array}{c} c_{11} \\ c_{12} \\ \vdots \\ c_{1m_1} \end{array} \\ \vdots \\ \boldsymbol{D}_i \begin{array}{c} c_{i1} \\ c_{i2} \\ \vdots \\ c_{im_i} \end{array} \\ \vdots \\ \boldsymbol{D}_o \begin{array}{c} c_{o1} \\ c_{o2} \\ \vdots \\ c_{om_o} \end{array} \end{array} \overset{\begin{array}{ccccc} \boldsymbol{D}_1 & & \boldsymbol{D}_j & & \boldsymbol{D}_o \\ c_{11} \cdots c_{1m_1} & \cdots & c_{j1} \cdots c_{jm_j} & \cdots & c_{o1} \cdots c_{om_o} \end{array}}{\begin{bmatrix} \boldsymbol{T}_G^{D11} & \cdots & \boldsymbol{T}_G^{D1j} & \cdots & \boldsymbol{T}_G^{D1o} \\ \vdots & & \vdots & & \vdots \\ \boldsymbol{T}_G^{Di1} & \cdots & \boldsymbol{T}_G^{Dij} & \cdots & \boldsymbol{T}_G^{Dio} \\ \vdots & & \vdots & & \vdots \\ \boldsymbol{T}_G^{Do1} & \cdots & \boldsymbol{T}_G^{Doj} & \cdots & \boldsymbol{T}_G^{Doo} \end{bmatrix}_{n \times n}}, \text{ for } 1 < i, j < o \le n. \tag{4}$$

For instance, the sub-matrix $\boldsymbol{T}_G^{D11}$ denotes the first dimension that has m_1 associated criteria, and $\boldsymbol{T}_G^D$ comprises $o \times o$ sub-matrices. All the elements of each sub-matrix should be averaged to generate a new dimensional matrix $\boldsymbol{T}^D$, which is indicated in Equation (5).

$$\boldsymbol{T}^D = \begin{bmatrix} t_{11}^D & \cdots & t_{1o}^D \\ \vdots & \ddots & \vdots \\ t_{o1}^D & \cdots & t_{oo}^D \end{bmatrix}_{o \times o} \tag{5}$$

Similarly, $\boldsymbol{T}^D$ can form two vectors: $\mathbb{R}^D = \left[t_{11}^D, \cdots, t_{1o}^D\right] = \left[r_1^D, \cdots, r_o^D\right]$ and $\mathbb{C}^D = \left[t_{11}^D, \cdots, t_{o1}^D\right]' = \left[c_1^D, \cdots c_o^D\right]'$. Following the same logic in **Step 3**, those two vectors may derive the cause–effect relationship among the dimensions. Again, the dimensional matrix

$\boldsymbol{T}^D$ needs to be normalized. The elements of the *i*-th row should be summed up to ${}^{\Sigma}t_i^D$ (${}^{\Sigma}t_i^D = \sum_{j=1}^{o} t_{ij}^D$), and each element of the *i*-th column could be normalized by dividing ${}^{\Sigma}t_i^D$. The normalized dimensional matrix $\boldsymbol{T}_N^D$ is shown in Equation (6).

$$\boldsymbol{T}_N^D = \begin{bmatrix} t_{11}^D / {}^{\Sigma}t_1^D & \cdots & t_{1o}^D / {}^{\Sigma}t_1^D \\ \vdots & \ddots & \vdots \\ t_{o1}^D / {}^{\Sigma}t_o^D & \cdots & t_{oo}^D / {}^{\Sigma}t_o^D \end{bmatrix}_{o \times o} \quad (6)$$

Step 5: Adopt the dimensional matrix to adjust and obtain the DANP weights.

Next, $\boldsymbol{T}_G^D$ should be transposed to serve as an unweighted super-matrix (i.e., $\left(\boldsymbol{T}_G^D\right)' = \boldsymbol{W}_S$), and the DEMATEL dimensional matrix-weighted initial super-matrix $\boldsymbol{W}_{ini}^{DEMATEL}$ can be obtained, as shown in Equation (7).

$$\boldsymbol{W}_{ini}^{DEMATEL} = \left(\boldsymbol{T}_N^D\right)' \times \boldsymbol{W}_S \quad (7)$$

In order to have the DANP influential weight of each criterion, $\boldsymbol{W}_{ini}^{DEMATEL}$ has to multiply with itself several times until a set of stable weights can be obtained. Finally, those weights need to be normalized to have the DANP influential weights, summing up to 100%. Aside from the obtained DANP weights, the two matrices, $\boldsymbol{T}$ and $\boldsymbol{T}^D$, could be analyzed to indicate the influential relationships among the dimensions and the associated criteria. We illustrated this analysis in Section 4.

3.3. Fuzzy Confidence-Based Performance Aggregations

Since the SCF strategy selection problem is complicated and involves multiple interrelated factors, how to collect and aggregating experts' opinions would be a challenging issue. In this study, we proposed a confidence-based fuzzy evaluation approach to assess the performance of each strategy, and the modified VIKOR aggregator was integrated with the DANP weights to have the final score for each strategy.

Step 6: Conduct confidence-based fuzzy assessments.

Though the present study would invite domain experts to seek their consensus on evaluating the performance of each SCF strategy on each criterion for a bank, they might not have full confidence in all judgments. In order to model the experts' confidence levels, this study adopted confidence-based fuzzy assessments in **Step 6**. This step requires two inputs from an expert on an evaluation. An example might be as follows: "Based on your judgment, what is the attractiveness/performance score of Strategy *A* (Low (L), Mid (M), or High (H)) for the bank and your confidence of this judgment (from 0% to 100%)?"

In order to capture the concept of "L," "M," and "H" of individual experts, all the experts would have to indicate their fuzzy assessment scale on the three levels. Additionally, we managed to adopt the prevailing fuzzy triangular membership function to transform experts' inputs. In other words, after collecting each expert's fuzzy parameters for the concepts of "L," "M," and "H," the evaluation score is obtained by multiplying the de-fuzzified figure with the associated confidence level.

3.4. Modified VIKOR

Step 7: Aggregate the final score by the modified-VIKOR method.

After collecting evaluations from the experts for the alternative strategies on all criteria, the final step is to aggregate the overall score for each strategy. The most intuitive aggregator might be the simple additive weighting (SAW) method, but it cannot identify the apparent gaps for improvements.

On the other side, the modified-VIKOR method proposed aggregating the performance gaps on all criteria and considering the highest gap—also deemed the maximal regret in its theory—to prioritize the alternatives. In this study, the alternatives are the four SCF Fintech strategies: (a) IPCH, (b) ISCH, (c) BCL, and (d) BCP. Since there would be multiple dimensions and criteria to be considered, none of the strategies would likely outperform the others on all criteria. In order to solve this ranking/selection problem, we adopted the modified-VIKOR method. The classical VIKOR was inspired by the well-known TOPSIS (the technique for order preference by similarity to ideal solution), which sets the best-performed alternative on each criterion as the ideal one. The worst performed was the bottom one. However, they both might cause a ranking reversal in some rare circumstances. Thus, the modified-VIKOR method redefines the evaluation scale from the ideal to the worst ones. By using this setting, Opricovic and Tzeng [66] proved that the modified-VIKOR may avoid the unwanted ranking reversal problem.

