



Internal supply chain integration during disruption recovery: A case study in the South African liquor industry

**Authors:**

Ian Wolmarans¹ 
Wesley Niemann¹ 

Affiliations:

¹Department of Business Management, Faculty of Economic and Management Sciences, University of Pretoria, Pretoria, South Africa

Corresponding author:

Wesley Niemann,
wesley.niemann@up.ac.za

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Orientation: Coronavirus disease 2019 (COVID-19) alcohol sale prohibitions have significantly impacted the South African liquor industry. This act of government halted the supply chain flow of both locally produced and imported products during this period. Both internal and external supply chain integration (SCI) became essential to ensure a rapid response to disruption recovery strategies.

Purpose: The purpose of this study in the South African liquor industry was to explore the impact of and the role that internal SCI antecedents, mechanisms and measurement play during supply chain disruption recovery using information processing theory as a lens.

Motivation for the study: Internal SCI has shown to improve performance and dependability during non-disrupted periods, but the influence of internal integration during a disruption period has yet to be determined.

Research design, approach and method: A single case study design was employed. Data were collected through 15 semi-structured interviews with executive and senior managers across the case organisation's supply chain. The collected data were analysed using a thematic analysis approach.

Main findings: Findings show that the antecedents of goal alignment, cross-functional awareness and a holistic management approach improved both the identification of and reaction to supply chain disruptions. During a disruption period, the recognised internal integration mechanisms have a threefold purpose: they collect information, eliminate information ambiguity and build recovery action plans. Although the most important internal integration measurement during disruption recovery was identified as on-time in full, all of the indicated measurements serve as both an output measure and a disruption indicator.

Practical/managerial implications: The study bridges the gap between the importance of information flow both during internal integration and disruption recovery and how internal integration implementation assists with disruption recovery.

Contribution/value add: The study introduces a framework to explain the interconnectivity between internal integration and disruption recovery.

Keywords: internal supply chain integration; supply chain disruption recovery; antecedents; mechanisms; measurements; liquor industry; single case study; South Africa.

Introduction

Industries across the globe are facing more uncertainties than ever before. This is because of an increase in natural hazard occurrences and the continuous expansion and complexity of their supply chains in the quest for growth and cost reduction (Karmaker Chitra & Ahmed 2020:179). Firms operating in the South African liquor industry experienced supply chain disruptions (SCDs) because of four government-imposed alcohol sales prohibitions during 2020 and 2021. These prohibitions were instituted as a precaution to prevent the spread of the coronavirus disease 2019 (COVID-19) pandemic in the country. This act of government halted the supply chain flow to the customers of locally produced products and imported products during this period. It was reported that R51.9 billion was lost towards the country's gross domestic product (GDP), which was 1% of the total GDP measured at a market price during that period (SALBA 2021). The liquor industry's financial and socio-economic importance in South Africa necessitates a shorter disruption recovery period or fewer SCDs to ensure business stability, continuity and sustainability (Azadegan et al. 2020:748).

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The importance of supply chain integration (SCI), both internally and externally, to ensure business survival can, therefore, not be ignored (Thabet, Lee & Khalid 2019:892). Supply chain integration is defined as the strategic and operational alignment of inter- and intra-organisational functions to ultimately increase customer value and service (Flynn, Huo & Zhao 2010:59; Thabet et al. 2019:892). Both internal and external SCI become essential to ensure a rapid response to disruption recovery strategies and common goal achievements through collaboration, coordination and the flow of material and information between supply chain members (Chai & Kim 2016:463; Flynn, Koufteros & Lu 2016:10). More importantly, the function of internal supply chain integration (ISCI) through departmental alignment and collaboration has been shown to improve operational performance, competitive capabilities, flexibility, reliability and organisation's performance (Kang et al. 2018:1750; Swink & Schoenherr 2015:69; Yuen & Thai 2016:33–34). Chai and Kim (2016:477). Duong and Chong (2020:3488) stated that SCI and ISCI not only improve the performance of the supply chain but also help in response and recovery during business uncertainty, such as an SCD.

Supply chain disruption combines unplanned and unexpected events that can occur anywhere on the upstream supply side, manufacturing processes, and the downstream demand side of the supply chain. These occurrences can significantly impact an organisation's normal course of operations, as has been the case with the South African liquor industry during 2020 and 2021 (Bode & Macdonald 2017:838; Bode et al. 2011:833).

Research on SCI and its influence on supply chain uncertainty, disruption and performance is abundant (Chai & Kim 2016:477; Kauppi et al. 2016:493; Mofokeng & Chinomona 2019:6). The impact of ISCI on SCD recovery (SCDR), however, has been overlooked. Therefore, it is suggested that scholars investigate the relationship between ISCI and SCDR in greater depth (Azadegan et al. 2020:745, 756). Studying the role of ISCI antecedents, mechanisms and measurements during SCDR can provide scholars with important insights into how organisations can address and limit losses and damages caused by SCDs (Azadegan et al. 2020:745). No prior academic research has focused on the liquor industry relating to either ISCI or SCDR. Therefore, it would be valuable, as the liquor industry plays a significant financial and socio-economic role in the South African context (SALBA 2021; Smollan 2021).

