

# Who shares wins? Understanding barriers to information sharing in managing supply chain risk.

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# **Who shares wins? Understanding barriers to information sharing in managing supply chain risk**

## **Abstract**

**Purpose:** Currently there is no universally accepted approach to supply chain risk management and assurance. To begin to shed more light on the practical operational challenges presented when considering supply chain risk mitigation through the sharing of information, this paper discusses the results of an empirical study conducted with manufacturing supply chain professionals. The study examines state-of-the-art challenges to managing risk in today's supply chains by reporting on data collected in 2021.

**Design/Methodology/Approach:** To develop a rich picture of the challenges of information sharing in multi-tier supply chains, we adopted a qualitative research design. We conducted 14 interviews with supply chain professionals and ran two focus groups that were industry specific; one focused on the nuclear industry and the other on automotive.

**Findings:** The study identifies contemporary practical challenges to information sharing in supply chains; specifically challenges related to data quality and the acceptance of sub-optimal normative supply chain practices, which have consequences for supplier assurance fatigue and supply chain transparency.

**Originality:** Our topical and contemporary study shows how an acceptance of the normative practices of a supply chain can have an effect on the likelihood of supply chain disruption due to shortcomings in approaches to information sharing. The notion of the acceptance of the status quo in this context has received limited research attention, and hence offers an extension to current discourse on supply chain risk and resilience.

Keywords: risk, assurance, supply chain, multi-tier, resilience

## **Introduction**

To meet the seemingly ubiquitous set of customer expectations predicated on speed, quality and reliability performance, firms are collaborating in ever increasing numbers (Olah, 2018). Driven by the aim of economic gain through improved efficiencies, this practice results in highly interdependent, complex multi-tiered global supply chain structures (Capaldo and Giannoccaro, 2015; Bode and Wagner, 2015). Such interdependence offers rewards across a supply chain, yet also carries risk; the risk of supply chain disruption as a result of co-ordination

failure. Co-ordination often takes the form of information sharing (Zhou *et al.*, 2017), therefore the risk of supply chain disruption amplifies as the supply chain increases its number of tiers and more information is required (Kembro *et al.*, 2017). Shortcomings related to supply chain co-ordination failure have been exacerbated in light of recent external shocks including Brexit (Brady, 2021), Covid-19 (Schumacher *et al.*, 2021) and the Suez Canal blockage (Lee and Wong, 2021), propelling supply chain management into daily news items and focusing the attention of firms on strategic supply decisions (Sharma *et al.*, 2020). Utilising risk management and assurance to improve resilience through improved information sharing therefore remains high on the agenda for supply chain actors (Yang *et al.*, *in press*).

In practice, there is no universally accepted approach to supply chain risk management and assurance resulting in the development and utilisation of numerous internal and third party systems (see e.g. KPMG, 2021; Deloitte, 2018). Research has examined a variety of ways in which the challenges brought on by expanding supply networks can be ameliorated. For example, Kamalahmadi and Parast (2017) suggest multi-sourcing strategies in conjunction with supply chain redundancy practices such as pre-positioning inventory, backup suppliers and protected suppliers, and Zare *et al.* (2019) recommend the use of risk-sharing contracts. However, these suggested strategies do not take into consideration operational challenges; successful implementation relies on a seamless flow of information across supply chain tiers. End-to-end visibility would therefore appear to be critical in ensuring efficient supply co-ordination, and for effectively managing risks within the chain (Christopher and Lee, 2004; Caridi *et al.*, 2014). Yet a recent survey of 451 European retailers found that 94% do not have a clear view of events affecting supply chain performance, although 87% held the view that full supply chain visibility can create competitive advantage (Zetes, 2019).

Empirical research finds that information sharing is desirable (Baihaqui and Sohal, 2013; Zhou and Benton, 2007), yet how this is achieved in practice requires further investigation. To begin to shed more light on the practical operational challenges presented when considering supply chain risk mitigation through the sharing of information, this paper discusses the results of an empirical study conducted with manufacturing supply chain professionals. The study examines state-of-the-art challenges to managing risk in today's supply chains by reporting on data collected in 2021. The following research question frames the study: *What are widespread practical challenges to information sharing when managing risk in contemporary multi-tier supply chains?*

## **Review of Literature: Challenges to Information Sharing in Managing Supply Chain Risk**

The study focuses on contemporary supply chain management practice. The scope of the study compares information sharing challenges discussed in the literature with those experienced by practicing supply chain management professionals. To do this it was important to review a broad range of literature at the outset of the research to identify key challenges identified in scholarly discourse, which could subsequently be compared with empirical data. Topics from the literature that were examined included supply chain management, data and information sharing across networks, information management, risk, resilience, collaboration and co-ordination. From this review six key challenges emerged:

- Achieving transparency across supply chains.
- Individual actors' willingness to share data and information.
- Accessing real-time information.
- Supplier assurance fatigue.
- Data reliability.
- Data validation.

