

Transdisciplinary Perspective on Sustainable Multi-Tier Supply Chains: A Triple Bottom Line Inspired Framework and Future Research Directions

Abstract

Global sourcing and increased interdependencies between organisations have created more complex multi-tier supply chains. While these supply chains have been instrumental in keeping the world moving, they equally pose sustainability issues. In the extant literature, there is a growing number of studies on sustainable multi-tier supply chains. However, there has been limited effort to take stock of existing research to set an agenda for future studies. To address this gap, this study reviews 64 articles through the lens of the triple bottom line theory. Based on the findings, the study develops a framework for sustainable multi-tier supply chains and provides direction for future research.

Keywords: Multi-tier Supply Chain; Sustainability; Triple Bottom Line Theory; Research Agenda

1. Introduction

As a result of the globalisation of supply chains, there is increasing interest in how business operations impact society (Sarkis, Santibanez Gonzalez, and Koh 2019; Orji, Kusi-Sarpong, and Gupta 2020). To gain competitive advantage, international companies have globally dispersed supply chains. This means that organisations have multiple stakeholders across countries. As a result, such organisations are faced with a more complex social responsibility with respect to the effects of their activities on society and the environment. Global organisations are therefore inevitably under pressure to ensure that their activities are sustainable (Kusi-Sarpong, Gupta, and Sarkis 2019). Consequently, sustainable supply chain management is receiving considerable attention across industries, media, governments, non-governmental organisations (NGOs), customers and academia (Jia, Gong, and Brown 2019). Most organisations are pressured to re-examine their products and processes to ensure that there are no adverse effects on the environment whilst at the same time safeguarding the social aspects of sustainability such as health and safety and community programmes (Gong et al. 2018; Huq, Pawar, and Rogers 2016). Earlier conventions expected first-tier suppliers to bear the brunt of the responsibility of ensuring and maintaining sustainable supply chains (Giunipero, Hooker, and Denslow 2012; Walker and Jones 2012). However, within multi-tier supply chains it is difficult to monitor all activities across the supply chain.

Multi-tier supply chains are increasingly international, complex, and challenging for suppliers and focal companies (Mena, Humphries, and Choi 2013). Internal and external stakeholders currently require organisations to take responsibility as well as act towards mitigating unsustainable practices and misconduct in their supply chains (Jabbour, de Sousa Jabbour, and Sarkis 2019). Generally, external stakeholders such as governments, NGOs, customers and the media would not extricate the activities of focal companies from their direct or indirect sub-suppliers. They therefore place the responsibility at the doorstep of the focal companies for non-compliance (Hartmann and Moeller 2014). Hence, there is increasing pressure on focal organisations to adopt a stakeholder driven sustainable multi-tier supplier management approach (Grimm, Hofstetter, and Sarkis 2016; Tachizawa and Wong 2014; Wilhelm, Blome, Bhakoo, et al. 2016). This means that focal organisations now need to adopt new practices to improve supplier and sub-suppliers' sustainability performance to maintain sustainable multi-tier supplier management (Dou, Zhu, and Sarkis 2018). Sustainability refers to the long-term maintenance of systems according to

environmental, economic and social considerations (Sarkis, Santibanez Gonzalez, and Koh 2019; Orji, Kusi-Sarpong, and Gupta 2020). Sustainable supply chains therefore need to perform well in social, environmental, and economic perspectives; often referred to as the triple bottom line (Elkington, 1997; Klassen and Vereecke, 2012).

Sustainable supply chain management, which is defined as the coordination of an integrated set of activities involving the flow of materials, information, and capital along a supply chain; which at the same time takes into consideration economic, social and environmental development goals (Sauer and Seuring 2018). It is therefore not surprising that economic, social and environmental concerns are shaping the growing literature on sustainable supply chain management (Jabbour, de Sousa Jabbour, and Sarkis 2019). Some studies (e.g., Tuni, Rentizelas, and Duffy 2018) have mostly focused on environmental issues alone without integrating these with the related social issues. For example, this field of research has seen a prevalence of studies addressing the environmental dimension of sustainability (Seuring and Müller 2008; Tuni, Rentizelas, and Duffy 2018), while examples of social issues in supply chain management have scarcely been explored (Jabbour, de Sousa Jabbour, and Sarkis 2019). The few studies (e.g., Mejías et al. 2019; Darvish, Archetti, and Coelho 2019; Wilhelm, Blome, Wieck, et al. 2016) that have combined the environmental and social issues have largely neglected the economic dimension. However, the economic dimensions of sustainability are intricately linked with social and environmental issues. Therefore, addressing social, environmental and economic dimensions in isolation has the potential to create gaps in the sustainable multi-tier supply chain management literature.

In addition, despite the recognition of departing from sustainable first-tier supply chain management to a more integrated sustainable multi-tier supply chain management (Mena, Humphries, and Choi 2013), there appears to be a variation in the approaches adopted in studying sustainable multi-tier supply chains. Also notable is the view that the literature on sustainable multi-tier supply chain management was initially dominated by conceptual works with initial empirical research focusing on case studies and qualitative approaches (Klassen and Vereecke, 2012). In addition, quantitative studies in the field have seen a recent upsurge. This means that the sustainable multi-tier supply chain management literature has sufficiently evolved but remains fragmented. There is now a need to examine the emerging themes as well as the nuances resulting

from the research approaches used to study sustainable multi-tier supply chain management to develop a holistic view.

Though there are some prior reviews, the focus has been on modelling multi-tier supply chain (Jabbour, de Sousa Jabbour, and Sarkis 2019), identifying quantitative methods for measuring environmental sustainability (Tuni, Rentizelas, and Duffy 2018), as well as developing frameworks that synthesise approaches and contingency variables to manage the sustainability of multi-tier supply chains and sub-suppliers (Tachizawa and Wong 2014). In addition, the extant reviews have largely focused on social and environmental aspects of sustainability with limited attention to more integrated social, environmental and economic perspectives. To a large extent, synthesising studies on economic sustainability of multi-tier supply chains have been neglected. Moreover, existing reviews have largely focused on the supply chain, production and operations domain without considering the inter-disciplinary nature of sustainable multi-tier supply chain research. As a result, there are limited studies that evaluate the emerging themes from prior sustainable multi-tier supply chain research to develop a holistic framework that can reveal gaps for future research. This calls for transdisciplinary review of on sustainable multi-tier supply chain. In line with this, the overarching aim of this study is to critically review existing research on sustainable multi-tier supply chain from a transdisciplinary perspective, identify emerging themes to propose future research agenda. To address this aim, the following research questions are proposed:

- (1) What are the emerging themes from prior sustainable multi-tier supply chain research?
- (2) How can sustainable multi-tier supply chains be achieved?
- (3) What gaps should future sustainable multi-tier supply chain research investigate?

