Comparing world regional sustainable supply chain finance using big data analytics : A bibliometric analysis

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Abstract

Purpose: Sustainable supply chain finance (SSCF) is a fascinated consideration for both academics and practitioners due to the indicators are still underdeveloped in achieving sustainable supply chain finance. This study proposes a bibliometric data-driven from the literature to illustrate a clear overall concept of sustainable supply chain finance that reveals hidden indicators for further improvement.

Design/methodology/approach:

A hybrid quantitative and qualitative approach combining data driven analysis, fuzzy Delphi method, entropy weight method and fuzzy decision-making trial and evaluation laboratory is employed to address the uncertainty in the context.

Findings:

The results show that blockchain, cash flow shortage, reverse factoring, risk assessment, and triple bottom line play significant roles in SSCF. A comparison of the challenges and gaps among different geographical regions is provided in both advanced local perspective and a global state-of-the-art assessment. There are 35 countries/territories being categorized into five geographical regions. Two of the five regions, Latin America and the Caribbean and Africa, show the needs for more improvement exclusively in collaboration strategies and financial crisis. Exogenous impacts of wars, natural disasters and disease epidemics are implied as inevitable attributes for enhancing the sustainability.

Originality/value:

This study contributes to (1) boundary SSCF foundations by data driven literature review, (2) identifying the critical SSCF indicators and provide the knowledge gaps and directions as refences for further examination, and (3) addressing the gaps and challenges in different geographical regions to provide advanced assessment from local viewpoint and to diagnose the comprehensive global state-of-the-art of SSCF.

Keywords: sustainable supply chain finance; big data; fuzzy Delphi method; entropy weight method; fuzzy decision-making trial and evaluation laboratory

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1. Introduction

Supply chain finance (SCF) is recognized as a significant concept in supply chain (SC) and is a fascinated consideration for both academics and practitioners (Yan et al., 2016; Xu et al., 2018). The SCF concept is a financing solution to optimize financing practices of production lines and information transactions that benefits SC members by unravelling monetary compressions with low interest, payment terms extension, and additional working assets (Gelsomino et al., 2016, Wuttke et al., 2016). Hofmann (2005) claimed that SCF is an approach for suppliers, buyers, and intra service providers, to create extra value through collaboration in developing and monitoring the financial resources movement within the SC. Wuttke et al. (2013b) regarded SCF as the optimized scheduling, planning, and management of SC cash flows to facilitate efficient material flows. Caniato et al. (2016) and Gelsomino et al. (2019) proposed the SFC concept as multiple schemes of buyers collaborating with financial services providers for inventory financing, reverse factoring, purchase order, and dynamic discounting to offer liquidity to suppliers. SCF is realized to cut down operational costs and generate more profit for up-and-downstream players, improve financial performance, hence, promote SC sustainability (Dye and Yang, 2015; Gong et al.,2018). However, there is limited in scope since the SCF is only considered as a financing instrument (Liu et al., 2015; Chakuu et al., 2019). This gives the needs to consider potential of SCF as an enabler of sustainability approaches (Aljazzar et al., 2018; Liang et al., 2018). Despite the fact that practices have begun to imply the advance financing mechanisms to encourage SC sustainability, studies on the sustainable supply chain finance (SSCF) are falling in short (Rajeev et al., 2017; Zhan et al., 2018).

In the literature, Silvestre (2015) concise collaboration, integration, and innovation as connected enablers to SCF sustainability by filling efficiency and responsiveness needs of SC actors. Zhan et al. (2018) explored the financing mechanism efficiency on sustainable SC management improvement that apprehensively captures the payment effect on the members' benefits. Zhao et al. (2018) examined the capital constraints between the relationship of sellers and the manufacturers' green product design that the sellers increase their order quantity and improve the profit from encouraging delay payments, thus, improving the SC efficiency. Sarkar et al. (2018) explored the variable carbon emission costs impacts and multi-delay payments on sustainable three-level SC on a global scale that established multi-level trade credits by adopting multiple deliveries. Tiwari et al. (2018) focused on trade credit policy and regulations to improve sustainable SC performance by heightening green manufacturing and payment periods.

However, the literature is limited on a holistic SSCF while most study tends to figure the connection of sustainability and SCF without fully understand the nature of this concept. Zhou et al. (2018) argued that comprehensive SSCF is critical for the SC to strengthening its sustainability and Martin and Hofmann (2019) claimed that there is a missing comprehensive classification for describing the SSCF instruments. Yet, the gaps of SSCF functions are still under-developed even though the SCF approaches or other mechanisms in achieving sustainability have been extensively discoursed among scholars (Liang et al., 2018; Zhan et al., 2018). The theories and practices of SSCF and sustainable SC management are straggling behind schedule due to the missing links

between the finance issues and SC, manufacturing procedures, and information management studies (Wang et al., 2019). There is an urgent need to create a deeper assessment to the SSCF and propose a bibliometric data-driven from the literature to illustrate a clear overall concept of SSCF that reveals hidden indicators for further improvement.

Furthermore, as global SC desires to cross borders and deal with different countries with different political and cultural backgrounds (Bui et al., 2021; More and Basu, 2013), the SSCF needs to consider the regional differences to be comprehended. Wuttke et al. (2013a) investigated six European countries implementing the SCF to increase the communication frequency between suppliers and the focal firm, contributing to SC collaboration in terms of financial issues development. In Asia, Liu et al. (2015) highlighted the regional distinctions in the SCF structural approaches in China. Tseng et al. (2018a) established balance of the TBL in SSCF in Vietnam to gain benefits in risk control propositions and sustainability. Regional differences present an opportunity for future study in the connection among product, market, and regulation with distinct economic phenomena (Jia et al., 2020a). However, geography and culture diversity cause communication complex among partners in the regions resulting in poor SC performance (Carter and Rogers, 2008). The lack of established regional policies and regulations would lead to unsustainable activities, informal behavior within the SC (Silvestre, 2015). SSCF throughout geographical regions is argued to structure a foundation of general practices toward a SSCF standard, thus, improving the SSCF ecosystem (Bals, 2019; Jia et al., 2020a). There is insufficient regional focus in the present SSCF studies. This study emphasizes on exploring the regional SSCF state-of-the-art from the literature bibliometric data driven. The study's objectives are targeted as follows:

- To explore SSCF though a bibliometric data-driven in the literature
- To identify critical indicators for future trends and challenges
- To determine the SSCF knowledge gaps among world geographical regions

Hence, both quantitative and qualitative methods are constructed in this study. A hybrid approach combined from content bibliometric analysis, fuzzy Delphi method (FDM), entropy weight method (EWM) and fuzzy decision-making trial and evaluation laboratory (FDEMATEL) is employed to face the uncertainty in the context. The bibliometric analysis is approached to identify the SSCF indicators based on the data of all publications in the Scopus database using the VOSviewer software to provide visuality results (Shukla et al., 2019). The FDM is applied to eliminate those invalid SSCF indicators by computing the experts' linguistic references (Bui et al., 2020). The EWM converts the indicators' occurrence value into comparable weights to determine the regional performances (Tseng, 2017). The FDEMATEL method is used to determine the improving indicators as further study trends (Tseng et al., 2018b).

This study contributes to (1) boundary SSCF foundations literature bibliometric data driven; (2) identify the critical SSCF indicators and provide the knowledge gaps and directions as references for further examination; and (3) address the gaps and challenges in different geographical regions to provide advanced practical assessment from local viewpoint and to diagnose the comprehensive global state-of-the-art of SSCF. Consistently, SSCF faces insufficient management due to information dispensation challenges and uncertainty making vulnerable the whole system (Tseng et al., 2018a; Jia et al., 2020b).

The rest of this study is organized in five sections. The next section discusses the SSCF literature. The third section explains the proposed analysis steps, data collection, methodologies. The results are discussed in fourth section. Then, the fifth section addresses the study trends and future challenges, and regional discussion. Concluding remarks and study's limitations is provided in the last section.

2. Literature review

This section provides the literature review of SSCF and SSCF from geographical region viewpoints

2.1. Sustainable supply chain finance

The SSCF is defined as financial mechanism providing business transactions to minimize negative effects and create benefits on environment, social, and economics (triple bottom line - TBL) for the entire SC (Business for Social Responsibility, 2018). The concept comprises two dimensions of internal and external financing mode. The internal financing dimension have been studied on peer-to-peer loaning, delay payment, credit guarantee, and so on (Bui et al., 2020b; Zhang and Chen 2021). Whereas, the external financing dimension has explored as the bank SCF constrains, financing equity, or independent mortgagee (Yang et al., 2019). These approaches provide supplementary benefits for both SC members and third-party financing agencies via collaboration in controlling and acquiring the financial resources movement within the SC (Hofmann, 2005). Aljazzar et al. (2018) proposed the dissemination phase of SC that using trade credit to improve the economic and environmental performance. Tseng et al. (2019) identified a SSCF hierarchical structure as a vital implementer for decisions making accurateness to improve the firms' benefits and costs efficiency under uncertainty.