In order to construct a modified-VIKOR aggregation model, we may begin by assigning a set of alternatives: $A_1,\ldots, A_k,\ldots, A_z$. Take the kth alternative, for instance, its performance on the jth criterion would be p_{kj}, and there are n criteria of this evaluation problem. Next, the DANP influential weights from **Step 5** would be applied to forming an *Lp-metric* for A_k, shown in Equation (8):

$$Lp_k = \left\{ \sum_{j=1}^{n} \left[w_j \left(\left| p_j^{\blacktriangle} - p_{kj} \right| \right) / \left(p_j^{\blacktriangle} - p_j^{\perp} \right) \right]^z \right\}^{1/z}, \text{ for } 1 \le s < \infty \text{ and } j = 1, \ldots, n. \tag{8}$$

In Equation (8), $p_j^{\blacktriangle}$ and $p_j^{\perp}$ denote the ideal and worst score on the jth criterion, and w_j is the DANP influential weight of this criterion. Additionally, the *Lp-metric* indicates the aggregated performance gap of alternative k on all criteria. In this study, we managed to set the ideal score as 10, the worst 0 (i.e., $0 \le p_{kj} < 10$ for alternative k on the jth criterion). It should be mentioned that the ideal score might not be attainable by using the confidence-based fuzzy evaluation approach. Since the de-fuzzified "H" would not be 10 by using the triangular fuzzy membership function, the obtained score would be close to 10, while an evaluation denotes "H" and 100% confidence.

After collecting the performance scores on all criteria, the modified-VIKOR suggests calculating three indexes—S, R, and Q—for each alternative. Again, take the kth alternative, for instance, while setting $z = 1$ and $z \simeq \infty$, the *Lp-metric* for A_k can be transformed into S_k and R_k as Equations (9) and (10), respectively.

$$S_k = Lp_k^{z=1} = \sum_{j=1}^{n} \left[w_j \left(\left| p_j^{\blacktriangle} - p_{kj} \right| \right) / \left(p_j^{\blacktriangle} - p_j^{\perp} \right) \right] \tag{9}$$

$$R_k = Lp_k^{z \simeq \infty} = \max{}_j \left\{ w_j \left(\left| p_j^{\blacktriangle} - p_{kj} \right| \right) / \left(p_j^{\blacktriangle} - p_j^{\perp} \right) \mid j = 1, 2, \ldots, n \right\} \tag{10}$$

It is intuitive to learn that S_k denotes the aggregated weighted average performance gap, which also implies the experts' group consensus. On the other side, R_k implies maximal regret, the highest weighted performance gap on a criterion. The combination of the two indexes can form the determining index Q_k, shown in Equation (11).

$$Q_k = v \times \frac{\left(S_k - S^{Best} \right)}{\left(S^{Worst} - S^{Best} \right)} + (1 - v) \times \frac{\left(R_k - R^{Best} \right)}{\left(R^{Worst} - R^{Best} \right)} \tag{11}$$

The conventional VIKOR follows Eq. (11) to conduct the calculations of the three indexes. However, according to the previous research [66], changing the settings in the modified-VIKOR may avoid the unwanted ranking reversal problem.

In Equation (11), while setting $p_j^{\blacktriangle}$ and $p_j^{\perp}$ as the ideal (10) and worst (0) scores, respectively, Q_k would turn out to be the combination of S_k and R_k. In which, $S^{Best} = R^{Worst} = 1$ and $S^{Worst} = R^{Best} = 0$, and Eq. (11) turns out to be:

$Q_k == v \times \frac{(S_k - 0)}{(1-0)} + (1-v) \times \frac{(R_k - 0)}{(1-0)} = v \times S_k + (1-v) \times R_k$, where v is a parameter that ranges between 100% and 0. Though the confidence-based fuzzy evaluation might not yield $p_j^{\blacktriangle} = 10$, we set it as 10 to denote the ideal score on a criterion. The hybrid MCDM model may support a bank choosing its SCF Fintech strategy by adopting the one with the lowest Q index.

4. Case Study from a Taiwan-Based Domestic Bank

Until early 2022, the global economy suffered from the pandemic for over two years. While the wave of COVID-19-related impacts shows an early sign of ebb, surging demand, geopolitical conflicts, and supply chain disruptions have deteriorated economic growth and led to inflation. Most central banks aim to tame inflation by raising interest rates, which would cause a higher cost of capital for SMEs. In other words, if SMEs may obtain cost-effective financing through SCF, they may be more likely to survive during this economic turmoil. Thus, from a bank's perspective, how to devise an efficient SCF platform would be a challenging but rewarding task. Additionally, by a preliminary analysis of this work, there are four plausible Fintech strategies (refer to Table 1) for a bank to choose from: (a) IPCH, (b) ISCH, (c) BCL, and (d) BCP.

In this study, we collaborated with the PwC Consultancy in Taipei and an SCF Fintech solution provider BSOS [67], to explore this strategic issue for the banking sector. BSOS focuses on providing blockchain-based financing solutions, an official partner of Hyperledger. And BSOS is collaborating with several giant financial enterprises in Taiwan. As suggested by the experts from the PwC Consultancy, KGI Bank [68], a Taiwan-based domestic bank, is keen on delving into Fintech-driven businesses to expand its operation portfolio and has plenty of SME customers. Therefore, we chose KGI Bank as a case study to illustrate the hybrid analytic approach.

As shown in Figure 1, we began by devising a Delphi questionnaire that contains five dimensions and 34 associated factors/criteria to construct an evaluation model referred from previous research. The initial Delphi survey involved five PwC, one BSOS, and two senior banking experts. All have over 15 years of experience in the related fields. Based on their feedback, the five dimensions were consolidated into four, which combined "Organization" and "Operation" into one dimension (i.e., Organization and Operation Management). Moreover, the four dimensions' extended criteria dwindled to 22 criteria. The second round Delphi survey expanded the experts' pool, including the five PwC analysts, three BSOS experts, and four banking domain experts (i.e., 12 experts). The finalized evaluation framework comprises four dimensions and 13 criteria, summarized in Table 2. The following DEMATEL analysis involves the same 12 experts.

Table 2. Summary of dimensions and criteria.