Each of these challenges is now discussed in turn.

### *Achieving Transparency across Supply Chains*

End-to-end visibility in the supply chain is a method of reducing risk across the whole chain (Kaipia and Hartiala, 2006). It promotes effective data and information sharing between parties involved in the supply network, thus increasing overall efficiency, performance and resilience (Sithole *et al.*, 2016). Supply chain transparency requires firms to know what is happening upstream and to communicate and act on this knowledge. In addition to co-ordination activities, transparency has become crucial to supply chain management as consumers and other stakeholders (e.g. government, pressure groups) demand information on how products are made, which raw materials are used, from where materials are sourced and under which conditions they are produced and traded (Nooraie and Mellat Parast, 2015; Hannibal and Kauppi, 2019).

There are two elements to achieving supply chain transparency; visibility and disclosure (Bouchery *et al.*, 2017). Visibility is the process of actively identifying and collecting data from

suppliers, whereas disclosure is how this information is communicated both internally and externally as required. Challenges as regards data and information sharing are reported (Tran *et al.*, 2016), yet it remains unclear as to why end-to-end visibility remains 'out of reach' for many supply chains. One challenge of achieving better visibility, often related to financial constraints, is ineffective communication from firms in lower tiers (Sithole *et al.*, 2016). A further challenge is how all stakeholders in the chain need to work towards a common goal; a practice that is not always taken as read. Research finds that in optimising individual goals (most commonly profit maximisation) stakeholders often ignore the outcome of their decisions on the rest of the supply network, thus creating whole supply chain challenges (Zhou *et al.*, 2017). Transparency across the supply chain therefore appears to be desirable, however there are challenges related to its operationalisation.

#### *Individual Actors' Willingness to Share Data and Information*

A further challenge to risk mitigation is the degree of willingness that supply chain actors have with regards to sharing data and information with other actors in the supply chain. Studies that have examined an unwillingness to share have reported concerns about confidentiality (Li and Zhang, 2008; Tan *et al.*, 2016), reliability (Lu *et al.*, 2021), competition (Ha and Tong, 2008; Huo *et al.*, 2013) and lack of trust (Tran *et al.*, 2016; Kembro *et al.*, 2017). Other studies have examined capability challenges to information sharing and report on a lack of know-how (Fan *et al.*, 2017), a lack of a standardised information sharing methodology (Wang and Wei, 2007) and concerns about the security of the sharing platform (Smith *et al.*, 2007; Barkataki and Zeineddine, 2015). It is notable that few such studies have examined both the willingness and capability constructs in a single study, and few have considered the implications of multiple actors and multiple supply chain tiers.

Firms appear to struggle to achieve end-to-end visibility across the supply chains with which they are engaged, and are frequently unaware of the identity of various upstream and downstream actors. In consequence, firms are unaware who will gain access to information that they hold or may choose to share confidentially, thus raising concerns about other supply chain actors sharing this information to gain an individual competitive advantage (Shang *et al.*, 2016; Du and Jiang, 2019). This challenge relates to the previous discussion on actors focusing on achieving their individual business goals rather than the goals of the entire supply chain (Grimm *et al.*, 2016). Research does show how strategic information sharing involving the whole supply chain maximises profitability for all (Zhou *et al.*, 2017), yet the willingness of

supply chain actors to share is often overlooked in information sharing literature, with studies placing greater emphasis on capability or connectivity (Fawcett *et al.*, 2007).

#### *Accessing Real-Time Information*

Supply chain disruption usually occurs with limited prior warning, and its impacts are experienced throughout the chain (Scheibe and Blackhurst, 2018). The Covid-19 pandemic exposed the vulnerabilities of global supply chains and led to widespread product shortages due to the impact of increased demand, staff absences and the closure of manufacturing facilities (Ivanov and Dolgui, 2020). As discussed, end-to-end visibility can be challenging to achieve in multi-tier global supply chains, and the impact of Covid-19 highlighted the need for increased supply chain resilience. Such resilience may be achieved by utilising real-time information (Nakasumi, 2017). Real-time information improves visibility across multi-tier supply networks by providing intelligence on sources of supply, work in progress and distribution channels (de Oliveira and Handfield, 2019). Such information can subsequently be used to indicate alternative sources of supply and distribution (Nakasumi, 2017). Real-time information assists firms in identifying problems at their source, and thus accessing real-time information and improving end-to-end supply chain transparency go hand in hand.