The SSCF indicators are acknowledged to diminish operative expenses and generate more profit by strengthen financial performance and encourage sustainability (Dye and Yang, 2015; Gong et al., 2018). Hu and Hu (2009) emphasized a fastened manipulation between the physical issues such as materials, products, logistics, and capital financial and cash flows in the financing system. Hofmann and Belin (2011) focused on the current assets or liabilities of payable account and inventory as a crucial SSCF innovation compared to traditional banking. Yan et al. (2019) analyzed how the financial restricted retailer's selection between the investment and trade credit offered by the supplier to meet their funding requirements. Cao and Yu (2019) investigated the financing modes selecting optimization on the SC capital constrains of supplier's bank loan and trade credit to consumers' demand and low-carbon predilection. Shi et al. (2020) studied the coordination in SSCF to solve the capital-constrained problem where the suppliers offer a buyback agreement to recompense the money lender to handle the nonpayment from the retailer.

In practices, Li and Chen (2019) demonstrated the SSCF encourages the market exploitation and improve financial performance, thus cultivating competitive advantage. Caniato et al. (2016) and Gelsomino et al. (2019) proposed a multiple organizational collaboration structure of buyers and financial agencies for inventory financing, reverse factoring, purchase orders, and dynamic discounting to enlighten supplier's liquidity. Zhang and Chen (2021) analyzed the interaction between financing mixture strategy and cleaner remanufacturing of risk antagonistic supplier and nonaligned risk capital restricted equipment producers in a dyadic closed-loop SC. However, SSCF is often referred to as a solution rather than an advance financial product/service. The current literature ordinarily focuses on a small insight, and in capable of delivering high quality measures

to promote the SSCF. Even though previous studies have realized the importance of SSCF performance to achieve competitive advantage and lined up the financial resources assessment, only few studies have considered the SSCF in integrating sustainable financing strategy, manufacturing production, SC operation as whole (Bui et al., 2021, Jia et al., 2020a). Innovative exploration to achieve SSCF as a new study concept to improve sustainable performance is needed.

2.2. Sustainable supply chain finance in geographical region issue.

The SC acquiescence in sustainable practices is important for the sustainability since upstream sustainable practices are tied to the downstream sustainable performance and directly influences the whole SC (Ma et al., 2020). Yet, diversity in geographical regions and culture supplementary complicates the SC communication in different regions leading to poor SC management, and the SC expand in various regions is argued to complement practical complexity, assisting to SC offense operation and disruption, thus weakening the sustainability progress (Jia et al., 2020b, Bui et al., 2021). Particularly, Liu et al. (2015) highlighted the regional differences in approaching and structuring the SSCF to better tolerance the successful enables either throughout time or beyond geographical regions to distill best practices. Bhuiyan et al. (2017) and Sim and Prabhu (2017) illustrated SSCF offers SC members to better access the financial resources, improve the income, especially for those in developing regions or rural areas. Accordingly, it is necessary for local firms to ensure their SC work accordantly to guarantee sustainability standards in overall SC.

More and Basu (2013) argued that there are needs to cross borders in today global SC to various countries with diverse cultural and political backgrounds. The regional differences play as opportunity for future academic investigation and practices to take advantages on the crossing of product, market, and regulation (Bals, 2019; Bui et al., 2021). Therefore, SSCF needs to contemplate these regional differences, which signifies the market and regulation feature in the meeting point with the production issues and the stakeholder approach. SSCF are declared not only within the financial value chain but also essentially different from the structures itself since the concept includes a strong non-profit constituent of SC, such as the interrelationship between the manufacturers in developing countries and their purchasers in developed ones (Navas-Alemán et al., 2015; van Bergen et al., 2019). For instance, developing regions usually have inadequate regulations and policies, resulting in significant social issues, such as manufacturing using slave workers or child labor, while absence of institutional involvement and unsustainable behavior, such as informal activities, emerges in the upstream SC influence to the firms reputations and revenue (Silvestre, 2015).

Therefore, SSCF helps to improve SC management through progressing collaboration, supplier monitoring and assessment. The concept facilitates relationship building between cross-border suppliers and focal firms by increasing the communication frequency, enabling information transparency, strengthening supplier management and helping to control SC frauds (Gelsomino et al., 2016; Jia et al, 2020a). However, there is insufficient in regional focuses as empirical studies in SSCF is not yet fully established. Investigating in SSCF in different regions with distinct ecological phenomenon is needed to contribute toward addressing and identifying an SSCF ecosystem. When SSCF is more and more recognized in SC operation, examining financial mechanisms in the sustainable SC context, gradually related SSCF is needed.

3. Data collection and proposed method

This section proposes analysis steps offering a clear explanation in relation to the data collection process, data driven analysis, FDM, EWM, and FDEMATEL.

3.1. Proposed analysis steps

In this study, 30 experts were approached to guarantee the reliability of the analysis procedures. The experts are a group of researchers and practitioners with at least 8-year experience of studying and working in SCF, including seven experts from the academic field, ten experts from practical SC field, six experts as executive managers from financial institutions. In addition, seven experts from government and NGOs agencies (as shown in Appendix A).

The analysis steps are proposed as follows:
(1) A feasible search term is identified for deductive coding - content analysis to collect the publication information from the Scopus database.
(2) Bibliographic analysis is conducted by adopting VOSviewer software to identify the SSCM indicators in disruption and ambidexterity, nations coupling and regional categorize are generated from the database.
(3) The experts' evaluation on proposed indicators is conducted using the questionnaire. The FDM is used to screen out the invalid indicators.
(4) The indicators' frequency is generated by conducting the inductive coding - content analysis, and the EWM is adopted to translate the indicators' entropy into comparable scales to specify the regional comparison.
(5) The important indicators for each region and the overall scenario are identified using the fuzzy DEMATEL to scrutinize the future study gaps. The analysis processes are presented in Figure 1.

INSERT Figure 1 HERE - Analytical procedure

3.2. Data collection

Scopus database is advantage due to it covers larger publications array with more applicable bibliometric descriptions compared to other sources (Ansari and Kant, 2017; Jin et al., 2018). Gelsomino et al. (2016) provided a systematic review of SCF using databases of Scopus. Bals (2019) conducted a systematic literature review from the Scopus database to develop a SCF ecosystem framework. Jia et al. (2020a) rigorously reviewed 47 publications identified in the Scopus in the SSCF context. The database is wide-cover of peer-reviewed literature: engineering, scientific, social sciences journals; books and conference proceedings with number of identifiers consisting of title, abstract, keywords, year of publication, author, author affiliation, citation record, and country. Accordingly, this study adopting the Scopus database to assess into the scholar of SSCF literature. A searching boundary was limited until December 23rd, 2019 constrains in English articles and reviews.

In this study, content analysis is used as a text mining instrument to cram documents based on systematic track of texts or artifact (Hodder, 1994). Based on text mining to classify the textual data, content analysis is essential to assess a high volume of data in a structured and systematic approach by precisely capture relevant information to identify valuable topics, methods and themes with manual approaches (Gao et al., 2020; Kazemi et al., 2019).There are two types of content analysis coding: deductive and inductive coding (Seuring and Gold, 2012). The deductive

content analysis obtained the coding before the data evaluation process and indicate the analytic groupings as the study center. The inductive one refers to coding generated from the data throughout the review procedure. The technique is powerful to define the full-text documents features through compressing substantial words and texts into smaller and predefined categories, thus, provides laborious and productive literature reviews on examining the literature distribution (Horne et al., 2020; Vaismoradi et al., 2013). Cheng et al. (2015) presented a review of the international manufacturing network existing literature using a combination of content analysis. Bhatt et al (2020) applied bibliometrics and content analysis to progress an intellectual literature structure of sustainable manufacturing. Bui et al. (2021) developed a data driven sustainable supply chain management literature towards disruption and organizational ambidexterity.

This study first using the deductive method as predefined search terms used to assess SSCF literature from Scopus databased. The search terms are defined as "("*sustainable supply chain finance*" or "*supply chain finance*")", the results are filtered by the titles, abstracts, or keywords. Next, the inductive coding is employed using bibliometric analysis to identify code-wording from literature review. The process is to pattern regional consistency of independent coding in counting indicator frequencies of each specific region through searching in the regional data generated from the Scopus database.