In addressing these questions, the study makes the following four theoretical and practical contributions. First, it advances our understanding of the major themes in sustainable multi-tier supply chain research. As this study is arguably the first to holistically examine themes from a transdisciplinary perspective in sustainable multi-tier supply chain research, it provides a strong foundation for research and practice. Second, the study develops a framework that offers a more nuanced view on how sustainable multi-tier supply chains could be achieved. Beyond, research advancement, the proposed framework is a useful tool for practitioners for developing sustainable multi-tier supply chains. Third, the study contributes to the literature by unveiling some pertinent research gaps to set an agenda for future research. Lastly, the study extends the existing literature

by explicating the relationship between the triple bottom line conundrum, sustainability realisation process, sustainability assessment approaches, and sustainable multi-tier supply chains.

The rest of the paper is organised as follows. Section 2 presents the background of multi-tier supply chain and sustainability literature. Section 3 presents the method while Section 4 teases out the themes from the systematic literature review and outlines the findings. Section 5 discusses the findings, develops a resulting sustainable multi-tier supply chain framework, sets an agenda for future research, as well as presents theoretical and practical implications.

2. Background: Multi-tier supply chain and sustainability

The need for international networks of value chains and the development of global supply chains have resulted in the understanding that organisations can no longer operate or compete as stand-alone entities (Lambert and Enz 2017). Supply chains comprise various tiers including the focal company/organisation, its suppliers, and the suppliers of those suppliers, as well as customers and their customers or end users (Kusi-Sarpong, Gupta, and Sarkis 2019). Invariably, supply chains encompass multiple stakeholders and therefore supply chain management requires comprehensive interlinkages and management of complex relationships (Lambert and Enz 2017; Jabbour, de Sousa Jabbour, and Sarkis 2019). Focal companies are often held responsible for any environmental or social infractions by other stakeholders along their supply chains with a disproportionate impact on the focal company's value and reputation (Huq, Pawar, and Rogers 2016; Jabbour, de Sousa Jabbour, and Sarkis 2019; Dou, Zhu, and Sarkis 2018). To be considered sustainable in the supply chain context, companies must perform well in all three dimensions of the triple bottom line, focusing explicitly on social, environmental, and economic issues (Klassen and Vereecke 2012). However, for this performance to be sustainable it needs to involve all the tiers along the supply chain.

The triple bottom line is a useful framework used to examine long-term sustainability (Wilhelm, Blome, Bhakoo, et al. 2016). Rising external pressures to apply the triple bottom line to the supply chains have often focused on the first-tier supplier as the company to disseminate the standards required to achieve sustainable multi-tier supply chain management (Grimm, Hofstetter, and Sarkis 2018; Wilhelm, Blome, Bhakoo, et al. 2016). The current sustainable multi-tier supply chain management literature primarily concentrates on the relationship between a focal company, often

the end product producer, and its direct suppliers (Walker and Jones 2012; Grimm, Hofstetter, and Sarkis 2016) resulting in the neglect of some important supplier networks such as lower-level tiers.

As raw materials are largely sourced from the lower-tier members of multi-tier supply chains, where sustainability violations are more likely, it is important for research to examine all tiers along the supply chain. In addition, these lower-tier members of the supply chain are often located in developing countries characterised by weak regulatory regimes and high levels of corruption (Senyo, Effah, and Addae 2016). Consequently, sustainability breaches such as worker exploitation, input adulteration and environmental degradation are often ignored or poorly monitored. However, sustainable multi-tier supply chain management requires a systematic examination of all tiers of the supply chain.

In addition, literature specifically exploring the triple bottom line issues that looks beyond the first-tier level suppliers to evaluate the multi-tier supply chain is relatively limited (Dou, Zhu, and Sarkis 2018). Such an approach to the field that seeks to integrate and synchronise all the network of relationships across the supply chain to attain sustainability is relatively scarce (Koh, Orzes, and Jia 2019). Despite the notable challenges in harmonising such supply chains the nuances of applying the triple bottom line to sustainable multi-tier supply chain management has been under researched. This systematic review seeks to extricate this phenomenon.

In using the triple bottom line, economic dimensions and benefits of sustainable multi-tier supply chain management can be highlighted. Encapsulating Porter's shared value, sustainability goes beyond the related costs and constraints, or sometimes charitable activities, to serve as a source of opportunity, innovation, and competitive advantage (Porter and Kramer 2006). In essence firms can do good and do well and therefore sustainability can result in increasing innovation, efficiency, reputation and market value of all suppliers along the multi-tier supply chain (Jabbour, de Sousa Jabbour, and Sarkis 2019). Although multi-tier supply chains are better characterised as networks with vertical and horizontal linkages among actors (Wilhelm, Blome, Bhakoo, et al. 2016) the innovations, efficiencies and reputation gains can create shared value along the multi-tier supply chain. Thus, examining the economic dimensions of multi-tier supply chains is important because it helps to articulate both financial and non-financial benefits that could accrue to organisations when sustainability is achieved. Beyond this, investigating economic dimensions of sustainability provides avenue for organisations to evaluate the benefits and gains made from their investments.

By highlighting research on the economic dimensions of sustainability, it can encourage other organisations within multi-tier supply chains to look at both financial and non-financial benefits of investing in sustainability initiatives.

Despite the contributions of existing reviews (e.g., Yang, Jia, and Xu 2019; Tuni, Rentizelas, and Duffy 2018; Jabbour, de Sousa Jabbour, and Sarkis 2019), there is still a need for a thorough discussion of the social, environmental and economic dimensions of sustainable multi-tier supply chains. This work addresses this knowledge gap by adopting the triple bottom line theory to review sustainable multi-tier supply chain research. In addition, this review also seeks to incorporate studies that combine elements of environmental, social and economic issues as well as those that treat them independently. This review also synthesises conceptual and empirical studies to build an integrated, transdisciplinary perspective of sustainable multi-tier supply chain management using the triple bottom line as the underpinning theory. In doing so, this review identifies key gaps in the literature to set an agenda for future research on sustainable multi-tier supply chain management.