Additionally, academic studies of ISCI and supply chain disruption management (SCDM) have primarily concentrated on developed countries (Azadegan et al. 2020:752; Basnet 2013:162; Kang et al. 2018:1754; Turkulainen et al. 2017: 304–305). Developing countries face multiple challenges and opportunities, which makes the setting unique and worthy of investigation. Challenges include unreliability of infrastructure, power and water supply, and telecommunication challenges

linked to countries' governance systems, exposure to natural hazards and backup systems (Rentschler et al. 2019:2, 5). Other characteristics of developing countries are low-middle income per capita compared to developed countries, market volatility and labour turbulence (Oladele & Vieyra-Mifsud 2021:184; Sil & Wright 2018:1–2). Therefore, this highlights a concerning gap in the existing literature.

The purpose of this single case study is to explore the role of ISCI during an SCDR period, specifically related to the South African liquor industry. Through the lens of information processing theory (IPT), this study expands on Turkulainen et al. (2017) by adding an SCDR context towards ISCI mechanisms and requirements. The study also explores the measurement used to determine effective ISCI during SCDR. Semi-structured interviews were conducted with executives and senior managers, who each have a specific focus field in the firm's supply chain and role towards internal integration and disruption recovery.

The following research questions guided the study:

1. What are the ISCI antecedents for SCD recovery?
2. Which ISCI mechanisms are used during SCD recovery?
3. How is ISCI measured during SCD recovery?

The study makes four contributions. Firstly, this article examines the role ISCI plays in an SCDR period, both in terms of industry and application. Secondly, it informs supply chain managers on the requirements and importance of ISCI during SCDR, urging practitioners to become more internally integrated to maximise the benefits thereof, as per the call made by Swink and Schoenherr (2015:69). Thirdly, the work adds new aspects to the theoretical knowledge of ISCI. The addition of service level agreements and stakeholder engagement as goal alignment and cross-functional awareness antecedents are identified. The identification of sales revenue as a financial measurement and departmental surveys as an operation measurement further adds to the literature. This study's final contribution was the establishment of a theoretical framework that links ISCI and SCDM antecedents and how this linkage affects ISCI mechanisms and performance measurement during SCDR.

The remainder of the article is structured as follows; firstly, the literature review section provides an overview of the relevant literature; secondly the research strategy and methodologies employed are then provided, followed by the findings of the study. Finally, the article discusses the significance of the findings before concluding with some limitations and future research opportunities.

Literature review

An overview of the South African liquor industry

The South African liquor industry can be categorised into manufacturing, distribution, wholesale and retailers, and it

forms part of the food and beverage sector of the South African economy (Bosman 2020:1; Fitch Solutions 2021:11; Statistics South Africa 2020:3). The liquor industry's vast product offerings include beer, wine, spirits, flavoured alcoholic, low and non-alcohol drinks (Bosman 2020:1). The South African liquor industry is a multi-billion Rand industry and translates into a total annual contribution to the South African GDP of R173bn (Smollan 2021). The industry is also responsible for over 200 000 jobs across the entire value chain, which is the equivalent of 1.22% of the national jobs in the formal and informal economic sectors (Fitch Solutions 2021:13; SALBA 2021). The South African liquor industry is facing significant threats, which could lead to more disruptions. The threats include growth in illegal and illicit markets and exchange rate fluctuations impacting market predictability. The continuous legislative uncertainty in liquor marketing, trading hours and legal age of consumption, with the increase in taxes and excise, places enormous pressure on the industry to become more innovative to ensure strong margins (Bosman 2020:47).

Information processing theory

The IPT states that an increase in environmental uncertainty grows the amount of required information to be processed by organisational decision-makers during task execution (Galbraith 1974:28). Bartnik and Park (2018:1281) defined information management as the collection, combination and interpretation of the relevant information at hand. Organisations are essentially seen as information processing systems. By increasing their capability in collecting, processing and executing information from the environment, they can mitigate the equivocality and uncertainty of the information and improve performance (Fan et al. 2017:64; Wong et al. 2020:2).