Dimensions	Criteria	Reference
Legal Compliance (D_1)	Financial Supervision and International Regulation (C_1)	[32–35]
	Authority Policy (C_2)	[36–38]
Organization and Operation Management (D_2)	Competitor Movement (C_3)	[39]
	Top Management Support (C_4)	[40–43]
	Increase Financing Business Opportunities (C_5)	[44,45]
Technology (D_3)	Internet Security (C_6)	[2,46–49]
	Platform Maintenance Capability (C_7)	[50–52]
	Improve the Timeliness of Information (C_8)	[53–55]
	Enhanced Debt Guarantee (C_9)	[56–58]
	Expand Business Application Scenarios (C_{10})	[18,59]

Finance (D_4)	System Construction Cost (C_{11})	[60]
	System Maintenance Cost (C_{12})	[61–63]
	Increase Profitability and Market Share (C_{13})	[64,65]

Table 3. Initial influence matrix ***A***.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}
C_1	0.000	3.923	3.231	3.538	2.231	1.154	0.538	1.154	1.923	1.615	1.538	1.385	1.231
C_2	0.154	0.000	3.615	3.308	2.846	1.308	0.615	1.385	1.923	1.385	1.231	0.923	1.231
C_3	0.154	0.538	0.000	3.077	1.385	0.769	0.538	0.462	0.538	0.923	0.538	0.692	1.769
C_4	0.154	0.462	1.077	0.000	0.692	0.462	0.538	0.769	0.615	0.769	0.538	0.692	0.462
C_5	0.231	0.846	0.923	3.538	0.000	0.692	0.615	0.615	0.692	3.077	1.769	1.462	3.462
C_6	0.538	0.308	0.308	1.615	0.615	0.000	1.000	0.462	0.615	0.615	1.231	1.154	0.538
C_7	0.615	0.385	0.538	1.538	0.462	1.385	0.000	1.154	0.538	0.615	1.923	2.692	1.231
C_8	0.231	0.308	0.231	2.000	1.769	1.308	1.308	0.000	2.692	1.923	1.077	1.077	1.538
C_9	0.385	0.538	0.385	2.769	2.000	0.538	0.462	0.615	0.000	1.769	0.615	0.462	2.462
C_{10}	0.308	0.385	0.462	2.846	3.538	0.615	0.462	1.538	0.462	0.000	1.231	1.308	3.385
C_{11}	0.231	0.231	1.462	2.154	0.538	0.846	0.615	0.385	0.462	0.538	0.000	1.846	0.769
C_{12}	0.308	0.308	1.385	2.000	0.615	0.615	0.538	0.615	0.462	0.692	2.615	0.000	0.538
C_{13}	0.462	0.308	3.231	3.615	3.077	0.385	0.462	0.615	1.231	3.308	1.769	1.462	0.000

The DEMATEL analysis began with collecting the 12 experts' opinions on the relative influence of one criterion over the others. The averaged initial matrix ***A*** (refer to Step 1, Equation (1)) is shown in Table 3. Additionally, the transformed total influence matrix ***T*** is in Table 4, referring to Steps 2 and 3. In addition, the cause–effect relationships among the dimensions and criteria can be obtained by calculating the associated $\mathbb{R}+\mathbb{C}$, $\mathbb{R}-\mathbb{C}$, $\mathbb{R}^D+\mathbb{C}^D$, and $\mathbb{R}^D-\mathbb{C}^D$, reported in Table 5 and illustrated in Figure 2.

Table 4. Total influence matrix ***T***.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}
C_1	0.011	0.140	0.150	0.204	0.129	0.065	0.040	0.066	0.094	0.103	0.092	0.085	0.097
C_2	0.014	0.016	0.145	0.179	0.133	0.063	0.039	0.065	0.085	0.088	0.075	0.064	0.089
C_3	0.010	0.026	0.025	0.137	0.071	0.036	0.028	0.029	0.032	0.056	0.040	0.043	0.081
C_4	0.008	0.020	0.047	0.031	0.040	0.024	0.024	0.033	0.030	0.041	0.032	0.036	0.034
C_5	0.016	0.040	0.069	0.179	0.050	0.042	0.036	0.043	0.046	0.135	0.090	0.079	0.148
C_6	0.021	0.018	0.028	0.083	0.039	0.011	0.039	0.026	0.031	0.038	0.056	0.053	0.037
C_7	0.025	0.023	0.044	0.096	0.043	0.058	0.013	0.050	0.035	0.046	0.086	0.106	0.064
C_8	0.015	0.023	0.037	0.123	0.093	0.058	0.055	0.020	0.102	0.095	0.065	0.063	0.088
C_9	0.018	0.029	0.042	0.139	0.097	0.032	0.027	0.036	0.019	0.089	0.047	0.041	0.110
C_{10}	0.018	0.027	0.053	0.156	0.149	0.038	0.032	0.067	0.039	0.047	0.074	0.073	0.145
C_{11}	0.012	0.015	0.064	0.102	0.038	0.037	0.029	0.024	0.027	0.037	0.020	0.074	0.045
C_{12}	0.014	0.018	0.063	0.100	0.042	0.032	0.027	0.031	0.028	0.042	0.098	0.021	0.040
C_{13}	0.023	0.027	0.134	0.189	0.142	0.035	0.033	0.044	0.062	0.144	0.092	0.081	0.055

Table 5. Cause–effect analysis by the DEMATEL technique.

Dimensions	r^D	c^D	r^D+c^D	r^D-c^D	**Criteria**	r	c	$r+c$	$r-c$
D_1	0.356	0.105	0.462	0.251	C_1	1.275	0.207	1.482	1.069
D_2	0.199	0.407	0.606	−0.208	C_2	1.055	0.422	1.477	0.633
D_3	0.221	0.199	0.420	0.022	C_3	0.614	0.900	1.514	−0.287
D_4	0.216	0.281	0.496	−0.065	C_4	0.400	1.717	2.117	−1.318
					C_5	0.972	1.067	2.038	−0.095
					C_6	0.481	0.529	1.010	−0.049
					C_7	0.689	0.423	1.112	0.266
					C_8	0.837	0.533	1.370	0.304

C_9	0.727	0.629	1.355	0.098
C_{10}	0.918	0.961	1.879	−0.042
C_{11}	0.522	0.868	1.391	−0.346
C_{12}	0.555	0.818	1.373	−0.264
C_{13}	1.061	1.031	2.092	0.029

In Figure 2, Legal Compliance (D_1) is the root-cause dimension, and the second cause dimension is Technology (D_3). The two cause dimensions influence the two effect dimensions: Organization and Operation Management (D_2) and Finance (D_4). The banking sector is a highly regulated business. All the innovative business operations have to comply with regulations, which is in line with our understanding during the survey. The Technology (D_3) Dimension, on the other side, is more flexible for banks to consider. As long as those technological aspects can be resolved and support new business growth, ambitious banks are willing to change their organizations and operations to adapt.