3.3. Bibliometric analysis

The bibliometric method is a quantitative tool to conduct the vividly cumulative literature providing scientific mapping on the objectives and studies' pattern (Zupic and Cater, 2015). The bibliometric analyses are performed in this study using VOSviewer version 1.6.11 to categorize documents that have similar meaning to each other into the same cluster to describe the relationships between them (van Eck and Waltman, 2019). The method develops quantitatively represent the knowledge structure and intellectual headway to properly classification the existing studies (Feng et al., 2017; Wang et al., 2019). Thus, this study uses VOSviewer to visualize bibliometric network and determine the SSCF indicators, exploring the knowledge gaps as opportunities for future studies and practices.

3.4. Fuzzy Delphi method

This study proposes the combination of fuzzy set theory and the Delphi method to solve the lack of expert references and build up questionnaire quality (Ishikawa et al. 1993). The method is applied to refine the indicators using the experts' linguistic references (Bui et al., 2020a). It provides advantages, e.g. reducing the number of respondent and the return time while ensuring effective assessment of expert's evaluation. The fuzzy evaluation is converted into exact numbers with additional supports in shortening survey time and expend.

The analytical process starts with expert a scales value of indicator b as $j = (x_{ab}; y_{ab}; z_{ab})$, $a = 1,2,3,…,n; b = 1,2,3,…,m$, as j_b is the weight of b presented as $j_b = (x_b; y_b; z_b)$ with $x_b = min(x_{ab})$, $y_b = (\prod_1^n y_{ab})^{1/n}$, and $z_b = max(z_{ab})$. Afterward, the linguistic references from experts are transformed into triangular fuzzy numbers (TFNs) (in Table 1).

The convex combination value D_b is calculated by means of a γ cut as:

$$u_b = z_b - \gamma(z_b - y_b), l_b = x_b - \gamma(y_b - yx_b), b = 1,2,3,…,m \qquad (1)$$

The γ value can be modified from 0 to 1 regarding to negative or positive of experts' perceptions. The value is usually specified as 0.5 in general scenario.

The D_b then is indicated as:

$$D_b = \int(u_b, l_b) = \delta[u_b + (1 - \delta)l_b] \tag{2}$$

In which, δ presents the positive balance on expert's ultimate assessment.
The threshold to refine the valid indicators is computed by $t = \sum_{a=1}^{n}(D_b/n)$.
Once $D_b \geq t$, indicator b is accepted. If not, it is obligately eliminated.

INSERT Table 1 HERE - Transformation table of linguistic terms for FDM.

3.5. Entropy weighted method

This study adopts adopting the EWM to determine the differences of SSCF among geographical regions.

The inductive content analysis is used improve the EWM on coding indicators' frequencies. The search term for each region is defined to generate the regional data. The frequency tracking is coded in comparable Excel file to avoid duplicating the computation activities and enhance the reliability of the result. A content analysis is applied to check the regional consistency of independent coding. The indicator frequencies for each specific region is counted by generating SSCF regional data from Scopus (See Appendix B). For example, the search term to generate the Africa SSCF data is *"TITLE-ABS-KEY ("Morocco" or "Nigeria")"*.

The entropy method computes unsystematic structure using weight measurement. An indicator with high entropy means large extend on responding to the structure (Wen et al., 1998; Tseng, 2017). The method includes function $f_i: [0, 1] \rightarrow [0, 1]$, justified by three constrains: (1) $f_i(0) = 0$, (2) $f_i(x) = f_i(1 - x)$, and (3) $f_i(x)$ to expand the range of $x \in (0, 0.5)$. The largest value of this function increases at $x = 0.5$, and the value $(\partial^{0.5} - 1)$ to make the result in the range $[0, 1]$. The entropy weighted computational processes are as follows:

The indicator's frequency ε is determined with coefficient value between zero and one, and generally set to 0.5 in general circumstance with:

$$\tau_{0,i} = \sum_{m=1}^{n} w_m \varepsilon_{0,i}(m) \text{ for } i = 1, 2, \dots, m \tag{3}$$

Where the weight $(w_m, \sum w_m = 1)$ for each distinctive indicator is calculated
Each indicator's coefficient arrangement is generated as:

$$C_j = \sum_{i=1}^{n} \varepsilon_i(j) \tag{4}$$

Each indicators' entropy weight is then computed using:

$$e_j = k \sum_{j=1}^{n} w_e \left(\frac{\varepsilon_i(j)}{e_j}\right) \tag{5}$$

The total entropy values are estimated:

$$E = \sum_{j=1}^{p} e_j \tag{6}$$

Each indicator weighted value is calculated:

$$w_j = \frac{\frac{1}{p} - E(1 - e_j)}{\sum_{j=1}^{p} 1/p - E(1 - e_j)} , j = 1, 2, 3, \dots, p \tag{7}$$

3.6. Fuzzy decision-making trial and evaluation laboratory

The fuzzy set theory is used to translate human linguistic judgments under uncertainty into the quantitative data, while the DEMATEL is intended to construct causal inter-correlations among indicators under complex situations (Tseng et al., 2018a). The method adopts the defuzzification technique to generate FTNs into the crisp values. The fuzzy membership functions

$\tilde{e}_{ij}^k = (\tilde{e}_{1ij}^k, \tilde{e}_{2ij}^k, \tilde{e}_{3ij}^k)$ are used to calculate the total weighted values. Accordingly, the left and right values are computed using the minimum and maximum fuzzy numbers. The crisp values are then acquired into a total direct relation matrix for diagram mapping to simplify analytical results. The inter-correlations structure comprises specific indicators denote vital means in the construct. A set of indicators is presented as $F = \{f1, f2, f3, \cdots, fn\}$ to execute pairwise evaluation creating the mathematical connections.

This study accumulates the crisp values using linguistic scales from VL (very low influence) to VHI (very high influence) (in Table 2). Provided that there are k experts joining the evaluation process, the $\tilde{e}_{ij}^k$ represents the fuzzy weight of indicator i^{th} effects on the indicator j^{th} estimated by expert k^{th}.

(INSERT Table 2 here- TFNs linguistic scale for FDEMATEL)

The fuzzy numbers are abbreviated as:

$$F = \left(f\tilde{e}_{1ij}^k, f\tilde{e}_{2ij}^k, f\tilde{e}_{3ij}^k\right) = \left[\frac{(e_{1ij}^k - mine_{1ij}^k)}{\Delta}, \frac{(e_{2ij}^k - mine_{2ij}^k)}{\Delta}, \frac{(e_{3ij}^k - mine_{3ij}^k)}{\Delta}\right] \tag{8}$$

where $\Delta = maxe_{3ij}^k - mine$

The left (lv) and right (rv) normalized values are generated follows:

$$\left(lv_{ij}^n, rv_{ij}^n\right) = \left[\frac{(fe_{2ij}^k}{\left(1+fe_{2ij}^k - fe_{1ij}^k\right)}, \frac{fe_{3ij}^k}{\left(1+fe_{3ij}^k - fe_{2ij}^k\right)}\right] \tag{9}$$

The total normalized crisp values (cv) is computed as:

$$cv_{ij}^k = \frac{[lv_{ij}^k\left(1-lv_{ij}^k\right)+(rv_{ij}^k)^2]}{(1-lv_{ij}^k+rv_{ij}^k)} \tag{10}$$

The synthetic values symbolization to accrue the individual insight from k respondents are implemented by:

$$\tilde{e}_{ij}^k = \frac{(cv_{ij}^1 + cv_{ij}^2 + cv_{ij}^3 + \cdots + cv_{ij}^3)}{k} \tag{11}$$

Consequently, the pairwise comparison is engaged to obtain direct relation (IM) $n \times n$ initial matrix, where $\tilde{e}_{ij}^k$ regards to the effective level of indicator i on indicator j, moderated as $IM = [\tilde{e}_{ij}^k]_{n \times n}$.

The normalized direct relation matrix (U) is developed as:

$$U = \tau \otimes IM$$
$$\tau = \frac{1}{\max\limits_{1 \leq i \leq k} \sum_{j=1}^k \tilde{e}_{ij}^k} \tag{12}$$

The inter-correlations matrix (W) is attained using:

$$W = U(I - U)^{-1} \tag{13}$$

where W is $[w_{ij}]_{n \times n}$ $i, j = 1, 2, \cdots n$

The values of the driving power (α) and dependence power (β) are summed up from the rows and columns values inter-correlations matrix using:

$$\alpha = [\sum_{i-1}^n w_{ij}]_{n \times n} = [w_i]_{n \times 1} \tag{14}$$
$$\beta = [\sum_{j-1}^n w_{ij}]_{n \times n} = [w_j]_{1 \times n} \tag{15}$$

The indicators are placed in an inter-correlations diagram obtained from the $[(\alpha + \beta), (\alpha - \beta)]$, which in turn organized into horizontal and vertical vectors. The indicators are grouped into causal and effected groups based on positive or negative value of $(\alpha - \beta)$. The $(\alpha + \beta)$ exhibits the indicators' importance, the larger $(\alpha + \beta)$ value indicator is, the more important it is. This study uses the average value of $(\alpha + \beta)$ to classify the top important causal indicators that need to be focused on.