Accessing real-time information is, however, challenging. Not all firms in a supply network manage supplier assurance requests in a timely fashion and are often unable to comply with the data requests received (Adobor, 2018). Further, there is a requirement for data sharing standards. Due to the myriad of suppliers in global multi-tier supply chains, there are seemingly countless mechanisms for presenting and sharing data, which can present challenges for those sharing and receiving the information. One solution could be to have all suppliers in a multi-tier supply chain utilising interconnected software systems that share information in real-time (Nakasumi, 2017). However, as the firms in a multi-tier chain will have access to different levels of financial resources and capability, achieving interconnectivity through software can be costly. Consequently, the variability in resources across a chain can make it very difficult to instigate a workable real-time information sharing method across all suppliers (Wang-Mlynek and Foerstl, 2020).

#### *Supplier Assurance Fatigue*

The supplier fatigue challenge refers to the exhaustion of resources and the constant monitoring required by firms to achieve supply chain transparency or to comply with supplier audits

(Adobor, 2018). As KPMG and Deloitte suggest, solving the supplier assurance problem requires collecting large amounts of data on each supplier (Deloitte, 2018; KPMG, 2021). Once the requisite data have been collected, analysis and interpretation can be extensive and exhausting, thus exacerbating the challenge (Khalid *et al.*, 2020). Often in lower tiers of the supply chain the nature of frequently changing buyer relationships and a lack of compliance to codes of practice add further to supplier fatigue (Tachizawa and Yew Wong, 2014). Labour can be outsourced to add further complexity to supply networks, thus creating additional visibility limitations (Schoenherr, 2010). Remaining diligent to the introduction of new suppliers can be exhausting, yet has to be completed to ensure full supply chain transparency (Zhang *et al.*, 2021). Software does have the potential to automate supplier assurance activities (Castka *et al.*, 2020) however, as discussed, transparency, the willingness of supply chain actors to share information, the accessibility of real-time information and the lack of data sharing standards pose challenges to this approach.

#### *Data Reliability*

Across multi-tier supply chains, firms experience challenges with the reliability of the data that are shared (Groth, 2013). Most frequently, data are missing, thus further complicating risk management (Castka *et al.*, 2020). The implementation of data sharing standards may go some way to addressing this challenge (Simatupang and Sridharan, 2005). However, from an operational perspective, utilising a vast array of suppliers makes it difficult to push certain standards, and questions are raised as to why firms should adopt a standardised data set championed by one organisation (Yu *et al.*, 2018). A further challenge in sharing data across supply networks is the potential for misinterpretation of the data, particularly when a high degree of accuracy is required (Zaheer and Trkman, 2017). As previously outlined, not all supply chain actors have information systems in place and are therefore limited in terms of enabling seamless connectivity (Wang-Mlynek and Foerstl, 2020).

#### *Data Validation*

Validation ensures the accuracy, reliability, data integrity and third-party reliability of the data received from a supplier (Wang *et al.*, 2016). If data are not validated this may compromise the risk management processes that a firm will undertake; to make the most effective supplier risk management decisions the data must be accurate (Wang *et al.*, 2016). Measuring supplier audit compliance is one method of ensuring that data are accurate by enforcing suppliers to conform to a firm's external audit requirements (McDowall, 2016). A shortcoming with

enforcing suppliers to comply with audits across an established multi-tier supply chain is that this practice can restrict firms in lower-tiers if they are not compliant and/or do not keep accurate records. Further, the cost of ensuring that audits are carried out can outweigh the benefits for certain sectors (Punniyamorthy and Manikandan, 2013). Validating data is therefore a key challenge in managing supply chain risk.