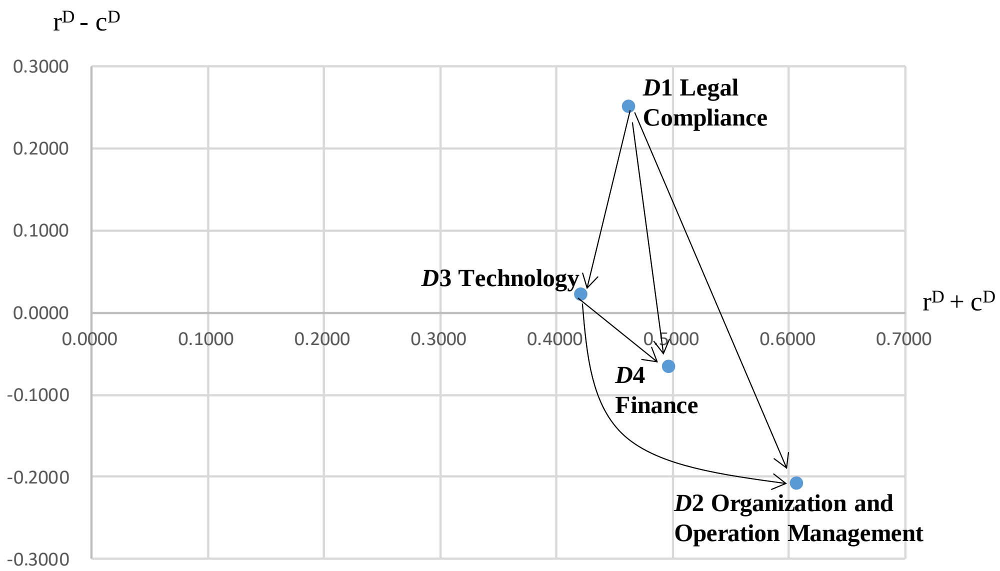

Figure 2. Dimensional cause–effect relationship map.

5. Results and Discussion

Referring to the Steps 4 and 5 in Section 3.2, the dimensional matrix $\boldsymbol{T}^D$ and the DEMATEL dimensional matrix-weighted initial super-matrix $\boldsymbol{W}_{ini}^{DEMATEL}$ are shown in Table 6 and Table 7, respectively. The finalized DANP weights are reported in Table 8 with the assessments of KGI bank on the 13 criteria. Only the five PwC analysts and three Fintech experts from the BSOS were involved during the evaluation phase. Their opinions were averaged and reported in Table 8.

Table 6. dimensional matrix $\boldsymbol{T}^D$.

	D_1	D_2	D_3	D_4
D_1	0.045	0.157	0.071	0.084
D_2	0.020	0.072	0.042	0.065
D_3	0.022	0.081	0.044	0.074
D_4	0.018	0.097	0.042	0.058

Table 7. DEMATEL dimensional matrix-weighted initial super-matrix $W_{ini}^{DEMATEL}$.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}
C_1	0.009	0.058	0.029	0.030	0.029	0.046	0.044	0.034	0.033	0.034	0.037	0.037	0.039
C_2	0.118	0.069	0.073	0.072	0.072	0.039	0.040	0.050	0.052	0.051	0.048	0.047	0.046
C_3	0.137	0.140	0.038	0.145	0.084	0.069	0.088	0.054	0.056	0.054	0.140	0.138	0.130
C_4	0.186	0.172	0.214	0.094	0.217	0.203	0.193	0.179	0.184	0.161	0.225	0.220	0.183
C_5	0.117	0.128	0.110	0.123	0.061	0.096	0.087	0.136	0.129	0.153	0.084	0.092	0.137
C_6	0.035	0.037	0.043	0.033	0.029	0.015	0.057	0.035	0.031	0.034	0.047	0.039	0.021
C_7	0.022	0.023	0.033	0.034	0.026	0.054	0.013	0.033	0.027	0.028	0.036	0.033	0.020
C_8	0.036	0.038	0.034	0.046	0.030	0.035	0.050	0.012	0.036	0.060	0.030	0.038	0.027
C_9	0.051	0.050	0.038	0.042	0.032	0.043	0.034	0.062	0.019	0.035	0.034	0.034	0.038
C_{10}	0.056	0.052	0.065	0.057	0.095	0.052	0.045	0.058	0.087	0.042	0.047	0.051	0.088
C_{11}	0.079	0.077	0.079	0.102	0.093	0.129	0.112	0.100	0.079	0.085	0.040	0.167	0.109
C_{12}	0.072	0.066	0.085	0.114	0.081	0.121	0.138	0.098	0.069	0.084	0.144	0.035	0.096
C_{13}	0.083	0.092	0.161	0.108	0.151	0.084	0.083	0.136	0.186	0.165	0.087	0.068	0.065

Table 8. DANP weights and SAW ranking result.

Criteria	Crisp Assessment					Confidence-Based Fuzzy				
	DANP Weights	(a) IPCH	(b) ISCH	(c) BCL	(d) BCP	DANP Weights	(a) IPCH	(b) ISCH	(c) BCL	(d) BCP
C_1	3.47%	2.75	3.75	4.00	3.75	3.47%	1.53	1.63	1.65	1.63
C_2	6.10%	3.75	4.00	4.75	4.63	6.10%	1.63	1.65	2.86	2.85
C_3	10.67%	4.63	5.75	6.38	6.25	10.67%	2.80	4.54	5.10	5.06
C_4	18.09%	8.13	8.13	8.63	8.13	18.09%	8.23	7.91	8.46	7.91
C_5	11.07%	7.13	7.88	8.50	7.38	11.07%	6.56	8.12	8.40	6.65
C_6	3.48%	3.25	4.00	4.13	3.63	3.48%	1.58	1.65	1.66	1.61
C_7	2.99%	3.88	4.38	4.25	3.88	2.99%	1.64	2.10	2.09	1.64
C_8	3.67%	7.75	7.63	7.88	7.75	3.67%	7.95	7.57	8.00	7.63
C_9	3.85%	5.88	7.75	7.63	7.50	3.85%	4.85	7.95	7.57	7.54
C_{10}	6.36%	5.63	7.75	8.50	8.38	6.36%	4.50	7.71	8.40	8.34
C_{11}	9.66%	6.25	5.88	6.38	6.50	9.66%	4.68	4.96	5.11	5.14
C_{12}	9.34%	6.13	6.13	6.38	6.38	9.34%	4.65	5.03	5.11	5.11
C_{13}	11.24%	6.50	8.13	8.38	6.63	11.24%	5.14	8.23	8.35	5.46
	Score (Rank)	6.08 (4th)	6.72 (2nd)	7.16 (1st)	6.68 (3rd)	Score (Rank)	5.00 (4th)	6.04 (2nd)	6.38 (1st)	5.73 (3rd)

In Table 8, the top-three DANP influential criteria are C_4 (Top Management Support), C_{13} (Increase Profitability and Market Share), and C_3 (Competitor Movement). All fall in the two effect dimensions: D_2 (Organization and Operation Management) and D_4 (Finance). Additionally, both the crisp and confidence-based assessments—using the simple additive weighting (SAW) aggregator—reveal consistent ranking: (c) BCL $\succ$ (b) ISCH $\succ$ (d) BCP $\succ$ (a) IPCH.