4. Results

This section discusses SSCF data driven and FDM results. The EWM results is employed to clarify the regional differences, and top indicators from the FDEMATEL analysis is determined for further discussion.

4.1. Bibliometric analysis

From the content analysis, the result shows that 296 articles and reviews are generated with the earliest year from 2006. This study organizes co-occurrence bibliographic coupling of author keywords obtained from Scopus (see Appendix C). There are 126 keywords listed with at least two times occurrence, in which SCF, SC management, SC, reverse factoring, and trade credit have the highest frequent occurrences compared with others. Author keywords distribution is illustrated in bibliographic coupling form via VOSviewer. The visualization expresses the SCF and SC management node represented as the central keywords, which then have interrelationship with the others. The yellow nodes, such as the SSCF, SC coordination, blockchain, big date, risk reference, moral hazard, are the latest occurring keywords since year of 2018 (See Figure 2).

INSERT Figure 2 HERE - Co-occurrence of author keywords by publication year

There are 35 countries/territories recorded, with the minimum number of documents for a country equal to 1. This study acquired bibliographic coupling by year with the most productive countries/territories is China followed by the United State. The latest countries/territories listed in the field are Sweden, Australia, Thailand, Malaysia, Finland since 2019 (see Figure 3). The countries/territories are then categorized to 5 geographical regions based the UN countries list (2019), including North America, Latin America and the Caribbean, Africa, Asia and Oceania, and Europe (shown in Appendix D). Unfortunately, the Latin America show no publication so far.

INSERT Figure 3 HERE - Bibliographic coupling of countries/territories by year

4.2. Fuzzy Delphi method

A face-to-face interview between the authors and expert group was held. Delphi technique is used by reviewing the secure agreement among respondents. The experts are requested to confirm the importance of the keyword using a nominal YES/ NO scale. The inclusion of indicators was based on a 75% or higher agreement of the experts identifying 45 indicators from the 126 author keywords for the FDM phase (Tsai et al., 2020). The set of SSCM indicators are evaluated by the expert and the linguistic references are converted into conforming TFNs (in Table 1). The proposed indicators are refined resulting in 16 indicators being accepted with a threshold of 0.362 (shown in Appendix E).

INSERT Table 3 HERE – Final List of FDM indicators result

4.3. Entropy weighted method

Table 4 depicts the indicators' entropy weights of the regions and the EWM employed entropy presents the information size. The higher the indicators' values are, the more information is provided. In another way, the larger the entropy value is, the smaller the entropy weight is, and the more information the indicator provides (He et al., 2016). This study uses the average weighted technique to determine the level of indicator information in each region. If the weight is larger than the average, the indicator requires for improvement (shown in Table 5). The results reveal that Asia and Oceania have the highest amount of information provided in the field of SSCF, followed by Europe. However, North America, Africa, and Latin America and the Caribbean presented no information in terms of selected indicators confirming there is still many rooms for developments.

INSERT Table 4 HERE - Regional entropy weights

INSERT Table 5 HERE - Region Entropy weight comparison.

4.4. Fuzzy decision-making trial and evaluation laboratory

From the FDM results, the experts evaluated the indicators' inter-correlation using the provided linguistic scales (see Table 2). The fuzzy direct relation matrix and the defuzzification are generated for the average crisp value computation to create the initial direction matrix (see Table 6). The total inter-correlation matrix is formed (see Table 7), as is the inter-correlation among the indicators (shown in Table 8). Figure 4 illustrates the inter-correlation diagram between regions based on the $(\alpha + \beta)$ and $(\alpha - \beta)$ cuts. The average value of $(\alpha + \beta)$ is used to classify the most important causal indicators that needed attentions. The differences between regions are also shown. In particular, the important indicators for Asia and Oceania are blockchain(I2), cash flow shortage(I4), financial crisis(I9), reverse factoring (I13), and TBL (I16). Europe focuses on blockchain(I2), cash flow shortage(I4), collaboration(I5), risk assessment (I14), and TBL (I16). For Latin American and Caribbean regions, the important indicators consist of cash flow shortage(I4), collaboration(I5), financial crisis(I9), risk assessment (I14), and TBL (I16). The most important indicators of the North America are blockchain(I2), cash flow shortage(I4), collaboration(I5), reverse factoring (I13), and TBL (I16). While blockchain(I2), cash flow shortage(I4), collaboration(I5) financial crisis(I9), risk assessment (I14), and TBL (I16) are important indicators of Africa region.

Overall, the top indicators for SSCF are blockchain(I2), cash flow shortage(I4), reverse factoring (I13), policy (I13), risk assessment (I14), and TBL (I16), respecting to have continuing and response impacts in the system. They are considered as critical study trends to approach SSCF.

INSERT Table 6 HERE – Overall initial direction matrix

INSERT Table 7 HERE – Overall total inter-correlation matrix**)**

INSERT Table 8 HERE - Causal inter-correlation among indicators.**)**

INSERT Figure 4 HERE - Causal inter-correlation of indicators among regions**)**

5. Discussion

This study offers a literature review, identifies indicators for future studies improvement and provide the regional SSCM state-of-the-art differences.

5.1. Study trend and challenges

The most critical indicators for SSCF are identified. The blockchain, cash flow shortage, reverse factoring, risk assessment, and TBL are deemed to play a significant role as guidelines for future studies and challenges in approaching the SSCF.

5.1.1. Blockchain

Blockchain is currently acknowledged as a game-changer in many sectors, such as service, manufacturing, and finance (Yadav and Singh, 2020). Blockchain technology is a consistent collective database technology maintained through decentralization and de-trusting (Chen and Wang, 2019). The technology offers advantages, such as security, concealment, traceability, scalability, scattered storage, and smart contract, that are capable to solve the double-spend problems (Chiaroni et al., 2019; Christidis and Devetsikiotis, 2016; Scherer, 2017). It unravels the centralization as well as apprehends the decentralized and peer transactions among members by using timestamp technology, asymmetric encryption algorithms, and disseminated compromise with no attained trust needed (González et al., 2018). Blockchain records transactions in a confirmable, encoded, and inexpensive way thus making transactions from the manufacturer to the end customers more cost-efficient, avoiding invalid and unnecessary hierarchical structure of information used, and helps to ensure transparency, guarantee the data to be valid, reliable and authenticated and makes the SC system more energy-efficient and high performance oriented (Aidara and Sagna, 2019; Anjum et al., 2017; Catalini and Gans, 2016). In another words, the blockchain is able to substantially cut the transaction costs for shareholders by reducing assessment cost and removing intermediate third-party in the business ecosystem (Ahluwalia et al., 2020).

Researchers and practitioners viewed the blockchain implementation as technological innovation that dislocates prevailing SC to improve the efficiency and effectiveness of resources used, and later helps to establish a SSCF (Hofmann and Johnson, 2016). Blockchain technology embodies some potentials areas of practices such as new commercial models and startup backing (Akbarpour, 2019; Morkunas et al., 2019, Tumasjan et al., 2019). The interaction between reciprocated trust and supplier partnership are explored, finding that emerging technologies adopted in SCF programs (such as blockchain) are effective in improving information transparency, thus helping to solve trust issues among the SC participants (Gelsomino et al., 2016; Francisco and Swanson, 2018). Blockchain has provided innovators the capability to produce digital tokens representing uncommon properties, possibly redesigning the firm scenery and innovation (Chen, 2018). The technology applications are combined in fractional calculus model to verify the feasibility of SCF system and find the connection between each other (Chen and Wang, 2019). Furthermore, the economics of blockchain is applied to transaction costs in startup financing to demonstrate how and why the technology is effective (Ahluwalia et al., 2020). Hence, the technology is an important driving indicator for SCF to integrate information and communication

technology and continuously endeavor to develop a sustainable efficient system than the inefficient design of traditional SC management.