### *Summary*

Six key challenges related to information sharing were identified from the review of literature. Each challenge has implications for information sharing. For example, visibility is important to enable information to be shared, however the mechanisms by which end-to-end visibility across multi-tier supply chains can be achieved remains unclear. Firms towards the top of the supply chain usually have higher capital reserves and can therefore invest in information systems, thus permitting the management of operations through efficient communications and effective supplier assurance as data requests can be issued with ease (Wang-Mlynek and Foerstl, 2020; Adobor, 2018). Lower down the supply chain however, these tiers often do not have the resources to implement software to manage their operations more efficiently (Wang-Mlynek and Foerstl, 2020). Supplier fatigue from audit and assurance requests from firms higher up the supply chain can impact information sharing due to cost and time resources (Khalid *et al.*, 2020). There can also be an unwillingness from supply chain actors to share information as there are concerns that they can subsequently be outsourced; essentially ‘cutting out the middleman’ (Shang *et al.*, 2016). When data are received, their reliability and validity may be questionable (Castka *et al.*, 2020; Wang *et al.*, 2016), and if not received in a timely fashion the data may be redundant (Adobor, 2018). Identifying how widespread such challenges are and whether additional challenges are currently being experienced by supply chain professionals requires further investigation, and is the focus of our empirical data.

### **Research Methods**

To address the research question: *What are widespread practical challenges to information sharing when managing risk in contemporary multi-tier supply chains?* we gathered qualitative data from supply chain experts working in manufacturing supply chains. Drawing on similar research designs that adopted a multi-tier perspective (e.g. Kanyoma *et al.*, 2018; Wilhelm *et al.*, 2016), we focused on UK-based supply chain professionals working in global multi-tier supply chains and sought experts with sufficient knowledge to engage in detailed debate about



supply chain risk and assurance. We identified potential research participants through desk-based research and reached out to them via email invitations. We found it challenging to engage potential participants in the research, which may have been due in part to the increased workload of supply chain professionals as a consequence of Covid-19. We used a phased approach to contacting respondents and in total we contacted 547 potential participants from 495 organisations; of these 25 experts, from a broad range of industries including healthcare, oil and energy, pharmaceuticals, food, automotive and nuclear, agreed to take part in the study. Table 1 provides an overview of the research participants.

In order to develop a rich picture of the challenges of information sharing in multi-tier supply chains, the research design utilised one-to-one interviews and focus groups as data collection mechanisms (Lincoln and Guba, 1985). Data were collected during May-July 2021. We conducted 14 semi-structured interviews that lasted approximately 60 minutes each and ran two focus groups that were industry specific; one focused on the nuclear industry and the other on automotive. Each focus group had six expert participants. The questions in the interviews and focus groups were based on exploring the 6 themes identified from the review of literature in a ‘business as usual’ context and we also asked participants to share examples of challenges to managing risk in supply chains (see Table 2). We did not ask identical questions in the interviews and focus groups as varying the questions and asking for different examples allowed us to collect as much data as possible and to identify any obvious areas where the quality of information may need further investigation. It was illuminating that all participants could readily provide recent examples of supply chain failure related to shortcomings in the risk management process. We also asked participants to share ‘blue sky thinking’ about supply chain risk management; for example, what might an ideal scenario look like and how might it be operationalised. Due to social distancing restrictions related to the Covid-19 pandemic, all interviews and focus groups were conducted using Microsoft Teams and were recorded and transcribed verbatim.

Thematic analysis was used to analyse the wealth of qualitative data collected. We followed the process developed by Braun and Clarke (2006) and utilised NVivo software to facilitate coding by multiple members of the research team. Initial codes were refined and collapsed into fewer codes, which showed the types of challenges experienced by the expert respondents.

[Insert Table 1 here]

## **Findings**

In analysing the themes emerging from the data, supplier fatigue, as identified from the literature, was a recurrent theme that was identified by the majority of the expert participants. What was of further interest were two new themes that were widespread across interview and focus group respondents; acceptance of the status quo and lack of data standardisation. Through further thematic analysis it was identified that supplier fatigue could be considered as a consequence of two overarching challenges; data quality and normative supply chain practices. Our analysis found that challenges to data quality and widespread normative supply chain practices were manifesting in supplier assurance fatigue and lack of supply chain transparency. From the data it is suggested that an outcome of the challenges and associated consequences identified is increased supply chain risk. Figure 2 outlines these challenges, consequences and the outcome, each of which are discussed below.

[Insert Figure 2 here]

### ***Challenges to Information Sharing in Managing Supply Chain Risk***

Two overarching challenges to data sharing in managing supply chain risk were derived from the empirical research; data quality and normative supply chain practices.