3. Research Method

Given that the aim of this research is to unravel the link between multi-tier supply chain and sustainability from a transdisciplinary perspective, we adopted a systematic literature review. We adopted this approach for the following three reasons. First, a systematic review enables wider literature coverage because it ensures all major literature sources are considered (Senyo, Addae, and Boateng 2018). Second, this approach leads to adequate extraction of meaning and association between studies. Lastly, it ensures thorough and transparent analysis of prior studies. We followed Senyo et al.'s (2019) five-stage approach to ensure a holistic coverage and thorough review process. We selected this approach to achieve a balance between systematicity and transparency. As presented in Figure 1, the literature review process went through these five stages: (1) defining the review' scope, (2) literature search, (3) literature refinement and selection, (4) literature analysis, and (5) presentation of findings.

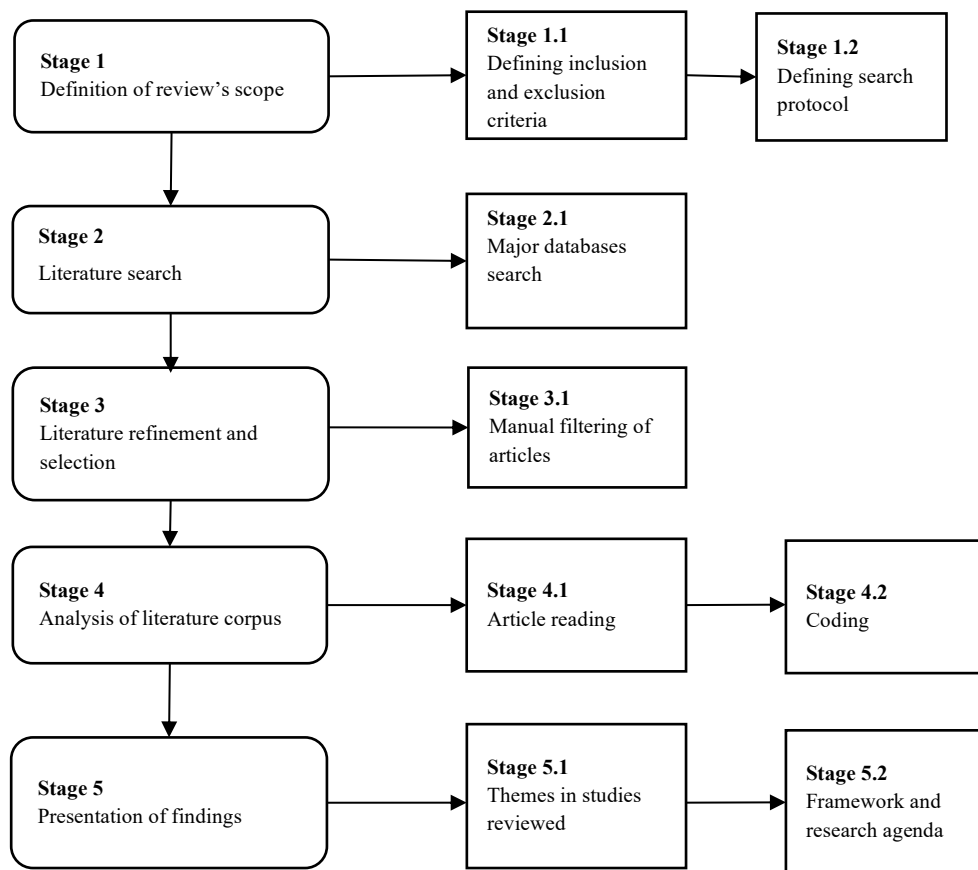


Figure 1: Literature review approach (Adapted from Senyo et al. 2019)

Stage 1: Definition of review's scope

We defined the review's scope to include only full-text peer-reviewed journal and conference articles because these sources cover high-quality contributions (Webster and Watson 2002). Consequently, we defined our exclusion criteria to cover books, book reviews, perspective, technical articles, editorials, dissertations, publications without full text and articles not in English. Next, we defined the search protocol in terms of search keywords and databases. As the aim of this study was to conduct a transdisciplinary review, we decided to ensure we capture articles from research areas beyond supply chain such as business ethics, corporate social responsibility, and information systems. In line with this aim, we also did not impose any timeline on the articles to be included in the study. Based on an initial scanning of the extant literature, we defined the keyword as "multi-tier supply chain" and "sustainability" or "sustainab*" to capture variants. Also, our initial scanning of the extant literature shows that Scopus and Web of Science databases host

majority of studies on multi-tier supply chain and sustainability. Therefore, we selected these two databases as our article sources.

Stage 2: Literature search

Based on the defined keywords, we performed independent search in Scopus and Web of Science databases. Using the advanced search functions in these databases, we performed the search on the title, abstract and keywords to ensure only relevant articles were returned. We iteratively searched the two databases until our search did not return any new articles. In all, the Scopus database search returned 79 while the Web of Science resulted in 63 articles. We exported the search results into a master Excel file for refinement and selection.

Stage 3: Literature refinement and selection

We began the literature refinement by first comparing the Scopus and Web of Science search results for duplicates since these two databases usually index the same articles. As presented in Figure 2, we found and removed 56 duplicate articles. Next, we applied our inclusion and exclusion criteria and discarded 22 articles from the literature corpus. For instance, articles that listed sustainability or multi-tier supply chain as keywords without further discussion in the main article and studies that use sustainability as example without any strong connection to the topic. Through the refinement processes, we ended up with 64 articles as the final set for the review. These studies are presented in Appendix A.