Even though there have been some studies on various facets of blockchain, the technology itself is in its early stages and so far, inadequate work has been carried out (Queiroz and Wamba, 2019). Studies exploring the SCF and sustainable business field of blockchain are fractional with limited qualitative and quantitative attempt (Catalini and Gans, 2016; Yadav and Singh, 2020). Specifically, the decentralization characteristic of blockchain does not allow storing data at one location instead of several located nodes in the chain, which has been seen in the traditional SC ecosystem, are causing a big obstacle in adapting and making the system become sustainable (Azaria et al., 2016). This tactical business model may cause inefficient due to high transaction costs in locational compensations, which are barring firms' development in areas lacking availability of a strong network of financial stakeholders (Mahto et al., 2018a; Guerrero and Urbano, 2019). Indeed, since the blockchain ecosystem involves a number of players in different development phases, it is causing ecosystem inefficiency and abstemiously due to the specialism of financial mediators, such as angels and venture capitalists, who are attentive in a specific industry or a specific stage of the partnership.

Despite blockchain has solved a various of hindering problems of development of SCF system, there should be more attention to develop the SSCF that is challenged either by government regulation or customer demand (Mahto et al., 2018b; Mahto and McDowell, 2018; Luthra and Mangla, 2018). Guarantee the quality of information flow are needed to help consumers to increase and re-claim their trust since they are uninformed in itineraries, production flow, and hazard involved in manufacturing, transport, supervision (Anjum et al., 2017). Thus, the lack of common standards could cause a pledge consequence to the system in dealing with databased systems and align to industry. Obtaining standards for this new technology is difficult and could take more time to adjust into sustainable practices. Furthermore, blockchain required the consumption of highly skilled manpower (Castillo, 2017). The occupational problems and educating employees are also under solving as it is not yet popular in both academicians and practices. Since the blockchain is not fully settled, there are significant risks for participators to get involved and applied the technology in their development strategy.

5.1.2. Cashflow shortage

The SCF strategies usually include two related but distinct issues: (1) dealing with monetary issue among SC partners and financial organizations; and (2) managing the cash flow of both internal and external of organization (Wang and Huang, 2019). The SSCF approach can benefit from collaboration among the SC participants, which generally results in lower debt costs, more loans obtained opportunities or working assets reductions and generates more values to the consumers (Gelsomino et al., 2016, Bui et al., 2020b). The SC alliance can cooperate to improve the cash flow operations, share the financial risk with lower cost (Zhang et al., 2019). The target is to line up financial transmissions along with production line and information flows, amending cash flow management within the SC (Wuttke et al., 2013a; Xu et al., 2018). However, the cash flow risks are varied due to the instabilities of the intra and inter cash flow or even within the SC (Tsai, 2008; Wu et al., 2019). The shortage of cash flow can seriously damage firms' financial balance in very high commodity price volatility situation, specifically when the payment provisions and the credit capabilities are not negotiable and/or distended to handle the new cost composition (Pellegrino et al., 2019).

In the past decades, SCF implementation is considered to be a solution for sustaining cash flow and progressing SC with more monetary healthiness and steadiness to get over the cashflow shortage (Hung et al., 2019). The SCF are applied to optimize the financial structure and the cash-flow within the SC to reduce the investment cost and accelerate the cash flow by involving fixed asset financing, working assets management, order cycle management, and information technology systems support (Gomm, 2010). Accounting metrics is proposed allowing modification of conventional instructions of payment terms influences and borrowing opportunities to conceal cash shortages (Song and Tong, 2012). Thus, SCF is an approximate to increase cash availability in the financial market to guarantee the SC operations by combining financial amenities and technology implementations that provide temporary credit to achieve working capital optimization (Carlo and Menno, 2014). Trade credit policies are also demonstrated to fundamentally solve the cashflow shortage by involving both payment term solutions and pre-payment remedies (Mateut, 2014; Yano and Shiraishi, 2016; Chakuu et al., 2019). Option contract application is considered in a buyer-led SC, where both supplier and purchaser are in risk-averse to confront problems in working capital shortage, channel synchronization, and enclose market threats (Fan et al., 2020). Hence, firms can reduce operational cost through SCF approval by diminishing the SC interruption intimidation, suppliers' cash flow risk, and transaction expenses (Wang et al., 2019).

However, the literature on SCF largely emphases on the design and optimization of the production line, and information and monetary movements among the SC partners (Srinivasa and Mishra, 2011; Yan and Sun, 2013). There are few studies on the details of cash flow interaction in SSCF design. The business cost is massive, either the scenarios of a firm that has bad performance or grow so quickly, is showing its problems. Plenty of businesses go bankrupt due to the primary indicator is not their financial statement but the shortage of cash flow (Ireland, 2008). Increasing order quantity, consistency in wholesale pricing decision, and extending payment terms can create more returns for the supplier as well as save vendors' interest costs, motivate the buyers to purchase more since they have sufficient capital to improve their cash flow (Dekkers et al., 2019; Wu et al., 2019). However, compromising trade credit between SC members could also aggravate undesirable effects such as cash flow shortages and evasion jeopardizes, which seriously damage firms' profitability (Sung and Ho, 2019). New outline of flexible SCF design to provide probable substitute platform for integrating financial operational strategies, balancing cash flow, collecting invoice payments and receivables, and dealing with excess inventory are needed.

Sustainability in cash flow management is a difficult issue, the SCF solution cannot completely avoid the credit risks in financing (Tang and Musa, 2011; Wuttke et al., 2013b). Thus, studies on credit risk in SSCF and developing efficient forecasting methods are also necessary in both academia and industry to handle cash flow shortage problems. There are challenges in sustaining the reliance manual processes. Traditional inputting payments data is time-consuming and risks of human error. How to apply the advance technology such as big data or blockchain are required as an accurate forecast needs a valid and reliable data goes into it. Another problem is the vital contradiction of cash flow management occurs between the up-and-downstream participants that are needed to be handles to speed up the SC and better cash flow accomplishment when the upstream participants want to be paid earlier while the downstream participants desire to extend the payment periods. The FinTech organizations can offer such SCF services as they take part in

the SC (Chen, 2016; Hung et al., 2019). However, they usually do not completely fulfill firms' financial statements, study on the third-party participations are also a potential niche for future. Developing a comprehensive mechanism directions, policies and regulation platform as well as additional data and robust analytic methods are needed to improve the quality of cash flow evaluation to confront possible jeopardies in SSCF.

5.1.3. Reverse factoring

Reverse factoring is defined as an SCF scheme, whereby the financial arrangement is formed, that a substantial buyer accelerates early payment of its trade credit commitments to suppliers (Tanrisever et al., 2012). The indicator is a substitute factoring apparatus for purchasers to cooperate with banks for offering loans to suppliers (Wang et al., 2019). For the upstream of the SC, reverse factoring can help overwhelm a liquidity scarcity, ease operations and production processes, create extra value, and reduce risks and expenses related to unbalanced information (Klapper, 2006). For the downstream, it improves the unsettled days' payable, reduces default risk and simplifies the supplier and purchaser transaction (Liebl et al., 2016). For intermediate financing procedure, reverse factoring also benefits channel performance (Tunca and Zhu, 2017). In reverse factoring, the mortgagee buys receivable accounts only from specific informationally transparent, high-quality purchasers, and the credit risk turns into the evasion risk of the high-quality purchasers rather than other risky low-key firms, making it possible to provide lower financial risk to high-risk suppliers (Gelsomino et al., 2019). The costs and benefits of reverse factoring are engendered when purchasers deliver reverse factoring to their suppliers in return of extending payment term, so that purchasers with strong bargaining power may courtesy reverse factoring usage. The purchaser's client can also be involved in making an unequivocal guarantee that the effects on the payment obligations are met (Wu et al., 2019). This guarantee entails all the factors that offer creditworthy at a rate the client itself can accept to deposits, then the purchaser can therefore use reverse factoring as a substantial reducing cost on financing credit of their suppliers (Van der Vliet et al., 2015).

Reverse factoring has obtained extensive consideration from both the SC practitioners and academics. Previous study has likened reverse factoring to better sustain the SC and efficiency (Wang et al., 2019). It is confirmed that reverse factoring is construed in terms of trust as well as distribution power among trio's collaboration between supplier, buyer, and intermediate financial institute (Wuttke et al., 2013a; Wandfluh et al., 2015; Martin and Hofmann, 2016). Through reverse factoring, suppliers' debt cost is proven to be lower than traditional financing cost and has improved supplier liquidity problems, thus advancing their profit and performance growth (Tseng et al., 2018a). An archtype for overtly capturing the payment effects on the suppliers' sustainability attempts and testing in difference financing situations to benefits the players is proposed, in which the higher the cost is, the higher the importance of reverse factoring influences sustainable SC (Zhan et al., 2018). The indicator is linked with financial inventory and dynamic discounting mechanism are found to benefit SC members depends on working capital requirements and funding limits (Gelsomino et al., 2018). The impact of reverse factoring on the SCF performance is assessed providing additional compensations to the supplier and retailer when the retailer is financially advantaged through a third-party in a SC (Wu et al., 2019).