Internal supply chain integration mechanisms, such as integrator roles, where individuals are assigned to serve as contact between units, using cross-functional teams and supply chain alignment, can reduce information equivocality, eliminating confusion or conflicting interpretation of the information (Bartnik & Park 2018:1282; Fan et al. 2017:64; Turkulainen et al. 2017:291). The lack of adequate, accurate, timely and concise information contributes to information uncertainty, as expected during a disruption period (Bartnik & Park 2018:1281–1282; Turkulainen et al. 2017:291). The richness, defined as the relevance, accuracy, reliability and availability, of information will improve the organisation's ability to overcome the equivocality and uncertainty of a disruptive situation and improve the response time required during disruption recovery (Bartnik & Park 2018:1282; Ivanov & Rozhkov 2020:388). Information processing theory is centred around the importance of information in decision-making by managers and organisations and links to the importance of supply chain visibility during SCD and the required mechanisms to process information evident in ISCI (Bartnik & Park 2018:1281; Kumar et al. 2017:816; Turkulainen et al. 2017:291; Wong et al. 2020:2).

Supply chain integration

The ultimate goal of SCI is to reduce fragmentation both inside and across supply chains. This is accomplished through sharing common goals and running the supply chain as a whole rather than as a collection of separate entities (Basnet & Wisner 2014:28). Supply chain integration is:

[T]he degree to which a manufacturer strategically collaborates with its supply chain partners and collaboratively manages intra- and inter-organisational processes. The goal is to achieve the effective and efficient flow of products and services, information, money and decisions to provide maximum value to the customer at a low cost and high speed. (Flynn et al. 2010:59)

Supply chain integration stimulates common trust, increases contract duration, improves decision-making and reliability, and encourages efficient conflict handling, sharing rewards, risks and information (Rudyanto et al. 2020:867).

Supply chain integration can be divided into two elements, external supply chain integration (ESCI) and ISCI. External supply chain integration entails upstream-supplier integration and downstream-customer integration. It is the collaboration of a supply chain with its external suppliers and customers on a longer-term basis through activities such as information sharing, close collaboration and joint decision-making (Kang et al. 2018:1751; Yuen & Thai 2016:34). Internal supply chain integration focuses on an organisation's cross-functional collaboration within its own supply chain, aligning organisational strategies, practices and processes into collaborative and synchronised processes. This also focuses on value-adding activities throughout the internal supply chain roles, leading to improved supply and demand alignment towards external customer expectations and supplier relationships (Kang et al. 2018:1750; Rudyanto et al. 2020:867; Wlazlak, Ferreira & Pimenta 2019:1706–1707).

Internal supply chain integration

Good ISCI has several advantages, including improving supply chain performance, such as inventory turns, operational performance, production flexibility, total logistics cost reduction and order fulfilment rate or on-time full delivery. Studies also indicate that good ISCI is an antecedent for ESCI (Basnet & Wisner 2014:27; Kumar et al. 2017:816–817, 820; Wlazlak et al. 2019:1706). When ISCI is implemented, silos and barriers across cross-functional areas are broken down, ensuring that customer requirements are satisfied (Flynn et al. 2010:60).

Antecedents of internal supply chain integration

Various studies have identified the antecedents or requirements for successful ISCI (Golgeci & Gligor 2017; Ji, Sui & Wang 2019; Mofokeng & Chinomona 2019; Turkulainen et al. 2017:294; Wlazlak et al. 2019). These factors are important to understand and identify as they determine the potential success of ISCI implementation. Basnet and Wisner (2014:32) identified that antecedents to improve ISCI are driven at different hierarchical levels within the organisation.

The three hierarchical levels are the top management-, functional- and employee levels. The first antecedent, organisational alignment, or goal alignment, relates to the synchronisation and alignment of supply chain strategies, culture, processes and structures across all functions and eliminating sub-goal pursuit and silo thinking (Golgeci & Gligor 2017:478–480; Vermeulen, Niemann & Kotze 2016:3). This is a top management required intervention and is also highlighted as the most critical antecedent for successful integration (Basnet & Wisner 2014:33). The second antecedent is cross-functional awareness, which refers to the linkage of knowledge creation and sharing through cross exposure and training of individuals from different supply chain functions. This forms part of the functional and employee level of intervention requirements. This will enhance the learning and solution creation to shared problems and communicate existing practices and data to support current operating activity improvements (Golgeci & Gligor 2017:478; Turkulainen et al. 2017:294). The third antecedent is a holistic approach to supply chain management that improves strategic thinking and implementation by including all business activities. Managing the power balance across the supply chain functions would promote synergy between cross-functional units and increase trust and cohesion among them (Golgeci & Gligor 2017:1722; Wlazlak et al. 2019:479).