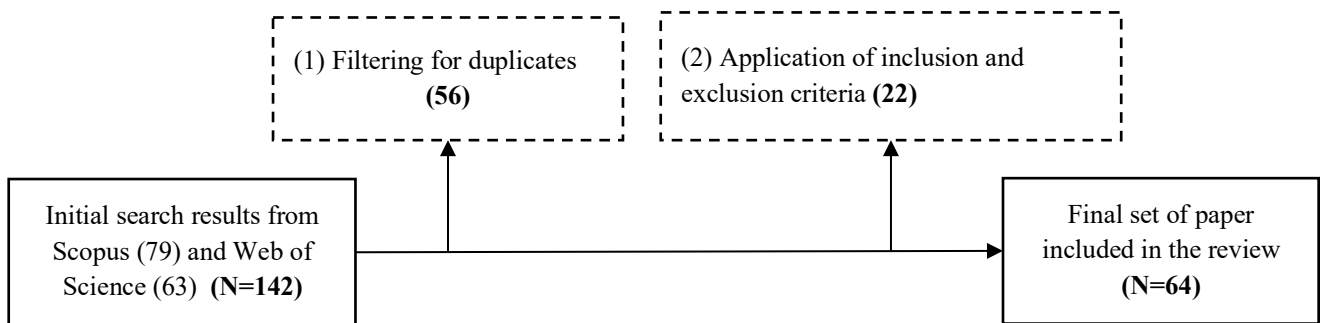


Figure 2: Literature selection and refinement

Stage 4: Analysis of literature corpus

We began by first analysing the literature corpus by reading and coding each article. Next, we extracted descriptive statistics on the articles based on codes extracted on elements like author(s), title, publication outlet, type (e.g., journal or conference proceedings) and year, context of study as well as primary categorisation. Following this, we conducted a more detailed analysis using grounded theory principles of open, axial and selective coding (Corbin and Strauss 1990) to derive themes in the literature corpus. We iteratively derived open codes by thoroughly reading each article and generating codes on aspects of sustainability on which the study focuses (i.e. social, economic, environmental, any two or all aspects), findings, and limitations. We then conducted axial coding by iteratively mapping and integrating the initial open codes for conceptual similarity (Corbin and Strauss 1990). Finally, we iteratively analysed the axial codes to generate selective codes as high-order aggregate dimensions as foundation for our sustainable multi-tier supply chain framework.

Stage 5: Presentation of Findings

We present the findings as the last stage of our literature review approach. The findings are presented on (1) themes in sustainable multi-tier supply chain studies, (2) sustainable multi-tier supply chain framework, and (3) agenda for research and practice.

4. Findings

From the analysis, we find that prior studies on multi-tier supply chain have increasingly been discussing sustainability issues. While majority of studies tend to discuss the three main elements of sustainability, namely environmental, social and economic individually, there are few that have focussed on two or all the elements. We identified four main themes as streams of research on sustainable multi-tier supply chains to address the first research question on themes that have been investigated in prior sustainable multi-tier supply chain research. We discuss these research themes in the ensuing subsections.

4.1. Sustainability assessment approaches

Studies in this theme focus on developing approaches to assess sustainability of multi-tier supply chains. These approaches range from methods, models, and frameworks all aimed at assessing sustainability of multi-tier supply chains. Three main insights emerged from our analysis of this

theme. First, we observed that there are approaches for assessing each element of sustainability in multi-tier supply chains. For instance, to assess environmental sustainability in multi-tier supply chains, Tuni and Rentizelas (2019) developed an eco-intensity-based method to quantitatively assess the environmental performance of extended supply chains. Using secondary data from four supply chains, the study assesses the method's applicability. Similarly, Ciardiello, Genovese, and Simpson (2020) developed a game-theory based framework for assessing pollution responsibility across multi-tier supply chains. The framework also draws on principles of upstream, downstream and local responsibility to derive rules that ensure fairness, efficiency and transparency. In terms of social sustainability assessment, Mejias et al (2019) developed a multi-criteria decision-making approach to determine companies achieving best performances. To validate the approach, sustainability reports of four fashion companies were examined and the findings reveal that training and developing capacity building teams, long-term planning processes and traceability systems can improve supply chain performance.

Second, we observe that sustainability assessment approaches have not holistically addressed all three elements of the triple bottom line. Though some studies attempt to provide assessment approaches for more than one element, focus has been on either social and environmental or economic and environmental assessments. For instance, Heydari, Govindan, and Aslani (2019) also developed a model for environmental and economic sustainability in three-tier dual-channel green supply chains. The findings show that the proposed model provides profitability to all members of the supply chain by simultaneously increasing green credentials of products as well as achieving price reductions. In the same vein, Tuni, Rentizelas, and Chinese (2020) developed a performance assessment method to achieve a balance between environmental and economic sustainability. It is envisaged that, by balancing environment and economic issues, tensions can be addressed in multi-tier supply chains. Even for the few studies that attempted to cover all elements of the triple bottom line, it is often evident that each element is not clearly explicated and the findings and analysis lacked sufficient depth. For instance, Jia, Gong, and Brown (2019) developed a framework on sustainable supply chain and point to the role of supply chain leadership, learning as well as multi-tier supply chain governance and structure. In spite of the framework's contribution to sustainable multi-tier supply chain research, it is unclear how social, environmental and economic issues are accounted for.

Lastly, we observed that sustainable multi-tier supply chain assessment approaches have not been widely validated and, in some cases, not empirically tested. However, some studies have validated their approaches based on primary and secondary data through case studies, interviews, and surveys (e.g., Mejías et al. 2019; Sauer and Seuring 2018; Tuni, Rentizelas, and Duffy 2018). Nonetheless, some of these assessment approaches have only been validated in one industry (e.g., Mejias et al. 2019). This narrow validation makes it difficult to determine applicability of the approaches beyond their initial domains. With the exception of these few studies, majority of the assessment approaches lack critical and in-depth evaluation. For instance, Sauer and Seyrunga's (2018) three-dimension framework for environmental assessment of multi-tier supply chain only provides interesting insights on how demand and supply uncertainty as well as suppliers' direct pressure for sustainability lead to compliance. Notwithstanding, the framework has not been thoroughly validated empirically. Given that multi-tier supply chains are complex and characterised by many uncertainties, it will be prudent to validate some of these assessment approaches to demonstrate their efficiency. Such an approach will allow more practical use as well as extend our understanding of multi-tier supply chains.

4.2. Digital technology application for sustainability

This theme covers studies that focus on the use of technology to address sustainability issues in multi-tier supply chains. As multi-tier supply chains transcend geographical boundaries, it is sometimes difficult for firms to ensure other partners within the chain are adhering to sustainability issues (Bai et al. 2019). This issue is compounded by demands from customers for companies to disclose their supply chain sustainability information (Wilhelm, Blome, Wieck, et al. 2016; Hartmann and Moeller 2014). Prior studies acknowledge that sub-suppliers' conformity to sustainability in multi-tier supply chains are difficult to ensure as supply chains expand into multi-tiers. While some organisation within the supply chain strive for sustainability, others do not (Orji, Kusi-Sarpong, and Gupta 2020). Thus, digital technology has been touted as a solution to address lapses in multi-tier supply chains. From our analysis, two main insights emerged on the application of technology for sustainable multi-tier supply chains.

The first group of studies advocate for the application of emerging technologies such as blockchain, internet of things (IoT), social media, big data and artificial intelligence. These studies posit that application of these technologies can provide companies with platforms to achieve

traceability to ensure other partners are complying with sustainability requirements (Orji, Kusi-Sarpong, and Gupta 2020). A classic example is the call for blockchain technology application in the recording of data at all levels of multi-tier supply chains into immutable blocks that are difficult to alter to achieve traceability and transparency. Other examples point to the use of IoT sensors to ensure food produce are not tampered with before they reach the final consumer. Despite the potentials of these technologies, research on their application are largely conceptual. For instance, Venkatesh et al. (2020) developed a conceptual system architecture for the application of emerging technologies such as blockchain, IoT and big data analytics in multi-tier supply chains to achieve effective and efficient social sustainability. Similarly, Miehle et al. (2019) developed a proof of concepts for the tokenisation of vehicle parts in a permissioned blockchain used to process parts ownership data in an immutable block to enable traceability of defects in recall of vehicles built with parts from multiple suppliers.