Even though the innovation on the field has obtained augmented attention, studies on reverse factoring are quite new, under-explored, and noticeably fragmented (Liebl et al., 2016; Grüter and Wuttke, 2017). The literature has inspected the apparatus of delayed payment, early

payment, and reverse factoring, but most of the studies still consider those concepts separately (Grüter and Wuttke, 2017; Lekkakos and Serrano, 2016; Wu et al., 2019). The comparison, relative benefits, linkage, and the relationship between the indicator and other SCF schemes are scarce. There are also needs for further studies to examine the lifecycle, ecosystem, and the SCF overall market (Bals, 2019). Since the SC is an up-down concentrating structure, the impact of different SCF members social behavior on reverse factoring has so far received little attention. Furthermore, practices strategy is now ideally targeted by small and medium businesses, the cash strapped in lacking fixed assets collator, which cannot always be funded by intermediate financial organizations may lead to significant problems that result in firms' financial crisis. Hence, developing such constraints and factorings with better and easier assessment will also improve the reverse factoring performance. Another challenge to consider is the level of indebtedness that reverse factoring encourages, and the intensity of risk that reverse factoring may cause for individual firm and economies, especially the SMEs. When reverse factoring programs were sufficiently widespread, such a default could trigger a market catastrophe. The indicator can raise the risk profile of SC to dangerous levels and could even cause a widespread of financial failure in the ecosystem. Hence, a sustainable reverse factoring standard, monitoring policy and regulation to recompense credit facilities for a favorable reverse factoring is considerably realized as an urgent study discipline.

5.1.4. Risk assessment

The nature of risk is complex. In SCF, it is defined as the risk that threats the stability of/or confidence in the financial system (Billio et al., 2012). The 2008 has witness a global financial crisis that demonstrated the true magnitude international markets connectedness across global financial communities, which had evidenced for propagating risk (Zhang and Broadstock, 2018). The risk exposure surges along with the complex of SC since the financial performance directly related to resources, materials and energy management as well as production lines, and commodities purchasing among the SC partners (Zsidisin et al., 2015). Particularly, risk also derives from other products price as commodities regularly characterize by a coherent percentage of their input costs (Pellegrino et al., 2019). Indeed, assessing in risk management makes SCs more time sensitive and complex than ever, and SCF can create value under demand cooperation strategic with important trading partners to reduce uncertainty of capital requirements among buyers and suppliers (Sodhi et al., 2012; McKinsey, 2015). There is a critical role for SCF to play in reducing financing cost and enhancing operational efficiency by implementing innovative reciprocated modification or better monetary mechanism within the SC (Lam et al., 2019). Therefore, analyzing and understanding such challenges is important to construct new SCF strategies for SCF for risks reduction purpose while avoiding of losing competitiveness.

SSCF plays an important role in stabilizing the SC to reduce risk. Risk assessment model is proposed for the multidimensional integration of financial interpretive framework, followed by firm's internal and external cooperation and collaboration for new product/service development and sustainability achievement (Zhang et al., 2014; Gelsomino et al., 2016; Wandfluh et al., 2016). A SC where the purchaser with capital-constrained and supplier, who is risk-averse, is investigated to acquire equilibrium resolutions by illustrate two financing strategies of credit trade measurement and risk aversion level (Li et al., 2018). An advanced amalgam communal machine learning is proposed to improve the credit risk forecasting accuracy of small and medium

enterprises (Zhu et al., 2019). The relationship among actors, tools, financing mechanisms, and SC processes is explored to ease the financial risk reduction by improving the cash-to-cash rotation and working capital collaboration (Chakuu et al., 2019). The SCF challenges of commodity price violation is addressed from a SC-oriented viewpoint by swapping suppliers and substituting merchandises to moderate production risk and pricing volatility (Pellegrino et al., 2019). Moreover, big data analytics for SC connection in banking is implemented as a tool to explore the internal business-to-business information to improve the SCF and the efficiency of marketing campaigns, thus, enhancing risk management performances (Hung et al., 2019).

Despite the literature focuses on the application of SCF on risk assessment has increased, rare study has examined how risk effects on decision making. There are still complex and unclear relationships between factors among SSCF. The uncertainty is critical in inheriting SC operations, specifically, the more time consuming the order fulfillment loop is, the greater potential the threats to SCF can be. This requires a tight coordination among SC partners to respond to dynamicity of environment, accomplish competitive advantages then achieve the sustainable requirements (Tseng et al., 2019, Bui et al., 2020b). However, lack of knowledge and collaboration within the SC related to SSCF are still ineffectiveness (More and Basu, 2013; Arani and Torabi, 2018). Inadequate financial statements, irrelevant performance, limited operational records also lead to high levels of risk, and many other factors to constrain effectively financing receivables. Likewise, the lack of information transparency also results in the needs for adopting SSCF solutions to reduce systemic risks and investment costs (Wang et al., 2019). Hence, integrating SC process and SSCF are essentially a study field. Offering optimization methods or simulation forecasting to solve either the short-term profitability and liquidity problem or the long-term fiscal risks are required to be represented (McKinsey, 2015). Managing knowledge and information, collaboration aspects development can be effective tools to control cash flow, share the financial risk and lower financing cost within SC, and solve material inequities and diminishing in operational financial system.

5.1.5. Triple bottom line

SCF offers critical solutions to search for improving sustainability opportunities and enhancing the number of studies of the concept. The literature has dedicated courtesy to the TBL impacts on different strategies on manufacturing, SC mechanisms and governance management models, and other key factors, such as trust, commitment, and procurement approaches that deliver higher performance (Alvarez et al., 2010; Smith, 2008; van Bergen et al., 2019). Jamali and Rasti-Barzoki (2018) considered economic and environmental dimensions of sustainability, and then determined the pricing and greenness level of product in competition with general product. Zhou et al. (2018) comprehensively analyzed the TBL in relation to SCF solutions to promote suppliers' sustainability performance. The function of SSCF is spreading from suppliers' cash-flow easing to sustain economy and achieving environmentally friendly and sustainable society in the whole SC. In practice, SCF has supported trade transactions, minimizes risk and provided economic, environmental, and social benefits for all SC members, delivering product/service to markets (Jia et al., 2020b). However, the studies on SSCF remains negligible; a fully realized the in deep value of TBL dimensions behind.

Economic dimensions take place in both the macro and the industrial levels. In the macro level, the influence of exchange rates and financial crises and exchange rates have been examined (Blackman et al., 2013; Filbeck et al., 2016). In the industry, the SCF service providers are

dedicated to balance the financial obligations and assets between suppliers and buyers and suppliers (Martin and Hofmann, 2017). This showed that there is sufficiently involved in such sustainable practices qualification to gain the economic benefits of SCF implementation, which adding innovation into the evaluation procedures (Liang et al., 2018). However, there is lack of studies linking SCF with sustainability (Xu et al., 2018). Studies on SCF economic dimension for financial organizations and resolution providers remain understated (Hofmann and Zumsteg, 2015; Silvestro and Lustrato, 2014; Bals, 2019). Uncertainties of macro economy such as technology, legislation and policy, are more and more unpredictable (Jia et al., 2020a). The challenges to sustainable financial problems from a long-term perception and the lack of assurance in short-term proceeds from firms' sustainable activities are under investigated given that the continuous growth on the environment tremendous impacts (Madani and Rasti-Barzoki, 2017; Zhan et al., 2018). As a result, new inducement mechanisms must be developed to steer the sustainability practices of SCF.

Environmental sustainability and green issues have become increasingly widespread among scholars and practices due to customer's suspense and compressions levied on manufacturers, and government regulations for green products/services (Moktadir et al., 2018). SSCF can lead to environmental benefits due to it intently motivate suppliers to promote green practices in the upstream of SC (Liang et al., 2018; Zhou et al., 2018). A positive association between SCF adoption and investment in green innovation has been found (Tseng et al., 2018). The impact of carbon emission permission on SCF performance to people awareness on balancing between responsibility and effectiveness is explored (Cao and Yu, 2018). The two-echelon green SC between one supplier and two capital-limited purchasers and the credit approach effects on the SC management based on capital constraints was analyzed (Yang et al., 2019). However, those studies only investigate mainly on trade credit influences, even though environmental dimension is considered to have great effects on SCF practices (Lorentz et al., 2016; Afrifa and Gyapong, 2017). Studies on the environmental effects other SCF practices, such as delay and early payment, reverse factoring, and inventory financing, are remained unclear. In addition, the benefits of understanding environmental uncertainties to SCF are excluded in financial networks management (Jia et al., 2020b). Hence, investigating the connecting relationship between environmental aspects and SCF with empirical evaluation is needed. Technical assistance, technology designs to strengthen environmental performance, new conscientiousness adapt tools for systems enhancement, as well as environmental responsibility the pressure the firms SCF performance are required for future studies.