*Data Quality:* The position of an actor in the supply chain appeared to influence how readily data could be accessed in real-time; “*How can I put it politely?...It depends how your suppliers see you. If they see you as a key in their supply chain, then they will supply you with key information on a regular basis... Other suppliers, even though you’re doing the same process, let’s say, they may not see you as a key supplier, and therefore you have to chase them for that information*” (Interviewee 6). “*Where you’re not such a big customer of theirs and you’re only buying once or twice a year, then it can be difficult*” (Interviewee 13). In accessing data, it appeared that relationships were just as important as systems and processes; “*A lot of it is about key relationships and understanding. Sometimes that breaks down, as you can imagine. People move on and you lose that person that you built that trusting relationship to work with, but yeah, it is very much about relationship management, very, very much about it*” (Interviewee 8).

Interviewees discussed how they coped with missing data, which appeared to be a significant challenge; “*We stumble over it, and trip over it, and fall, and face-plant every now and again,*

*and get ourselves back up, wipe ourselves down and make sure we don't do it again”* (Interviewee 8). Others appeared to be overwhelmed with data, yet had concerns about reliability and validity; *“There's too many applications so even [with] simple communications there's too much information. Whether it be Teams or Slack or email or messaging... WeChat and WhatsApp. Then you've got spreadsheets, you've got people doing reports in BI. To me it's about where's the information, where's the source of truth? Out of all this information, which is the source of truth”* (Interviewee 14). When discussing data reliability and validity, keeping up to date was challenging: *“The amount of time I go back into a company and find that something's just expired, something's just out of date, you know, Jimmy's left, Mary's not there anymore, you know, that type of thing all has an impact on risk and the final kind of quality of the documentation and product we get out”* (Interviewee 24, Nuclear Industry Focus Group). The reliability and validity of data really came to the fore when provenance was required. Interviewee 4, for example, explained *“we can't write it on the back of a pack on a ready meal that this is a Chinese ready meal with the finest spices from wherever in China. And really, there's some that were grown in Norfolk on a field somewhere.”*

*Normative Supply Chain Practices:* When examining normative supply chain practices associated with risk management, it is interesting to note that supply chain actors appeared to expect others in the chain to share, but were not always willing to do so themselves. For example, an excerpt from an interview with Interviewee 1 was revealing as there was an expectation that suppliers shared information: *“...subcontractors are more guarded about their processes, they want to keep some things proprietary, that makes our life harder to be honest. And if anything, that's the driver for moving away from some subcontractors... they're not open and honest, and if they can't share information we can't keep the regulators happy and keep the products on the market. So, it has to be a two-way thing”* yet later in the interview the following statement was made: *“We're going to redact anything that's proprietary or might give too much away. I think everyone's got to protect their own interests.”* In terms of sharing performance issues, an ‘unwritten code of conduct’ about not sharing unless deemed absolutely necessary was discussed; *“I don't think there's anything that you'd share outright, going right up the value stream, up the supply chain, unless there was any real cause for concern.”* (Interviewee 4).

Whilst challenges were discussed, there seemed to be a general acceptance of the status quo, and that perhaps supply chain transparency was a futuristic concept: *“This concept of broad openness and transparency, I’m not entirely sure that society is ready for that as yet”* (Interviewee 2). When information was not forthcoming, which was a common occurrence, the use of ‘workarounds’ was discussed, which included gathering data via informal networks or discussing with other suppliers. *“As with all industries, people gossip. There is information out there to plug into”* (Interviewee 7). *“If somebody’s in trouble, or somebody’s struggling to pay, you normally hear it. Engineering’s quite incestuous. So you get to hear a lot of things that are going on”* (Interviewee 10).

Respondents agreed that the lack of data standardisation was a challenge, referred to by Interviewee 14 as ‘clunky’, yet seemed reluctant to streamline or pioneer standard approaches. Data standardisation is the process of bringing data into a common format that allows for the sharing of tools, software portals, collaborative research, and large-scale analytics. There were no common communication methods, software portals, ERP or MRP systems, which created a data standardisation problem for the respondents in the study. Participants explained how, across the multiple businesses they deal with, they have multiple accounts to log into, and numerous portals and software to share data with suppliers. Each of these accounts must be monitored, requiring additional resources.

### ***Consequences of Information Sharing Challenges***

The challenges of data quality and normative supply chain practices had clear consequences for managing supply chain risk. Supplier assurance fatigue and a lack of supply chain transparency were important consequences of these challenges.