While the first group of studies advocate specific use of emerging technologies to achieve sustainable multi-tier supply chains, studies in the second group highlight the benefits of using technology in general. These studies point to how digital technologies could enable better information flow, better collaboration, as well as efficient production and replenishing planning in multi-tier supply chains (Hernández et al. 2014). As multi-tier supply chains stretch across different geographical boundaries and involves complex relations and numerous organisations, it is envisaged that using digital technology could streamline processes through accurate information sharing and better collaboration (Kembro, Näslund, and Olhager 2017). For instance, it is evidenced that application of collaborative digital technologies could reduce waste as more accurate production planning could be achieved through information systems integration across the supply chain, thereby contributing to environmental, social and economic sustainability. Similarly, studies have also argued that application of digital technologies can enable information sharing and reduce information asymmetry across multi-tier supply chains to ensure compliance and transparency in sustainability issues (Kanyoma, Agbola, and Oloruntoba 2018). For instance, White and Mohdzain (2005) demonstrate the role of information systems in achieving integration in multi-tier supply chain through the use of technological standards. Thus, apart from emerging technologies, generic digital technologies remain beneficial for sustainable multi-tier supply chains. Therefore, organisations could improve sustainable multi-tier supply chains by augmenting existing technologies to incorporate emerging digital technologies such as blockchain, IoT, big

data and artificial intelligence. Such technologies have the potential of enhancing the achievement of the triple bottom line.

4.3. *Sustainability strategies*

Studies in this third theme focus on strategies to achieve sustainability in multi-tier supply chains. From the analysis, we find a variety of collaborative strategies ranging from forming strategic alliances, delegation, ‘jumping the chain’ and top-down sustainability enforcement. Studies aligned with strategic alliance advocate that organisation should thoroughly evaluate the risks associated with dealing with other companies in their supply chain (Lechler, Canzaniello, and Hartmann 2019). Though numerous suppliers exist in multi-tier supply chains, well-established brands tend to take more blame whenever there are issues with their supply chains as minor suppliers are less visible from public scrutiny (Wilhelm, Blome, Wieck, et al. 2016). Thus, proponents of strategic alliance strategy advocate the need to evaluate risks between direct and delegated sourcing in multi-tier supply chains (Chen, Xu, and Zhou 2020).

Other studies aligned with strategic alliance stream of the literature also suggest a holistic assessment of sub-suppliers in relation to compliance with sustainability issues. In this regard, Soundararajan and Brammer (2018) for instance investigate how sub-supplier at the first-tier level respond to sustainability issues imposed on them by their intermediaries and the antecedents that influence their responses. The findings show that the manner in which intermediaries structure social sustainability requirement determine how sub-suppliers perceive procedure fairness and how to reciprocate. If social sustainability requirements are labelled as opportunities and involve engaging in practices that are considered fair, sub-suppliers respond positively. Therefore, in strategic alliances in multi-tier supply chains, lead organisation or intermediaries need to strategically frame their sustainability requirements in a way that project benefits to all parties.

Relatedly, other studies also highlight the strategy of a buying firm, jumping the chain, to work directly with lower-level stakeholders. As multi-tier supply chains comprise numerous organisations, it is expected that some actors might not comply with sustainability requirements. Thus, studies have proposed ‘jumping the chain’ as a strategy to address sustainability issues. This strategy dictate that the buying firm jump over non-compliant partners to work directly with lower-level stakeholders so that they can control how sustainability issues are addressed. By this, top-tier

firms can leave risky sub-suppliers out of their supply chain to enable it become sustainability compliant. For instance, Young, Fernandes and Wood (2019) find that in mineral supply chains, top-tiers firms utilise jumping the chain strategy to engage directly with actual physical suppliers as a way to ensure transparency and compliance with sustainability due diligence. Although this strategy may appear straight forward and simple, it is more complicated and sometimes impossible given that some sub-suppliers are powerful and may not be easily discarded in multi-tier supply chains.

We also find that sustainability strategies in multi-tier supply chains can be undertaken through open, closed, and third-party strategies (Mena, Humphries, and Choi 2013; Wilhelm, Blome, Wieck, et al. 2016). Open strategies involve buying firms allowing suppliers to independently address sustainability issues because they operate in a highly regulated environment like Europe or the United States (Wilhelm, Blome, Wieck, et al. 2016). In contrast, closed strategies involve buying firms taking direct control and enforcing top-down sustainability requirement across multi-tier supply chains. This strategy is proposed when supply chains include geographical locations with relaxed sustainability enforcement regimes. Lastly, third-party strategies entail a buying firm and its tier one supplier sharing sustainability responsibilities (Mena, Humphries, and Choi 2013). While the buying firm may provide sustainability requirement, implementation and enforcement across lower levels of their supply chain is left to third parties. However, it is important to note that deciding on any if these options depend on factors such supply chain complexity, sustainability management capabilities and the element of sustainability in focus.

4.4. Multi-tier supply chain sustainability management

Studies in this last theme frame discussions on issues related to the overall management of sustainability in multi-tier supply chains. While some studies focus explicitly on sustainability issues, others focus on related aspects that culminate to achieving efficiency and effectiveness in multi-tier supply chains. Topical among the issues include multi-tier supply chain optimisation, the role of agency and corporate sustainability standards. First, studies on corporate sustainability standard investigate their effectiveness of managing sub-suppliers through compliance (Lechler, Canzaniello, and Hartmann 2019). These studies argue that more often, compliance with corporate sustainability has largely been on suppliers without thorough analysis at the upstream sub-supplier levels (Grimm, Hofstetter, and Sarkis 2018). Thus, for effective multi-tier supply chain

management, corporate sustainability standards need to be investigated at the sub-supplier level. In this regard, Grimm, Hofstetter and Sarkis (2016) investigated the management of sub-suppliers compliance with corporate sustainability standards, the findings show focal firm's channel power, perceived risks of sub-supplier and public attention to sub-supplier as antecedents. Relatedly, Grimm, Hofstetter and Sarkis (2018) also highlight that critical success factors of a focal firms' corporate sustainability standards compliance by sub-supplier management include involvement of direct supplier, the power of the focal firm over direct suppliers and long-term committed relationships between direct and sub-suppliers. Thus, it is important the corporate sustainability standards compliance are evaluated at all levels of multi-tier supply chains instead of focusing solely at the supplier level.