5.1. Sensitivity analysis

To examine the proposed hybrid approach, we applied the modified VIKOR aggregator (refer to Section 3.2) to integrate with the DANP weights. By setting v = 1.00, 0.95, and 0.90, the crisp and confidence-based fuzzy assessments revealed the same ranking order in Table 9. Strategy (c) BCL (blockchain-based leading operator) is the best choice for the KGI bank to implement its SCF platform. Though the crisp and confidence-based fuzzy assessments all come to the same conclusion, the confidence-based fuzzy assessment has disclosed more information regarding the uncertainty and confidence of experts, which also received positive feedback from experts during the survey.

Table 9. Combine DANP weights and VIKOR aggregator.

	Crisp Assessment					Confidence-Based Fuzzy				
Criteria	**DANP Weights**	**(a) IPCH**	**(b) ISCH**	**(c) BCL**	**(d) BCP**	**DANP Weights**	**(a) IPCH**	**(b) ISCH**	**(c) BCL**	**(d) BCP**
C_1	3.47%	0.725	0.625	0.600	0.625	3.47%	0.847	0.838	0.835	0.837
C_2	6.10%	0.625	0.600	0.525	0.538	6.10%	0.837	0.835	0.714	0.715
C_3	10.67%	0.538	0.425	0.363	0.375	10.67%	0.720	0.546	0.490	0.494
C_4	18.09%	0.188	0.188	0.138	0.188	18.09%	0.177	0.209	0.154	0.209
C_5	11.07%	0.288	0.213	0.150	0.263	11.07%	0.344	0.188	0.160	0.335
C_6	3.48%	0.675	0.600	0.588	0.638	3.48%	0.842	0.835	0.834	0.839
C_7	2.99%	0.613	0.563	0.575	0.613	2.99%	0.836	0.790	0.791	0.836
C_8	3.67%	0.225	0.238	0.213	0.225	3.67%	0.205	0.243	0.200	0.237
C_9	3.85%	0.413	0.225	0.238	0.250	3.85%	0.515	0.205	0.243	0.246
C_{10}	6.36%	0.438	0.225	0.150	0.163	6.36%	0.550	0.229	0.160	0.166
C_{11}	9.66%	0.375	0.413	0.363	0.350	9.66%	0.532	0.504	0.489	0.486
C_{12}	9.34%	0.388	0.388	0.363	0.363	9.34%	0.535	0.497	0.489	0.489
C_{13}	11.24%	0.350	0.188	0.163	0.338	11.24%	0.486	0.177	0.165	0.454
	S (v = 1.00)	0.392	0.328	0.284	0.332	S (v = 1.00)	0.471	0.367	0.333	0.398
	(Rank)	(4th)	(2nd)	(1st)	(3rd)	(Rank)	(4th)	(2nd)	(1st)	(3rd)
	R	0.025	0.022	0.021	0.022	R	0.052	0.051	0.051	0.051
	Q (v = 0.95)	0.374	0.312	0.271	0.316	Q (v = 0.95)	0.450	0.351	0.318	0.380
	(Rank)	(4th)	(2nd)	(1st)	(3rd)	(Rank)	(4th)	(2nd)	(1st)	(3rd)
	Q (v = 0.90)	0.355	0.297	0.258	0.301	Q (v = 0.90)	0.429	0.335	0.304	0.363
	(Rank)	(4th)	(2nd)	(1st)	(3rd)	(Rank)	(4th)	(2nd)	(1st)	(3rd)

The four combinations—"DANP + SAW + Crisp assessment," "DANP + SAW + confidence-based fuzzy assessment," "DANP + VIKOR + Crisp assessment," and "DANP + VIKOR + confidence-based fuzzy assessment"—all reveal consistent ranking, which suggests the reliability of the ranking. In addition, we conducted a sensitivity analysis to ensure the robustness of the result. By setting the parameter v (refer to sub-section 3.4 and Eq. (11)) in different values, from 0.9 to 0.6, the combinations of the DANP + VIKOR + confidence-based fuzzy assessment all indicate consistent ranking, summarized in Appendix A (Table A.1).

5.2. Discussion

Based on the findings from the DEMATEL analysis and the DANP weights, the present study contributes to the theoretical aspect of research in adopting a Fintech-based SCF strategy in two directions. First, the highest DANP influential crite-rion is C4, which suggests that the top management support would be the most critical driving force for a bank to embrace an innovative Fintech strategy. This result echoes a previous work [43] and emphasizes a crucial factor overlooked in the previous study [26], based on the Technological Acceptance Model (TAM). On the other side, technol-ogy-related issues are not the primary concerns. Second, the cause-effect analysis re-veals that Legal Compliance (D1) is the most vital influential dimension, and the re-maining ones are all influenced by it. For instance, the Technology (D3) aspect should pay close attention to the SCF-related international regulations. In other words, though the Fintech technologies may enhance or transform the business model and operations of banks, the success of adopting new technology hinges upon the conformance of legal compliance.

In practice, the proposed hybrid approach supports identifying the ideal SCF Fintech strategy for a bank. However, while adopting the selected alternative (i.e., (c) BCL (Blockchain-based leading operator in this case), the bank still needs to learn the complicated interrelationships among the dimensions to utilizing its limited resources. The combination of the DEMATEL analysis and modified VIKOR may serve this aim.

Referring to Table 9, the highest weighted gap falls on C_1 (Financial Supervision and International Regulation). In this case, since D_1 is the cause dimension and this criterion is beyond the banks' control, there might be no immanent measure for it to take. However, the second weighted gap is on C_6 (Internet Security), which belongs to Technology (D_3) Dimension. Based on DEMATEL's cause–effect analysis (Table 5), D_3 (Technology) would be influenced by D_1 (Legal Compliance). In other words, once the KGI bank adopts a blockchain-based system and serves a leading role, it should scrutinize the relevant legal compliance to strengthen its internet security while devising its SCF platform. Furthermore, while we delve into this dimension (D_3), C_6 (Internet Security) has the lowest $r-c=-0.049$, which suggests that all the other criteria (i.e., C_7, C_8, C_9, and C_{10}) may influence C_6. As a leading operator, the bank should heed those interrelationships while planning its block-chain-based SCF ecosystem. And aside from selecting the ideal Fintech strategy, those insights are additional findings from the DEMATEL analysis in practice.

6. Concluding Remarks

To conclude, this study is an early attempt to analyze the Fintech alternatives for a bank to select its SCF strategy. Since SCF involves various participants, from giant corporates to numerous SMEs (suppliers) and banks, the complexity of the interorganizational collaborations is a thorny problem. Therefore, we proposed a hybrid approach based on the DEMATEL, DANP, modified VIKOR and confidence-based fuzzy assessment to solve this problem. The main results and contributions of the present study in solving this problem are as follows:

1. Identify the critical dimensions and criteria for banks to evaluate the Fintech strategy on SCF;
2. Clarify the cause–effect interrelationships among the dimensions and criteria for this problem;
3. Construct a hybrid evaluation model for the KGI bank, as an illustrative example, to select its ideal Fintech strategy: blockchain-based leading operator.