*Supplier Assurance Fatigue:* Keeping up to date with supplier assurance requests was described as a ‘revolving door’ as it was a constant process. *“I think the big shock to new entrants is how much paperwork is involved and it’s that old adage, ‘I’ll give you that fan for nothing but I’ll charge you £250,000 for the paperwork’ ”* (Interviewee 20, Nuclear Industry Focus Group). Myriad of different processes were in place, wherein different information was requested, over differing timescales, in differing formats. Respondents queried how assurance data was used: *“I do actually wonder if anybody reads this stuff, I’ve got to be honest. I think it probably won’t get read in any great detail”* (Interviewee 15, Automotive Industry Focus

Group). Questionnaires were the most common method of data collection, yet the questions posed were non-standard and teams of colleagues responding to supplier assurance questionnaires were commonplace. The subjective nature of some of the questions posed difficulties to their completion. In addition, many of the questions were repetitive in nature, causing duplication of effort and adding to assurance fatigue.

*Lack of Supply Chain Transparency:* Very few of the research respondents believed they had supply chain transparency, with some reporting that their fellow supply chain actors did not understand what they contributed: *“The big difficulty we have is that there’s very limited knowledge within the supply chain about what we do and how we do it and we almost have to start from scratch every time to educate them [other supply chain actors]”* (Interviewee 23, Nuclear Industry Focus Group). Achieving full transparency was not the norm across supply chains: *“You look at your tier one supplier, you maybe look at your tier two supplier, you’re very lucky if you get to your tier three supplier”* (Interviewee 18, Automotive Industry Focus Group). Most appeared to be comfortable, to some degree, with this; a finding that supports the theme of *acceptance of the status quo*. For example, Interviewee 4 stated *“A lot of supply chains work in pretty much blind isolation, really, because unless there is a problem, you don’t tend to go looking.”*

### ***Outcome of Information Sharing Challenges: Increased Supply Chain Risk***

The interviewees could quickly provide examples of instances where supply chain risk had increased due to the challenges and impact of information sharing as illustrated. Examples included:

- A key supply chain actor going in administration.
- Incorrect sizing of components due to manufacturing specification errors that had not been verified.
- Shortage of component parts delayed completion of finished product.
- Product/service no longer available from supplier, and no notice period provided.
- Scheduling changes not communicated, leading to late delivery of component parts.

### **Discussion: Implications for Supply Chain Management Practice**

In addressing the research question: *What are widespread practical challenges to information sharing when managing risk in contemporary multi-tier supply chains?* the analysis of the

empirical data identified two widespread practical challenges; data quality and normative supply chain practices. From Figure 1 it can be seen that both of these challenges encompass the issues identified from the review of literature, however we offer a new contribution by elucidating two widespread and important contemporary challenges to information sharing in multi-tier supply chains. Further, whilst respondents agreed as to the importance and benefits of information sharing, the current normative supply chain practices of an unwillingness to share information, acceptance of a suboptimal status quo and a lack of data standardisation were practical examples of the difficulties of sharing information in practice. Across the respondents the agreement in principle appeared to be that ‘who shares wins’, however whether supply chain actors were actually willing to share in practice was a much-debated issue.

What was surprising from our research was how readily respondents accepted all of the shortcomings and challenges identified. This is an important finding as the acceptance of sub-optimal normative supply chain practices as regards information sharing is a theme that has received relatively limited research attention. Studies have examined the lack of willingness to share information across the supply chain (Li and Zhang, 2008; Tan *et al.*, 2016; Huo *et al.*, 2013; Kembro *et al.*, 2017), and our study extends this work by highlighting how a level of inertia and acceptance of the status quo has the potential to exacerbate current supply chain information sharing shortcomings. Our study finds that whilst the respondents tended to agree that supply chain transparency was desirable, its operationalisation was far from straightforward and they had become fatigued. Hence we identify a lack of supply chain transparency and supplier assurance fatigue as consequences of the challenges of data quality and normative supply chain practices.

The study offers important contributions to supply chain management practice as we illustrate how seemingly unrelated challenges (e.g. inability to access data in real-time, a lack of data standardisation or an unwillingness to share information) manifest as systemic supply chain challenges; specifically, data quality and the acceptance of sub-optimal risk assurance practices as the norm. These challenges have consequences for supplier assurance fatigue and the transparency of a supply chain, which in turn increase the propensity for supply chain risk through disruptions, limited resilience and challenges to business continuity.

The findings of the study suggest that tackling seemingly unrelated challenges, such as the quality of the data received and the cultural norms of the chain as regards assurance, have clear

potential to mitigate risk in a supply chain. Whilst the study did not set out to examine causation between the different challenges identified, we do suggest consequences and outcomes that affect supply chain risk. Tackling these seemingly discrete challenges offers supply chain professionals the opportunity to examine systemic supply chain norms and to begin to address important shortcomings.