Second, we find that sustainability management in multi-tier supply chains can be achieved through agency role. Though the responsibility of ensuring sustainability is sometimes laid at the forefront of focal firms, the complex nature of multi-tier supply chains makes undertaking this task difficult (Gold and Awasthi 2015). Thus, effective management of sustainability in multi-tier supply chains is sometime delegated to others such as first-tier suppliers under the agency-role (Mena, Humphries, and Choi 2013). However, this form of management is orchestrated as a double agency process. The role include disseminating standards and practices of the focal firm to lower-tiers as well as ensuring compliance. At the same time, these first-tier suppliers themselves must comply with sustainability issues. To explain this further, Wilhelm et al. (2016) draw on double agency and institutional theories to explain the conditions under which first-tier suppliers comply with primary and secondary agency roles in sustainable multi-tier supply chain management. The findings show focal firms need to incentivize each agency role separately as well as reduce information asymmetries at the second-tier level. However, for double agency sustainability management to be effective, focal firms must provide the needed resources, clearly define aspects of sustainability that suppliers and sub-suppliers across the supply chain need to focus on, exert its power when required and align internal sustainability to its entire purchasing and supply operations.

Lastly, studies on multi-tier supply chain management through optimisation focus largely on risk mitigation. Generally, these studies rely on mathematical and forecasting modelling as well as simulations to evaluate how multi-tier supply chains will perform under certain conditions. For

instance, these studies investigate sustainability issues such as agent-based reverse pricing (Mujaj and Leukel 2007), value of information exchange (Viswanathan, Widiarta, and Piplani 2007), scheduling systems (Holweg et al. 2005), inventory systems modelling (Ekanayake, Joshi, and Thekdi 2016), risk-cost optimisation for procurement planning (Mori et al. 2017), information sharing (Zhang and Zhang 2007). While these studies are largely conceptual, their findings provides interesting insights into the nuances of multi-tier supply chain management.

5. Discussion and Conclusion

In this study, the overarching aim was to critically synthesize studies on multi-tier supply chains and sustainability towards the development of a sustainable multi-tier supply chain framework as well as set agenda for futures studies. Having analysed the literature and presented the findings, we move on to discuss our framework, present agenda for future research and discuss theoretical and practical implications.

5.1. Sustainable multi-tier supply chain framework

To address the second research question on how to achieve sustainable multi-tier supply chains, we draw on the themes that emerged from our systematic literature review. Our analysis affirms the importance of the triple bottom line theory in the assessment of sustainable multi-tier supply chains and confirm that social, environmental and economic issues are more often addressed separately by firms. Some of the literature shows emphasis on one or the other and there is substantial literature that combines the social and environmental elements with limited literature on in-depth analysis of all three. Our analysis reveals that although these dimensions of sustainability are distinct, they are interdependent and that sustainable multi-tier supply chains require a strategic integration of social, environmental and economic dimensions of all stakeholders across the multi-tier supply chain. In the context of multi-tier supply chains, these three dimensions are more prominent as stakeholders such as customers, governments and society demand transparent disclosure—creating a sustainability conundrum. However, there is limited knowledge on how to achieve sustainable multi-tier supply chains that demonstrates adherence to the triple bottom line to the satisfaction of key stakeholders. Drawing on our findings, we propose a framework for sustainable multi-tier supply chains as presented in Figure 3.