Since the literature mostly emphasizes on the economic and environmental dimensions of SSCF, there are very few studies mentioned social sustainability. This has marked a great opportunity for future research to manage the social performance context. The public health and wellbeing are emphasized to have obvious influences on integrated financial sustainability performance (Marshall et al., 2015). The role SCF in providing better financial resources assessment to improve the supplier's livelihood is addressed (Bhuiyan et al., 2017; Sim and Prabhu, 2017). The effect of social sustainability on SC performance is proposed through the mediating role of supplier performance (Mani et al., 2018). However, such practice of SSCF integration are under-developed. While existing literature generally concentrates on the suppliers' financial network, the influence of uncertainties among other SCF members, such as third-party logistics, SC orchestrator, bank and other financial institution, are less explored (Jia et

al., 2020b). Supplier sustainability performance, enthusiasm promotions financing engagement, along with social equity, downstream customer SSCF behavior is not yet to be determined. Furthermore, the emerging economics exists serious social issues such as labor safety and child labor, due to having inadequate regulations (Awaysheh and Klassen, 2010), are is chances for future studies to investigate. Maintaining the balance among economic, environmental, and social performance is needed in SSCF to improve sustainability performance

5.2. Regional discussion.

This study revealed that there are less publications on SSCF in Africa and America that need more attention. Besides, each region also shows its distinct development trends compared with others. This discusses five world regions including Africa, Latin America, North America, Europe, Asia and Oceania with difference practicing challenges of SSCF due to their geographic proximity and economic scenarios. Particularly, the Africa and Latin America should concentrate more on collaboration and financial crisis aside from the common trends from the above sections. The North America and Europe show their weakness in collaboration strategy, while Asia and Oceania need to deal with potential financial crisis.

5.2.1. Africa

Africa is claimed to have huge financial needs and limited financing solutions. While interest is increasing across the continent, there are many companies and suppliers that remain unconvinced that SCF are worth the effort and time to pursue. Therefore, the features of SCF can be valuable for all institutions involved in the chain. However, this by far from the SSCF, especially in collaboration and financial problems.

SCF provides tools for planning and managing optimizations as well as controlling cash flows in order to enable SC system efficiency. SCF is being used in Africa to boost the capacity of suppliers to fulfil contracts. It is rather new among industries requiring some substantial quantifying the potential benefit for both up-and-downstream of the SC. However, most of the growing firms in Africa, which mainly contributes to continent economies, are SMEs. These firms are new in accepting the SCF while struggling in approaching finance resource, articulating deficiency of short-term loaning that drives the relationship among firms to their partner with intermediate financial institution. Therefore, collaboration, as a core of SCF, is vital for sustainable financial flow, providing inexpensive funding for smaller traders to satisfy the bigger customers (Caniato et al., 2016). Indeed, collaboration is required to solve fiscal problems such as cash-to-cash rotations and/or cost handling (Randall and Theodore Farris, 2009). It is argued that there are needs to have more effectively communication tools among member to make additional calls for SCF service while the financing gap among SMEs is predominantly grave. Although academics and financial specialists has proposed the role of collaboration in SSCF, the concepts have lagged the commodity and information management (Wang et al., 2019). This will unsustain the SC because of improper management methods.

Further, low goods prices, the pull from advanced economies, globalizations pressure are depressing exporter in the region, making them uncertain, giving judicious diagnoses, and causing foreign exchange shortages. The SCF is now not an optimal choice due to slow decision-making process and uptake rate delaying. Consequently, the internal financial crisis may occur because of high risk and security fraction that limits financing approaches to SMEs and newcomers due to the guaranteed relationships with banks and their customers. The crisis impacts more new entrants in approaching global markets since banks would rather work with recognized

organizations that have plenty financial resources and business connections to sustain themselves in dynamic problems. The lack of financial information in Africa depresses financial entities from supporting SMEs, given a cumulative insufficiency of resources to local SC members, who often be fastened to number of required documents, cost-effective reviewing. The crisis comprehensively distresses firms' trade credit decisions causing interruption payment to suppliers from their buyers (Gonçalves et al., 2018). Hence, implementing monitoring actions to reduce its negative effects is needed. How to inspect the SSCF from the governments or related entities, as a maintaining instrument to the SCs, keeping fundamental suppliers in business, increasing the local suppliers' capabilities are needed for further investigation. Introducing technological advancements, new SSCF models, such as cloud-based solutions, big data, blockchain platform are again recommended. Developing digital innovations distributed by fintech organizations or collaborative efforts between digital intermediaries, financial institutions and integration solutions among SSCF can be another better idea to sustain business chains

5.2.2. Latin America

Latin America is becoming a gradually appealing investment occasion for both global industrialists and strategic traders because: (1) shorter transportation and lead times to North America, (2) low wages, and (3) diverse of free trade agreements (Pearson, 2013; Pagliacci, 2020). The expand of SCF market originated from the Europe, United States, China, and India setting to high development record of intra-regional SC. In lieu of this, SSCF are exclusively opened with high rate of large international financial players, and significant emerged of local and regional banks, offering vary financial products/services to corporate clients. However, there are significant resistant by commodity prices dropping and indirect threat from the Chinese economy crisis, which is a major importer from the region. Therefore, the reserve of financing costs is constrained and the inequality of financing credits between suppliers and buyers are seldom denoted making firms assuage the financial limitations then abate virtual inventory echelons (Udenio et al., 2018). Although there occur arguments that the value chain is less invulnerable to spreadable financial risk during crisis stages, the SCF seem to be able to ease the financial operations situations in a SC, and thus alleviate the whole SC (Zhang et al., 2019). Seeking to new solution to ease the financing credit is a crucial priority since the current economic slump and discrepancies has further amplified the firms' financial compression (Ali et al., 2018; Lekkakos and Serrano, 2016).

However, changing pecuniary circumstances across the region has caused the SSCF challenges to estimate the size of this potential market. Differences in the diagnoses of each specific country, domestic difficulties, and different legislation and financial systems also make banks must modify the SCF mechanism, especially for SMEs. The SCF are unsustainable and the SCF members are also struggling with potential business prospects. Lacking local knowledge even causes greater challenges in communicating and educating the suppliers, impeding that financial institutions wrestle with funding and risk problems. Proposing new collaboration model to reduce cost and make more profits is obligatory to optimize the relationship among SC members. Innovative collaborative efforts can enabled the financial institutes to deliver multi-funding resolution and endow firms with the ability to integrate international subsidiaries SC finance programs on a single platform should be tested. The role of inter-organizational integration procedure should need further examination (Templar et al., 2016). Focusing on IT technologies adoption to intensify

the collaboration capability to benefit the SSCF implementation, such as synchronization in decision making process is suggested as future empirical studies.

5.2.3. North America

Though the North America shows less publications on SSCF, the region is witnessed significant growth due to strict sustainable environmental regulations. This incentivizes suppliers with strong sustainable ability, ensures a win-win condition for suppliers, buyers, and related financial institutions. However, there are still misapprehension. The SSCF implications are not always optimistic due to the SC continues to grow and more complex. Varying payable accounts and multiple enterprise resource planning systems have caused strenuous to monitor the cash flow. Firm confuses among the pros and cons to define the most efficient solutions to move forward their business (Barkley et al., 2016, Zou et al., 2021). Hence, empirical studies on collaboration practices, either via SC planning incorporation or via win-win contracts to optimize the SSCF and produce higher profits should be spent more focuses (Pfeiffer, 2016; van Bergen et al., 2019). Especially, at a global level when most of the big financial service providers are from the regions, the SCF dependence develop connects most SC construct leading to customized requirement for SSCF systems. Collaboration to technology developers to make better transactions network between buyers and suppliers to integrate financing into their transactional flows are becoming as SSCF strategy. The evolution will create more distinguishability funding, open opportunities for a more flexible system and guarantee an extensive array of financing possibilities. The studies about the influence of FinTech firm on SSCF are pending. As financial technology businesses are transforming the SSCF strategy, literature on this coordination are highlighted for additional study to fulfil, especially the gaps in empirical based, oriented practices.