### **Conclusions, Research Limitations and Recommendations for Further Work**

The study offers a contemporary investigation of current widespread practical challenges to sharing information in multi-tier supply chains. We add to the body of knowledge on supply chain risk and assurance by highlighting two important information sharing challenges; data quality and acceptance of sub-optimal normative supply chain practices and suggest that these challenges have consequences for supplier assurance fatigue and supply chain transparency. Identification of these challenges and consequences is important in mitigating supply chain risk, and once understood as shortcomings by actors in the chain may form the basis of strategic supply chain management decision making.

Whilst current and topical, the study is not without its limitations. We acknowledge that it is predominantly a cross-sectional study examining a range of different supply chains. Further work could adopt a whole supply chain perspective to analyse the particular challenges of information sharing for supply chain actors working in different tiers of the same chain. Further, whilst we offer challenges, consequences and an outcome from our analysis of the qualitative data, we are unable to comment on causation. Further work may adopt a quantitative research design to examine each of the challenges and assess its impact on supply chain risk. Nevertheless, our study offers important insight into the operational challenges related to risk that are experienced in today's global supply chains. As the disruptions ricocheting through supply chains from external shocks, including Brexit and Covid-19, begin to diminish, supply chain professionals will be seeking opportunities to ensure resilience is designed into multi-tier supply chains. Our findings offer suggestions as to systemic challenges that can be investigated further with the aim of reducing supply chain risk.