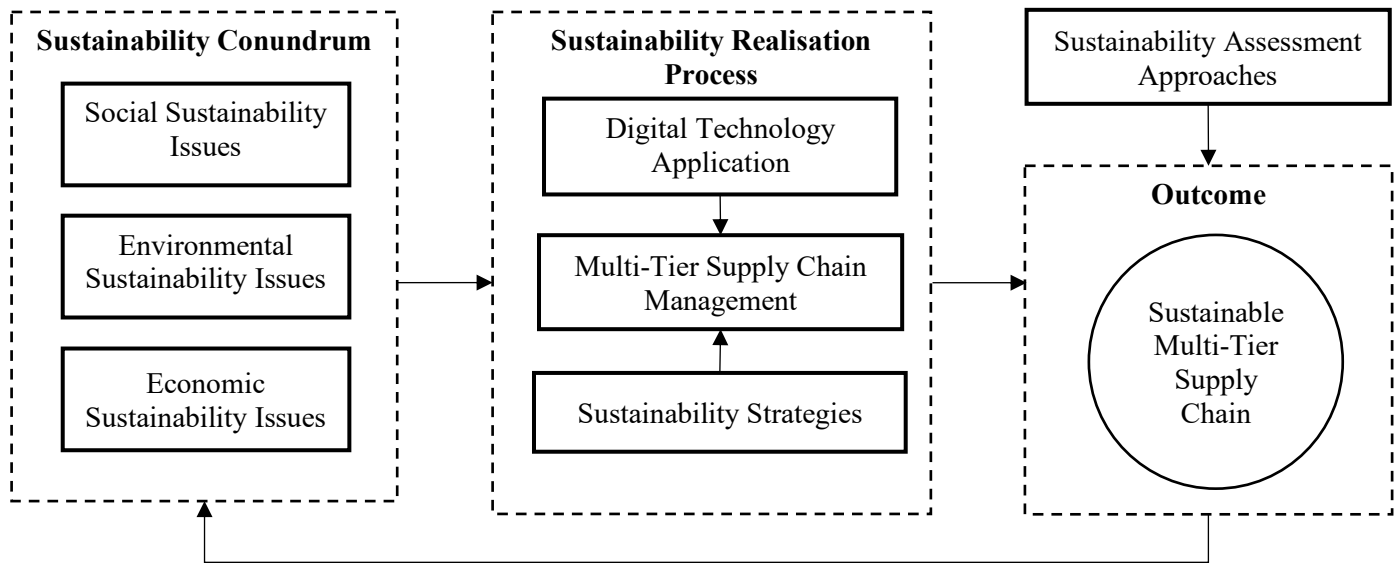


Figure 3: Sustainable multi-tier supply chain framework

The framework suggests that sustainability conundrum marks the beginning of the process. Whilst it is important to identify issues related to social, environment and economic sustainability, organisations need to find ways to strategically integrate these to ensure long-term profitability. For instance, social sustainability issues such as human rights, safe working conditions, diversity, ethical behaviour, and forced labour (Hannibal and Kauppi 2019) need a lot of attention as stakeholders such as customers, NGOs and the media pay particular attention to these. Similarly, economic and environmental sustainability issues such as pricing, profiteering, cost minimisation as well as emission, energy consumption, land occupation and water consumption (Tuni, Rentizelas, and Chinese 2020) have become issues that stakeholders now expect companies to be accountable for. Following the identification of the sustainability issues that encompass all elements of the triple bottom line, the next step is the work towards achieving the outcome of sustainable multi-tier supply chains. Our findings reveal that digital technology applications through the use of emerging technologies such as blockchain, IoT, artificial intelligence, platforms, and bigdata (Mubarik et al. 2021) analysis alongside the use of generic technologies for collaboration, information flow and coordination are essential for the sustainability realisation process. Application of these technologies provides benefits such as corruption reduction, information asymmetry and increased transparency (Senyo, Effah, and Osabutey 2021). Through these benefits, multi-tier supply chains can be effectively managed to achieve sustainability. In addition, the findings also highlight a number of strategies for multi-tier supply chain management. These strategies include forming strategic alliances, delegation and top-down sustainability

enforcement. Moreover, multi-tier supply chains can also adopt open, closed and third-party strategies.

The last component of the framework shows the outcome of achieving a sustainable multi-tier supply chain relies on combining the sustainability realisation process with assessment approaches. As multi-tier supply chains are dynamic, new and emerging sustainability issues need to be assessed and addressed continuously. Therefore, organisations need to constantly review their triple bottom line responsibilities to assess their sustainability activities to ensure that they are paying sufficient attention to address emerging issues. In addition, sustainability assessment approaches allow firms to also evaluate the extent to which existing processes are working. Moreover, achieving a sustainable multi-tier supply chain is not static but a dynamic and evolutionary process that needs to respond to the changes in the business environment and the resulting expectations of key stakeholders. Thus, there is a need for regular evaluation to identify and sometimes anticipate issues in order to address them actively and proactively. Such assessments also reveal non-performing supply chain members. Therefore, sustainability assessment approaches are crucial in the pursuit of sustainable multi-tier supply chains. In the event that a multi-tier supply chain become unsustainable, there is a need to use evaluation and feedback as basis for diagnostics and revisitation of the sustainability conundrum in the first step of the framework.

5.2. *Agenda for future research*

While prior research on sustainable multi-tier supply chain management provide useful insights, our review reveals that there are notable gaps in the literature. We address the third research question by formulating an agenda for future research. We find five key gaps that future research could explore: (1) investigating social, environmental and economic dimensions of sustainability together, (2) effect of government regulation, (3) perspectives of non-supply chain members, (4) emerging and developing economy perspectives, and (5) rigorous empirical validation of sustainability assessment approaches and the need for more interdisciplinary lenses.

First, we call for future studies to consider investigating all three dimensions of the triple bottom line together. In prior research, we note that majority of the studies often focus on the elements of the triple bottom line separately. The majority of studies that attempt to investigate more than one

element often focus on two, mainly the social and environmental components to the neglect of the economic dimension. Even the very few studies that could be argued as investigating all three dimensions are not explicit about how each element is accounted for. While we acknowledge that there could be resource and scope challenges involved in investigating all three, it is also important to note that they are interdependent practically and theoretically.

Second, since multi-tier supply chain transcends geographical areas, regulation in different countries becomes key to achieving sustainable multi-tier supply chains. Prior research indicate that countries with strong regulations require open strategies to achieve sustainable multi-tier supply chains (Mena, Humphries, and Choi 2013). Conversely, this strong regulation could sometimes be counter intuitive to achieving sustainability. However, from our analysis, it is evident that there is less research on the role of government regulation in sustainable multi-tier supply chains. Therefore, future research could provide more insights on the effect of government regulation.

Third, future studies are encouraged to consider non supply chain member perspectives in sustainable multi-tier supply chain research. Majority of prior studies focus on active or direct participants in the multi-tier supply chains without incorporating views of other indirect stakeholders whose power/interest can influence the ability of the firm to achieve triple bottom line. This is because sustainable multi-tier supply chains have rippling effects which transcends immediate and direct stakeholders. Therefore, to examine the holistic effects of sustainable multi-tier supply chains, it is important to consider the views of non-supply chain members who have high power/interest and influence.

Fourth, we call for more studies from emerging/developing economies perspectives. Our analysis shows that prior research on multi-tier supply chain has largely been conducted in the context of developed countries. Though there are few exceptions (e.g., Jia, Gong, and Brown 2019; Gong et al. 2018), majority of the studies focus more on developed countries. Given that majority of lower-levels tier of supply chains are located in emerging/developing economies, where institutions are weak and the regulatory regimes poor (Osabutey and Croucher 2018), it is important to incorporate more developing/emerging economy perspectives and how they influence the international dimensions of sustainable multi-tier supply chain management.

Lastly, there is avenue for future research to rigorously validate sustainable multi-tier supply chain assessment related approaches. In previous research, a number of approaches have been developed ranging from models, frameworks and methods (e.g., Ciardiello, Genovese, and Simpson 2020; Tuni and Rentizelas 2019; Mejías et al. 2019) . However, majority of these are conceptual. Some of the approaches use simulation or artificial data which do not provide actual performance measures; making it difficult to ascertain the performance of these approaches. In other instances, some approaches are only validated with data from a single industry (e.g., Mejías et al. 2019). As multi-tier supply chains are complex, dynamic and could vary from one industry to another, it is important that developed approaches are rigorously validated in multiple sectors and countries. In the same vein, more inter-disciplinary research will enrich our understanding of multi-tier supply chains. In addition, interdisciplinary research can provide lenses that can enhance strategic sustainable multi-tier supply chain management.

5.3. *Theoretical implications*

This systematic literature review led to the development of the sustainable multi-tier supply chain framework. This framework theoretically contributes our understanding of sustainable multi-tier supplier chains to provide a useful extension to the literature. In particular, this review emphasises that in the sustainability realisation process adapting and using emerging digital technology applications can contribute to achieving triple bottom line. This is because such digital technologies improve transparency which is crucial for monitoring and evaluating sustainability policies and practice across all tiers of the supply chain. Our study is unique in the way it addresses research gaps alongside developing a sustainable multi-tier supply chain framework. Furthermore, our study confirms the transdisciplinary nature of sustainable multi-tier supply chain management. So far, research on sustainable multi-tier supply chains have largely focused on domains or disciplines of supply chain or production and operations management. However, through this study, we have highlighted that sustainable multi-tier supply chain encompasses fields such as business ethics and corporate social responsibility, information systems, and international business and strategy. Optimal sustainable multi-tier supply chains require multi-disciplinary synergy of expertise from these auxiliary fields. In the same vein, our study has implications for the application of the triple bottom line theory in systematic review of literature on multi-tier supply chains. Thus far, our study is arguably the first to apply the theoretical lens to review sustainable multi-tier supply chain research. By doing so, our study differs from previous reviews. Our

analysis reaffirms the importance of the triple bottom line theory in the assessment of sustainable multi-tier supply chains and suggests that social, environmental and economic issues should not be addressed separately.