5.2.4. Europe

The sustainability is realized to completely integrate firms' sourcing and finance functions in Europe. The SSCF promotions can increase the suppliers and buyers' communication, thus contribute to financial collaboration development issue in terms of ameliorating financial issues in the SC (Wuttke et al., 2013a). The SSCF provides autonomous mechanism to enable dematerialize and manage collaborative transaction. However, risk occurs related to the collaborations both inside and outside of the firm that slower the sustainability (Lorentz et al., 2016; Chakuu et al., 2019). Implementing SSCF would necessitate a closer collaboration including legal acquiescence, payment transparency to observing the commodity provenance. Developing blockchain are able to secure sharing information and data transmission between all parties. Study in regulations and policy support can potentially enhance the bonding connection among SCF members, then improving system sustainable performance. Furthermore, the gaps ethical SSCF progress and linkage of corporate social responsibility such as the ethical sourcing are unsolved in pushing the collaboration.

5.2.5. Asia and Oceania

Asia and Oceania are substantial punters of open account trade financing. Inter- and intra-regional commerce plays a critical role in the region development. Thus, financial service providers have fundamentally contributed to SCF implementation especially since it is still in the beginning stage (Ma et al., 2020). In practices, ahead of Europe, there are banks already applying blockchain as well as using artificial intelligence technology to provide quicker financial services. However, achieving SSCF remains a difficult proposition for suppliers requiring payment and buyers seeking for funding along their SC. The SSCF expertise is not widespread while the demand

for financial services is high. The approval also gets along with high potential risks, and not many firms are willing to approach due to the lack of disclosure. The motivation for sustainable performance is tight with firms' business and its social responsibility. Increasingly emphasizing sustainable practices follow a negative headlines sequence toward the SC. Most of the suppliers, particularly SMEs suppliers, prerequisite an extra provocation to imply the sustainability. Inter-organizational financing collaboration approach is unfailing to be attained helping those members to cut down their financial burden. Developing digital aspects can providing tools for better funding or even information availability to the SC participations and intermediators at the earlier period of SSCF.

However, the working capital burden of the suppliers has risked the buyer solidity in financial crisis case because the manufacturing process is not able to continue without a balance financial statement. The regions deem to be inadequate in management capabilities guarantee, and physical facilities (Pasadilla, 2014). SCF is an effective solution that solves the conflictions between sellers and buyers when they both targets in maximizing liquidity effectiveness. How to make the SCF members aware of the advantages to shift into global market competitions is important (Gelsomino et al., 2019). In addition, the regulation and policy structure related to financing security is not yet well developed. There are still arguments on the value chain is protected to spreadable financial risk during crisis period (Zhang et al., 2019).

5.3. Additional implication.

Recent literature has called to increase empirical studies on the SSCF applications (Xu et al., 2018). However, there are some remarkable exogenous factors that are potential to cause a global breakdown of SCF has not yet to point to such as wars, natural disasters, and epidemics. For example, the Covid-19 has spread all over the world leading to a global economic recession possibility, sequent to global trade interruption and financial crisis. The economic shocks are via financial markets making the SCF become part of the problem of sustainability decline. This severely damages confidence of suppliers, buyers, and intermediate financial institutions. The epidemic shuts down and temporarily ceases operations and production lines, paralyzes SCs, making chaos of work leaves and downsizings. Consumers are discretely spending and stressing about the longer term. Financial institutions, banks, funding organizations, and investors are afraid to provide services and will withdraw from the market due to slow response from the global economy. Consequently, the world is changing from globalization decaying to decentralize with alternative SC models from domestic production or other countries in the regions which are less influenced. Changing in technology is argued as solutions for to save the SCF. Since these catastrophes cannot be met by fiscal or monetary tools implementation of medical, educational, politics or even military solutions are needed to be evaluated to handle the situation.

6. Future studies implementations:

This study contributes to providing knowledge gaps assisting future studies:

The blockchain implementation should be focused as potentials areas of SSCF practices, thus requiring guaranteeing the quality of information flow, increase and re-claim their trust, common standards, occupational problems and educating employees.

The cashflow shortage, which damages firms' financial balance, is recommended to handle through efficient trade credit policies, comprehensive mechanism directions possibly to diminish the SC interruption intimidation, suppliers' cash flow risk, and transaction expenses. Further, the details of cash flow interaction in SSCF design, aggravate undesirable effects from cash flow

shortages and evasion jeopardizes also need further assessment. Study on the third-party participations, integrating financial operational strategies, balancing cash flow, collecting invoice payments and receivables, developing additional data and robust analytic methods to deal with excess inventory are needed to handle cash flow shortage problems.

Reverse factoring helps firms to overcome the liquidity scarcity by cooperating purchasers to with banks for offering loans to suppliers. Yet, delayed payment, early payment, relative benefits, linkage relationship between the indicator and other SCF schemes have not yet fully developed. Insufficient SCF members social behavior on reverse factoring has caused significant problems in SC operation and resulted in firms' financial crisis. A sustainable reverse factoring standard, monitoring policy and regulation to recompense credit facilities for a favorable action plans are urgently required as a state-of-the-art study discipline.

Risk assessment and uncertainty is critical in inheriting SSCF operations. Hence, coordination among SC partners, knowledge and information management, collaboration development can be effective tools to share the financial risk and lower financing cost within SC and solve material inequities and diminishing in operational financial system. Additionally, the lack of knowledge and information transparency can be harmful either to the short-term profitability and liquidity problem or the long-term fiscal risks, offering advance methods to forecasting and solve the situation are needed.

The SSCF are argued to be a critical factor to balance the TBL in the SC. Continuing study on the TBL can support trade transactions, minimizes risk and provided economic, environmental, and social benefits for all SC members, delivering product/service to markets, growth on the environmentally tremendous improvement. Investigating new inducement mechanisms connecting relationship between environmental aspects is recommended for enhance the SSCF empirical evaluation. Technical assistance, technology designs, new conscientiousness adapt tools for systems enhancement, as well as environmental responsibility are required for future studies. SSCF integration practice on supplier sustainability performance, enthusiasm promotions financing engagement, along with social equity, downstream customer SSCF behavior to maintaining the balance among TBL is needed in improving SSCF performance.

7. Concluding Remarks

There is limited in scope since demonstrating the necessity and potential of SSCF as an enabler of sustainability approaches. However, gaps are remained even though the SCF approaches in achieving sustainability has been extensively discoursed among scholars. Thus, there is a need to create a deeper analysis towards the SSCF. A comprehensive assessment is still missing in the extant literature, making it necessary to accomplish a systematic review to acknowledge the related literature and reveal potential directions for future studies. This study to propose a bibliometric data-driven from the literature to illustrate overall concept of SSCF that reveals hidden indicators for further improvement. A hybrid of both qualitative and quantitative methods is developed, combining data driven analysis, FDM, EWM and FDEMATEL, to address the uncertainty in the context.

1. In this study, a data driven analysis is delivered to determine the critical indicators as gaps for future studies. There are 126 keywords listed and 16 indicators accepted as critical based on the experts' evaluation. Top important indicators are chosen as essential for future direction, including blockchain, cash flow shortage, reverse factoring, risk assessment, and

TBL. The directions for future studies and challenges are provided contributing to the prioritization of exploration opportunities for both scholars and practices.

2. There are 35 countries/territories identified and arranged into 5 regions, including Asia and Oceania, Europe, North America, Africa, Latin America and Caribbean. The results showed that Asia and Oceania have the highest number of SSCF publications, followed by Europe and North America, and Africa, while Latin America and Caribbean gives no publications. Generally, two of the five regions show the needs for more improvement. The Africa and Latin America should spend more concentrate on collaboration and financial crisis aside from the common trends from the above sections. The North America and Europe show their weakness in collaboration strategy, while Asia and Oceania needs to deal with potential financial crisis. The identified gaps between geographical regions not only contribute local viewpoints but also offer the comprehensive global state-of-the-art of SSCF.

3. and practical implementations trend. The SSCF actors can refer to this study as a reference for decision-making. Governments, firms and professionals can denote this study for useful information to support SCF planning, practical design, and policy implementation to sanction innovative achievements.

4. There are exogenous factors that are potential to cause a global breakdown has not yet to point to such as wars, natural disasters and disease epidemics. This leads to a global economic recession, sequent to global trade interruption and financial crisis making the SCF become part of the problem of sustainability decline. The innovation in technology is proposed. The involvement of medical, education, politics or even military solutions are implied for further evaluated to handle the situation.

However, this study still exists some limitations. The authors scrutinized the publication from Scopus database. Future studies may apply other data sources or combine various recourses to enhance the results' generalizability. The expert committee only involved of 30 members, which may cause biases in the analysis procedure due to their knowledge, experience, and the research field familiarity. Future studies should increase the number of respondents to avoid this problem. As this study provides an in-depth tool for data-driven analysis, exploiting it in another sector is recommended for both academic and practical investigation field.

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