In addition, the DANP model suggests that the top-three influential criteria are: C_4 (Top Management Support), C_{13} (Increase Profitability and Market Share), and C_3 (Competitor Movement); none of them belongs to the technological concern. According to the survey, "Top Management Support" is the most critical factor. In other words, though selecting a Fintech strategy is inevitable to gauge the technology aspect, the top priority is still business-driven. Either from inside of an organization or its competitors.

The benefits brought by blockchain technology are substantial in developing an IOS (interorganizational system). As discussed in Section 1, it may build trust among supply chain participants by sharing encrypted, distributed, and timely information. Though the benefits of the blockchain-based solution are evident, it is interesting that KGI bank's second option is ISCH (internet-based shared coordination hub), not BCP (blockchain-based participant). This point partially reflects the cost concern of building and maintaining a blockchain-based platform. Thus, the prospect of leveraging the SCF platform and creating more business potentials based on blockchain should be the bank's long-term goal, which echoes the second weighed DANP criterion: C_{13} (Increase Profitability and Market Share).

Aside from the findings, there are still several research limitations. First, we as-sume all criteria are interrelated by adopting the DEMATEL and DANP methods. Thus, this approach might not be sufficient to handle too many independent factors. Second, the inputs from the domain experts are based on their knowledge and experience. Third, all the experts are not from the KGI bank; there might be hidden concerns that those outsiders overlooked. Fourth, the case study only covers the domestic banks in Taiwan. Giant international banks might have different weights while evaluating this problem.

Though the present study has reached a consistent outcome for a domestic bank and clarified the complicated relationships among the critical factors in selecting an SCF strategy, future research may collaborate with international banks in different regions. Giant banks operating on multiple continents might have more resources and fewer constraints while setting their SCF strategy. Additionally, it would be of high value to have banks' internal teams join such research.

Author Contributions: Conceptualization, Y.-C.K., K.-Y.S., and S.-T.L.; methodology, K.-Y.S.; validation, Y.-C.K., K.-Y.S.; formal analysis, K.-Y.S. and J.C.P.S.; investigation, Y.-C.K. and S.-T.L.; resources, K.-Y.S. and S.-T.L.; data curation, Y.-C.K.; writing—original draft preparation, Y.-C.K. and K.-Y.S.; writing—review and editing, K.-Y.S.; visualization, K.-Y.S.; supervision, K.-Y.S. and J.C.P.S.; project administration, K.-Y.S.; funding acquisition, K.-Y.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Ministry of Science and Technology of Taiwan, grant numbers 109-2410-H-034-037-MY2; K.-Y.S received the grant.

Institutional Review Board Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: The authors are grateful for the feedback and supports from the PwC analysts in Taipei and the management team of BSOS.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Sensitivity analysis of the hybrid approach based on DANP + VIKOR +Confidence-based fuzzy assessment.

Indexes	(a)	(b)	(c)	(d)
	IPCH	ISCH	BCL	BCP
S	0.471	0.367	0.333	0.398
R	0.052	0.051	0.051	0.051
Q (v = 0.90)	0.429	0.335	0.304	0.363
(Rank)	(4th)	(2nd)	(1st)	(3rd)
Q (v = 0.85)	0.408	0.320	0.290	0.346
(Rank)	(4th)	(2nd)	(1st)	(3rd)
Q (v = 0.80)	0.387	0.304	0.276	0.328
(Rank)	(4th)	(2nd)	(1st)	(3rd)
Q (v = 0.75)	0.366	0.288	0.262	0.311
(Rank)	(4th)	(2nd)	(1st)	(3rd)
Q (v = 0.70)	0.345	0.272	0.248	0.294
(Rank)	(4th)	(2nd)	(1st)	(3rd)
Q (v = 0.65)	0.324	0.256	0.234	0.276
(Rank)	()	(2nd)	(1st)	(3rd)
Q (v = 0.60)	0.303	0.241	0.220	0.259
(Rank)	(4th)	(2nd)	(1st)	(3rd)

References

1. Moretto, A.; Caniato, F. Can Supply Chain Finance help mitigate the financial disruption brought by Covid-19? *J. Purch. Supply Manag.* **2021**, *27*, 100713. https://doi.org/10.1016/j.pursup.2021.100713.
2. Liu, J.; Yan, L.; Wang, D. A Hybrid Blockchain Model for Trusted Data of Supply Chain Finance. *Wirel. Pers. Commun.* **2021**, *30*, 1–25. https://doi.org/10.1007/s11277-021-08451-x.