5.4. Practical implications

The study also offers a number of practical implications. First, our proposed framework is a useful tool for multi-tier supply chain practitioners and organisations to pursue sustainability issues. More often, in practice, organisations focus largely on environmental, social or economic sustainability issues separately. However, our framework, demonstrate that achieving sustainability requires addressing issues related to all the three aspects as are they are interrelated. Second, the study provides insights on the need for constant horizon scanning and sustainability assessment of multi-tier supply chains because multi-tier supply chains are dynamic and continuously evolve. Our study proposes the use of sustainability assessment approaches to ensure multi-tier supply chains respond to emerging expectations of stakeholders. Given the nature, complexity and size of multi-tier supply chains, it is important to automate sustainability assessment approaches to proactively assess, find and alert of emerging issues. Lastly, this study highlights the role of digital technology in realising sustainable multi-tier supply chains. Generally, digital technologies are considered to provide supporting roles instead of spearheading sustainable multi-tier supply chain activities. However, from our study, we highlight the importance of digital technologies; especially emerging ones such as artificial intelligence and blockchain for the management of sustainable multi-tier supply chains. With this insight, practitioners should consider implementing digital technologies as the focal tool during the sustainability realisation processes if they want to derive optimum benefits. At the same time, these technologies should align with the sustainability strategies of organisations in multi-tier supply chains as deploying these technologies in isolation will not yield required results.

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Appendix A: List of studies reviewed

Publication outlet	Study
Article	
African Journal of Economic and Management Studies	Sancha C., Mária S.J J.F., Gimenez C. (2019)
Annals of Operations Research	Ciardiello, Genovese, Simpson (2018)
European Journal of Operational Research	Mori, Kobayashi, Samejima & Komoda (2017)
Group Decision and Negotiation	Hernández, Mula, Poler & Lyons (2014)
IIEE Transactions	Karaer, Kraft & Yalçın P. (2020)
International Journal of Logistics Management	Kanyoma, Agbola & Oloruntoba (2018)
International Journal of Logistics Systems and Management	Ekanayake, Joshi, & Thekdi (2016)
International Journal of Operations and Production Management	Chae, Lawson, Kull, & Choi (2019) Gong , Jia, Brown & Koh (2018) Meinlschmidt, Schleper & Foerst (2018)
International Journal of Physical Distribution and Logistics Management	Lippert & Forman (2006)
International Journal of Production Economics	Darvish M., Archetti C., Coelho L.C. 2019 Deyong G.D., Pun H. (2015) Gong M., Gao Y., Koh L., Sutcliffe C., Cullen J. 2019 Hannibal C., Kauppi K. 2019 Heydari J., Govindan K., Aslani A. 2019 Jia F., Gong Y., Brown S. 2019 Kembro J., Näslund D., Olhager J. 2017 Lechler S., Canzaniello A., Hartmann E. 2019 Mejías A.M., Bellas R., Pardo J.E., Paz E. 2019 Sauer P.C., Seuring S. 2019 Tuni A., Rentizelas A. 2019 Wilhelm M., Blome C., Wieck E., Xiao C.Y. 2016
International Journal of Production Research	Chen, Xu & Zhou (2019) Ghadge, Kidd, Bhattacharjee & Tiwari (2019) Lyons & Ma'Aram (2014) Mula, Lyons, Hernández & Poler (2014) Sawik (2019) Viswanathan, Widiarta & Piplani (2007) Yoon, Narasimhan & Kim (2018)
Journal of Business Ethics	Hofmann, Schleper & Blome (2018)
Journal of Cleaner Production	Grimm, Hofstetter & Sarkis (2016;2018)
Journal of Operations Management	Holweg, Disney, Hines & Naim (2005) Soundararajan & Brammer (2018) Wilhelm, Blome, Bhakoo & Paulraj (2016)
Journal of Purchasing and Supply Management	Dou, Zhu & Sarkis (2018) López & Ruiz-Benítez (2020)
Journal of Supply Chain Management	Mena,Humphries & Choi (2013)
Kybernetes	Covaci & Zaraté P. (2019)
Materiaux et Techniques	Bajaj (2017)
Journal of Engineering Manufacture	Evans, Gao, Martin & Simmonds (2018)
Production Planning and Control	Coronado Mondragon, Mastrocinque & Hogg (2017) Hernández, Lyons, Poler, Mula & Goncalves (2014) Tuni, Rentizelas & Chinese (2019)
Reliability Engineering and System Safety	Quigley & Walls (2007)
Resources	Young, Fernandes & Wood (2019)
Robotics and Computer-Integrated Manufacturing	Venkatesh, Wang, Zhong & Zhang (2020)
Safety Science	McDermott & Hayes (2018)
Simulation Modelling Practice and Theory	Zhang & Zhang (2007)
Studies in Informatics and Control	Mori, Kobayashi, Samejima & Komoda (2014)
Supply Chain Forum	Stekelorum, Laguir, Courrent & Jaegler (2018)
Supply Chain Management	Kalaitzi, Matopoulos & Clegg (2019) Sauer & Seuring (2018)
Sustainability Accounting, Management and Policy Journal	Akhavan & Zvezdov (2019)
Conference publications	
Americas Conference on Information Systems	Mujaj & Leukel (2007)
IEEE International Symposium on Industrial Electronics	Mori, Kobayashi, Samejima & Komoda (2014)
IFAC-Papers	Gold & Awasthi (2015)

Procedia CIRP	Nishi & Yoshida (2016)
International Congress on Advanced Applied Informatics	Samejima (2016)
IEEE International Conference on Decentralized Applications and Infrastructures	Miehle, Henze, Seitz, Luckow, & Bruegge (2019)
IEEE International Conference on E-Commerce Technology	Mujaj, Leukel & Kirn (2007)
Annual Association of Researchers in Construction Management Conference	Bygballe, Havendim Hughes, Orstavik & Torvatn (2015)
International Conference on Electronic Business	White & Mohdzain (2005)