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## Figures

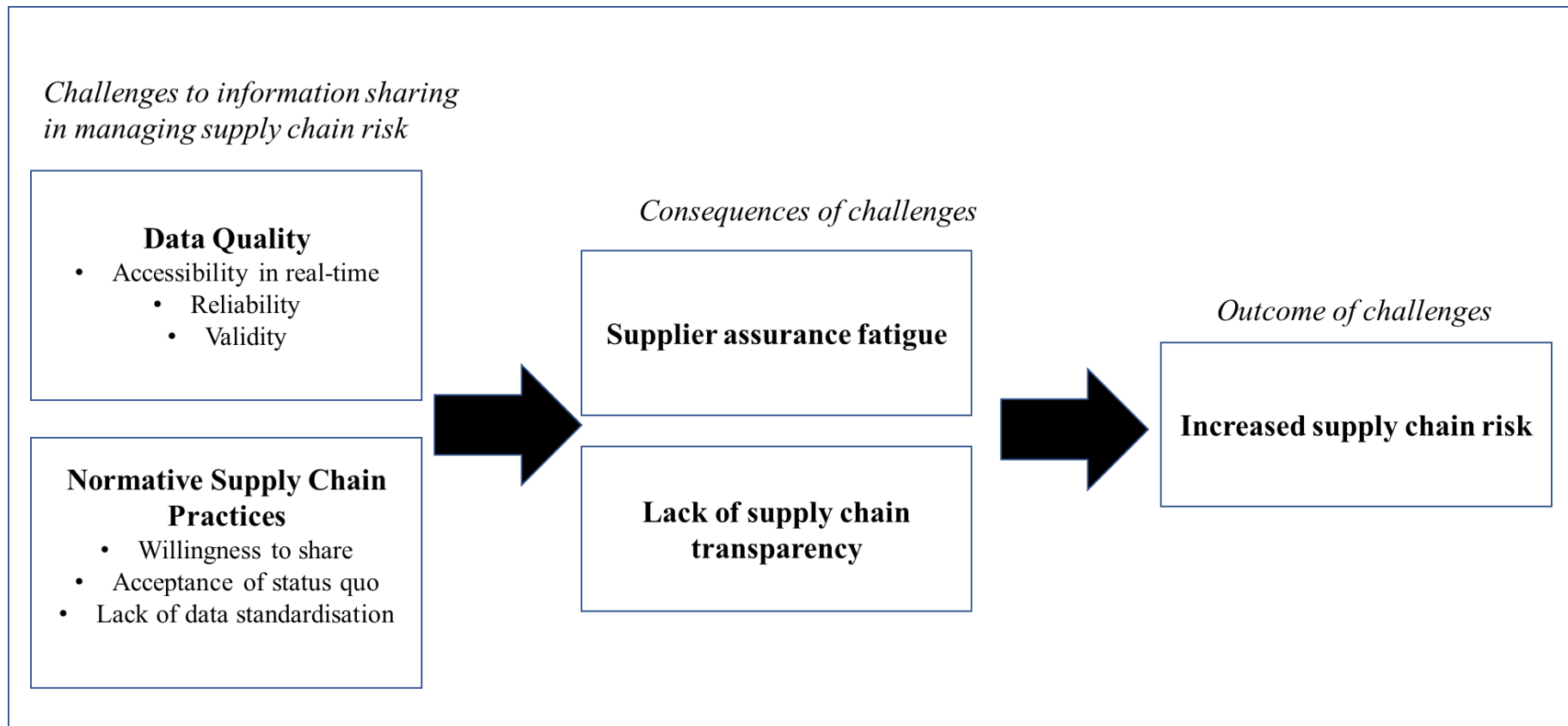


Figure 1 – Challenges to Data Sharing in Managing Supply Chain Risk

## Tables

Interviewee Number	Job Role	Industry	Location	Interview	Focus Group
1	Head of Operations	Healthcare equipment	High Wycombe	X	
2	Director of Distribution and Supply Chain	Pharmaceutical regulator	Wales	X	
3	Head of Supply Chain	Consumer goods – steel and metal	Chorley	X	
4	Operations Director	Food	Nantwich	X	
5	Business Development Director	Metal treatment	West Bromwich	X	
6	Chief Executive Officer	Automotive	Preston	X	X
7	Head of Procurement	Aerospace, defence and security	London	X	
8	Director	Metal – steel	Liverpool	X	
9	Head of Procurement	Agricultural buying group	Northwich	X	
10	Managing Director	Metal services	Liverpool	X	
11	Director of Operations	Supply chain services	Liverpool	X	
12	Head of Procurement	Cleaning chemicals	Oldham	X	
13	Head of Procurement	Oil and energy	London	X	
14	Buyer	Automotive	Northern Ireland	X	
15	Supply Chain Director	Automotive	Leeds		X
16	Vice President Supply Chain				X
17	Director of Manufacturing and Supply Chain	Automotive	London		X
18	Supply Chain Industrial Manager	Automotive	Liverpool		X
19	Operations Manager	Automotive	Derby		X
20	Supply Chain Manager	Nuclear	Congleton		X
21	QHSE Manager				X
22	Commercial Director	Nuclear	London		X
23	Operations Director	Nuclear	Inverness		X
24	Managing Director	Nuclear	Congleton		X
25	Managing Director	Nuclear	Halifax		X

Table 1 – Anonymised Research Participant Overview

<b>Theme Identified from Literature</b>	<b>Example Interview Question</b>	<b>Example Focus Group Question</b>
Achieving transparency across supply chains.	<p>How much of the supply chain are you aware of, and how many suppliers are you in communication with?</p> <p>Do you share the results of your activities with your tier 1 suppliers to benefit their supplier assurance processes?</p>	<p>Do you review your suppliers and understand the risks they pose to your business, in relation to disruption?</p> <p>Have you ever experienced challenges within your own business because of a supply chain issue/ disruption that occurred from a multi-tier supplier? Could you share an example of this? Could it have been predicted if you had fuller visibility?</p>
Individual actors' willingness to share data and information.	<p>What tools, templates or methods do you use to make requests for supplier information and what are the benefits and challenges?</p> <p>Are you willing to share information with suppliers further up the chain?</p> <p>What are the barriers to widespread sharing of supplier assurance data from your perspective?</p>	Do you have any reservations about sharing data with suppliers?
Accessing real-time information.	<p>What is the frequency of information sharing?</p> <p>Do you think this is sufficient?</p> <p>How up to date is your supplier information?</p> <p>What do you think is an acceptable time period for information like this to remain current?</p>	<p>From a timeliness perspective, how useful is the information that you collect?</p> <p>Does this change significantly from supplier to supplier?</p> <p>From your perspective, would managing risk in real-time help to resolve the supplier assurance problem / help to manage risk? Why?</p>

Supplier assurance fatigue.	<p>How do you deal with the volume of information requested?</p> <p>How much process automation is involved?</p>	<p>In your view, what changes to current practice would help to make supplier assurance better? Why? Can you give an example?</p>
Data reliability.	<p>How do you perceive the reliability of data from your suppliers?</p> <p>Is there a process to determine this reliability (i.e. audit, analytics)?</p> <p>How do you ensure the reliability of third-party or fourth-party data on your suppliers?</p>	<p>How do you perceive the reliability of data from your suppliers?</p>
Data validation.	<p>Do you rely on industry certifications to provide you with assurance?</p>	<p>How do you validate the information that you receive from suppliers?</p>

Table 2 – Example Interview and Focus Group Questions