3. Liu, L.; Zhang, J.Z.; He, W.; Li, W. Mitigating information asymmetry in inventory pledge financing through the Internet of things and blockchain. *J. Enterp. Inf. Manag.* **2021**, *34*, 1429–1451. https://doi.org/10.1108/jeim-12-2020-0510.
4. Daiy, A.K.; Shen, K.Y.; Huang, J.Y.; Lin, T.M.Y. A Hybrid MCDM Model for Evaluating Open Banking Business Partners. *Mathematics* **2021**, *9*, 587. https://doi.org/10.3390/math9060587.
5. Amazon Managed Blockchain. Available online: https://aws.amazon.com/managed-blockchain/?nc1=h_ls (accessed on 16 May 2022).
6. Yang, Y.; Chu, X.; Pang, R.; Liu, F.; Yang, P. Identifying and Predicting the Credit Risk of Small and Medium-Sized Enterprises in Sustainable Supply Chain Finance: Evidence from China. *Sustainability* **2021**, *13*, 5714. https://doi.org/10.3390/su13105714.
7. Available online: https://www.jpmorgan.com/solutions/treasury-payments/global-trade/supply-chain-finance-working-capital (accessed on 16 May 2022).
8. Li, M.; Shao, S.; Ye, Q.; Xu, G.; Huang, G.Q. Blockchain-enabled logistics finance execution platform for capital-constrained E-commerce retail. *Robot. Comput.-Integr. Manuf.* **2020**, *65*, 101962. https://doi.org/10.1016/j.rcim.2020.101962.
9. Alora, A.; Barua, M.K. Barrier analysis of supply chain finance adoption in manufacturing companies. *Benchmarking Int. J.* **2019**, *26*, 2122–2145. https://doi.org/10.1108/BIJ-08-2018-0232.
10. Zhu, K.; Kraemer, K.L.; Gurbaxani, V.; Xu, S.X. Migration to open-standard interorganizational systems: Network effects, switching costs, and path dependency. *MIS Q.* **2006**, *30*, 515–539. https://doi.org/10.2307/25148771.
11. Steinfield, C.; Markus, M.L.; Wigand, R.T. Through a Glass Clearly: Standards, Architecture, and Process Transparency in Global Supply Chains. *J. Manag. Inf. Syst.* **2014**, *28*, 75–108. https://doi.org/10.2753/mis0742-1222280204.
12. Demirkan, H.; Cheng, H.K.; Bandyopadhyay, S. Coordination Strategies in an SaaS Supply Chain. *J. Manag. Inf. Syst.* **2014**, *26*, 119–143. https://doi.org/10.2753/mis0742-1222260405.
13. Loukis, E.; Janssen, M.; Mintchev, I. Determinants of software-as-a-service benefits and impact on firm performance. *Decis. Support Syst.* **2019**, *117*, 38–47. https://doi.org/10.1016/j.dss.2018.12.005.
14. Liu, X.; Zhou, L.; Wu, Y.-C. Supply Chain Finance in China: Business Innovation and Theory Development. *Sustainability* **2015**, *7*, 14689–14709. https://doi.org/10.3390/su71114689.
15. Dang, Y.; Singh, M.; Allen, T.T. Network Mode Optimization for the DHL Supply Chain. *INFORMS J. Appl. Anal.* **2021**, *51*, 179–199.
16. Jabbar, R.; Dhib, E.; Said, A.B.; Krichen, M.; Fetais, N.; Zaidan, E.; Barkaoui, K. Blockchain Technology for Intelligent Transportation Systems: A Systematic Literature Review. *IEEE Access* **2022**, *10*, 20995–21031. https://doi.org/10.1109/ACCESS.2022.3149958.
17. Li, J., Zhu, S., Zhang, W., & Yu, L. Blockchain-driven supply chain finance solution for small and medium enterprises. *Frontiers of Engineering Management* **2020**, *7*(4), 500-511. https://doi.org/10.1007/s42524-020-0124-2
18. Chen, N.P.; Shen, K.Y.; Liang, C.J. Hybrid decision model for evaluating Blockchain business strategy: A bank's perspective. *Sustainability* **2021**, *13*, 5809. https://doi.org/10.3390/su13115809.
19. Bahrami, Y.; Hassani, H.; Maghsoudi, A. Spatial modeling for mineral prospectivity using BWM and COPRAS as a new HMCDM method. *Arab. J. Geosci.* **2022**, *15*, 394. https://doi.org/10.1007/s12517-022-09630-1.
20. Si, S.L.; You, X.Y.; Liu, H.C.; Zhang, P. Dematel Technique: A Systematic Review of the State-of-the-Art Literature on Methodologies and Applications. *Math. Probl. Eng.* **2018**, 3696457. https://doi.org/10.1155/2018/3696457.
21. Chiu, W.Y.; Tzeng, G.H.; Li, H.L. A new hybrid MCDM model combining DANP with VIKOR to improve e-store business. *Knowl.-Based Syst.* **2013**, *37*, 48–61. https://doi.org/10.1016/j.knosys.2012.06.017.
22. Khan, S.; Maqbool, A.; Haleem, A.; Khan, M.I. Analyzing critical success factors for a successful transition towards circular economy through DANP approach. *Manag. Environ. Qual.* **2020**, *31*, 505–529. https://doi.org/10.1108/MEQ-09-2019-0191.
23. Hofmann, E.; Belin, O. *Supply Chain Finance Solutions*; Springer: Berlin/Heidelberg, Germany, 2011.
24. Gelsomino, L.M.; Mangiaracina, R.; Perego, A.; Tumino, A. Supply chain finance: A literature review. *Int. J. Phys. Distrib. Logist. Manag.* **2016**, *46*, 348–366. https://doi.org/10.1108/IJPDLM-08-2014-0173.
25. Kim, H.M.; Laskowski, M. Toward an ontology-driven blockchain design for supply-chain provenance. *Intell. Syst. Account. Financ. Manag.* **2018**, *25*, 18–27. https://doi.org/10.1002/isaf.1424.
26. Rijanto, A. Blockchain Technology Adoption in Supply Chain Finance. *J. Theor. Appl. Electron. Commer. Res.* **2021**, *16*, 3078–3098. https://doi.org/10.3390/jtaer16070168.
27. Kamble, S.S.; Gunasekaran, A.; Sharma, R. Modeling the blockchain enabled traceability in agriculture supply chain. *Int. J. Inf. Manag.* **2020**, *52*, 101967. https://doi.org/10.1016/j.ijinfomgt.2019.05.023.
28. Queiroz, M.M.; Wamba, S.F. Blockchain adoption challenges in supply chain: An empirical investigation of the main drivers in India and the USA. *Int. J. Inf. Manag.* **2019**, *46*, 70–82. https://doi.org/10.1016/j.ijinfomgt.2018.11.021.
29. Hofmann, E.; Strewe, U.M.; Bosia, N. *Supply Chain Finance and Blockchain Technology: The Case of Reverse Securitisation*; Springer: Berlin/Heidelberg, Germany, 2017.
30. Cantisani, A. Technological innovation processes revisited. *Technovation* **2006**, *26*, 1294–1301. https://doi.org/10.1016/j.technovation.2005.10.003.
31. Kamble, S.; Gunasekaran, A.L.; Arha, H. Understanding the Blockchain technology adoption in supply chains-Indian context. *Int. J. Prod. Res.* **2019**, *57*, 2009–2033. https://doi.org/10.1080/00207543.2018.1518610.
32. Schuetz, S.; Venkatesh, V. Blockchain, adoption, and financial inclusion in India: Research opportunities. *Int. J. Inf. Manag.* **2020**, *52*, 101936. https://doi.org/10.1016/j.ijinfomgt.2019.04.009.

33. Schlecht, L.; Schneider, S.; Buchwald, A. The prospective value creation potential of Blockchain in business models: A delphi study. *Technol. Forecast. Soc. Chang.* **2021**, *166*, 120601. https://doi.org/10.1016/j.techfore.2021.120601.
34. Takeda, A.; Ito, Y. A review of FinTech research. *Int. J. Technol. Manag.* **2021**, *86*, 67–88.
35. Bu, Y.; Li, H.; Wu, X. Effective regulations of FinTech innovations: The case of China. *Econ. Innov. New Technol.* **2021**, https://doi.org/10.1080/10438599.2020.1868069.
36. Hodson, D. The politics of FinTech: Technology, regulation, and disruption in UK and German retail banking. *Public Adm.* **2021**, *99*, 859–872. https://doi.org/10.1111/padm.12731.
37. Zhang, Z.; Song, Y.; Sahut, J.M.; Hong, P. How to establish a coordinated supervisory mechanism of internet finance companies in China? *Can. J. Adm. Sci.* **2021**, 1–15. https://doi.org/10.1002/cjas.1645.
38. PWC. Establishing Blockchain Policy. Available online: https://www.pwc.com/m1/en/publications/documents/establishing-blockchain-policy-pwc.pdf (accessed on 16 May 2022).
39. Morikawa, M. Price competition vs. quality competition: Evidence from firm surveys. *J. Econ. Bus.* **2021**, *116*, 106007. https://doi.org/10.1016/j.jeconbus.2021.106007.
40. Bajaj, A. A study of senior information systems managers' decision models in adopting new computing architectures. *J. Assoc. Inf. Syst.* **2000**, *1*, 4. https://doi.org/10.17705/1jais.00004.
41. Hsu, H.Y.; Liu, F.H.; Tsou, H.T.; Chen, L.J. Openness of technology adoption, top management support and service innovation: A social innovation perspective. *J. Bus. Ind. Mark.* **2019**, *34*, 575–590. https://doi.org/10.1108/JBIM-03-2017-0068.
42. Khurana, S.; Haleem, A.; Luthra, S.; Mannan, B. Evaluating critical factors to implement sustainable oriented innovation practices: An analysis of micro, small, and medium manufacturing enterprises. *J. Clean. Prod.* **2021**, *285*, 125377. https://doi.org/10.1016/j.jclepro.2020.125377.
43. Lustenberger, M.; Malešević, S.; Spychiger, F. Ecosystem readiness: Blockchain adoption is driven externally. *Front. Blockchain* **2021**, *4*, 720454. https://doi.org/10.3389/fbloc.2021.720454.
44. Liu, S. Blockchain Technology Market Size Worldwide 2017–2027. Available online: https://www.statista.com/statistics/1015362/worldwide-blockchain-technology-market-size/ (accessed on 16 May 2022).
45. Lingens, B.; Böger, M.; Gassmann, O. Even a Small Conductor Can Lead a Large Orchestra: How Startups Orchestrate Ecosystems. *Calif. Manag. Rev.* **2021**, *63*, 118–143. https://doi.org/10.1177/00081256211005497.
46. Chang, V.; Baudier, P.; Zhang, H.; Xu, Q.; Zhang, J.; Arami, M. How Blockchain can impact financial services—The overview, challenges and recommendations from expert interviewees. *Technol. Forecast. Soc. Change* **2020**, *158*, 120166. https://doi.org/10.1016/j.techfore.2020.120166.
47. BBC. Hackers Steal Nearly $100m in Japan Crypto Heist. Available online: https://www.bbc.com/news/business-58277359 (accessed on 16 May 2022).
48. BBC. Hackers Steal $600m in Major Cryptocurrency Heist. Available online: https://www.bbc.com/news/business-58163917 (accessed on 16 May 2022).
49. BBC. BitMart: Crypto-Exchange Loses $150m to Hackers. Available online: https://www.bbc.com/news/technology-59549606 (accessed on 16 May 2022).
50. Zheng, W.; Zheng, Z.; Chen, X.; Dai, K.; Li, P.; Chen, R. NutBaaS: A Blockchain-as-a-Service Platform. *IEEE Access* **2019**, *7*, 134422–134433. https://doi.org/10.1109/access.2019.2941905.
51. Lu, Q.; Xu, X.; Liu, Y.; Weber, I.; Zhu, L.; Zhang, W. uBaaS: A unified blockchain as a service platform. *Future Gener. Comput. Syst.* **2019**, *101*, 564–575. https://doi.org/10.1016/j.future.2019.05.051.
52. Ma, Z.; Zhao, W.; Luo, S.; Wang, L. TrustedBaaS: Blockchain-Enabled Distributed and Higher-Level Trusted Platform. *Comput. Netw.* **2020**, *183*, 107600. https://doi.org/10.1016/j.comnet.2020.107600.
53. Helo, P.; Shamsuzzoha, A.H.M. Real-time supply chain—A blockchain architecture for project deliveries. *Robot. Comput.-Integr. Manuf.* **2020**, *63*, 101909. https://doi.org/10.1016/j.rcim.2019.101909.
54. Zhu, X.N.; Peko, G.; Sundaram, D.; Piramuthu, S. Blockchain-Based Agile Supply Chain Framework with IoT. *Inf. Syst. Front.* **2021**, *25*, 1–2. https://doi.org/10.1007/s10796-021-10114-y.
55. Ko, T.; Lee, J.; Ryu, D. Blockchain Technology and Manufacturing Industry: Real-Time Transparency and Cost Savings. *Sustainability* **2018**, *10*, 4274. https://doi.org/10.3390/su10114274.
56. Chakuu, S.; Masi, D.; Godsell, J. Exploring the relationship between mechanisms, actors and instruments in supply chain finance: A systematic literature review. *Int. J. Prod. Econ.* **2019**, *216*, 35–53. https://doi.org/10.1016/j.ijpe.2019.04.013.
57. Zhao, L.; Huchzermeier, A. *Supply Chain Finance*; Springer: Berlin/Heidelberg, Germany, 2018.
58. Wang, L., Luo, X. R., Lee, F., & Benitez, J. Value creation in blockchain-driven supply chain finance. Information & Management **2021**, 103510. https://doi.org/10.1016/j.im.2021.103510
59. Yan, N.; Tong, T.; Dai, H. Capital-constrained supply chain with multiple decision attributes: Decision optimization and coordination analysis. *J. Ind. Manag. Optim.* **2019**, *15*, 1831–1856. https://doi.org/10.3934/jimo.2018125.
60. Cocco, L.; Pinna, A.; Marchesi, M. Banking on Blockchain: Costs Savings Thanks to the Blockchain Technology. *Future Internet* **2017**, *9*, 25. https://doi.org/10.3390/fi9030025.
61. Melo, C.; Araujo, J.; Dantas, J.; Pereira, P.; Maciel, P. A model-based approach for planning blockchain service provisioning. *Computing* **2022**, *104*, 315–337. https://doi.org/10.1007/s00607-021-00956-4.
62. Qin, B.Y.; Hao, Z.; Qiang, Z. Programmable Implementation and Blockchain Security Scheme Based on Edge Computing Firework Model. *Int. J. Inf. Technol. Web Eng.* **2021**, *16*, 1–22. https://doi.org/10.4018/IJITWE.2021010101.

63. Xu, J.H.; Tian, Y.; Ma, T.H.; Al-Nabhan, N. Intelligent manufacturing security model based on improved blockchain. *Math. Biosci. Eng.* **2020**, *17*, 5633–5650. https://doi.org/10.3934/mbe.2020303.
64. Nazaritehrani, A.; Mashali, B. Development of E-banking channels and market share in developing countries. *Financ. Innov.* **2020**, *6*, 1–9. https://doi.org/10.1186/s40854-020-0171-z.
65. Inoue, Y. Indirect innovation management by platform ecosystem governance and positioning: Toward collective ambidexterity in the ecosystems. *Technol. Forecast. Soc. Chang.* **2021**, *166*, 120652. https://doi.org/10.1016/j.techfore.2021.120652.
66. Opricovic, S.; Tzeng, G.H. Extended VIKOR method in comparison with outranking methods. *Eur. J. Oper. Res.* **2007**, *178*, 514–529. https://doi.org/10.1016/j.ejor.2006.01.020.
67. BSOS Official Website. Available online: https://www.bsos.co/ (accessed on 31 May 2022).
68. KGI Bank Official Website. Available online: https://www.kgibank.com.tw/en/ (accessed on 31 May 2022).