Mechanisms for internal supply chain integration

There are a range of different mechanisms, also known as management tools that can implement, achieve and sustain ISCI within a supply chain or organisation (Wlazlak et al. 2019:1707). These mechanisms can be classified into two broad categories: personal and impersonal. Personal mechanisms entail interpersonal or human interaction, such as establishing teams, direct contact of supply chain roles or integrator roles to facilitate integration and information sharing across different departments. Impersonal mechanisms define mechanisms that do not include direct human-to-human interactions but rather interactions with policies, procedures, rules and regulations (Turkulainen et al. 2017:291). The mechanisms can also be categorised as either a formal process or an informal process and relate to how these mechanism processes arise. Formal processes are usually managed by hierarchical power, such as top management, and informal processes occur through beneficial environmental circumstances or voluntary behaviour displayed by supply chain employees (Wlazlak et al. 2019:1707). Therefore, it is important to understand what these mechanisms are and how they impact ISCI. Table 1 categorises and summarises these mechanisms with a short definition of each mechanism. The linkage to ISCI antecedents is also indicated.

Measures of internal supply chain integration

The measurement of ISCI spans multiple aspects of supply chains and can be divided into three categories, namely, performance, financial and operational. Therefore, selecting the appropriate measurement is complicated because of the supply chain complexity in different organisations and hence will need to be determined by each supply chain

independently (Flynn et al. 2010:60). Table 2 summarises the performance aspects that ISCI may influence.

Internal supply chain integration's ability to improve performance and stability within an organisation has been well documented. The impact of ISCI during an SCD has yet to be explored and therefore requires a better understanding of SCD on what drives SCDR.

Supply chain disruption management

Supply chain disruption is an unexpected or unintended breakdown or disturbance in the flow of materials, products or services between a supplier and customer, and it threatens the normal course of business (Bode & Macdonald 2017:837; Duong & Chong 2020:3489; Messina et al. 2020:490). Supply chain disruptions can be dealt with in both a proactive and reactive manner (Bode & Macdonald 2017:837). Supply chain risk management (SCRM) is a proactive response to SCD and focuses on prevention and/or mitigating mechanisms without considering recovery. When the proactive approach of SCRM is unable to contain the disruption impact or does not account for a specific disruption scenario, SCDM becomes critical. Supply chain disruption management is the reactive approach to disruption and is mainly based on the resilience of the organisation in unanticipated disruption scenarios (Macdonald & Corsi 2013:271). Proactivity focuses on disruption mitigation and readiness, while reactivity focuses on supply chain recovery and stability (Ivanov et al. 2017:6160). Because of an organisation's supply chain complexity and dependence on intra- and inter-organisational firms and functions, disruption is inevitable to all organisations and their supply chains (Bode & Macdonald 2017:837).

Supply chain disruption management process

As a result of the inevitability of disruption, the SCD management (SCDM) process and stages need to be well understood to ensure a quick recovery and limit any resultant negative effects. The SCDM process consists of three stages defined as discovery, recovery and redesign (Macdonald & Corsi 2013:271). Discovery is the first stage where an organisation or supply chain becomes aware of disruption, and managers end the disruption investigation process and start recovery (Macdonald & Corsi 2013:272). The decline of supply chain performance from its base performance norm, known as system performance, illustrates this. This is also the start of the disruption management process.

During this stage, information is processed to determine the impact of the disruption on the organisation or supply chain at hand. The discovery stage commences when disruption signals become visible and identifies the moment managers become aware of the disruption to their supply chain. The recognition of disruption and the diagnosis of the disruption further define the scanning and information gathering during the discovery stage. The speed at which disruption is identified and acted upon is critical to limit the potential

TABLE 1: Summary of integration mechanism with definition and linkage to antecedent and mechanism category.

No.	Integration mechanism	Defining the mechanism	Antecedent linkage	Mechanism category
1	Standardisation	Formal implementation of standardised processes, policies, operations, and systems.	Cross-functional awareness	Impersonal
2	Centralisation	Allocating decision-making authority and responsibility to a single individual or group of individuals.	Holistic approach	Impersonal
3	Cross-functional team structure	Cross-functional individuals form a group to collectively share responsibility for outcomes.	Cross-functional awareness	Personal
4	Integrator role	A formal role assigned to an individual to act as a contact between cross-functional units and with an organisation.	Cross-functional awareness	Personal
5	Relationship building	Informal communication across cross-functional teams. Ways in achieving this will be mentioned as mechanisms separately.	Holistic approach	Personal
6	Joint planning	Planning of activities and operations through cross-functional teams.	Organisational or goal alignment	Personal
7	Mutual understanding	Understanding of cross-functional requirements and processes through knowledge share.	Cross-functional awareness	Impersonal
8	Longevity of relationships	Time spent together by individuals or groups and relationships built over time. This can also be achieved through job rotation as a mechanism.	Cross-functional awareness	Personal
9	Cross-functional meeting	Meetings conducted with representatives from cross-functional units to ensure alignment, improving information sharing and collaboration.	Cross-functional awareness	Personal
10	Information sharing	Sharing of information through various mechanisms, such as meetings and information systems.	Organisational or goal alignment, holistic approach	Personal
11	Job rotation	Rotating individuals into roles across various functions to improve knowledge and understanding of the specific function through experience. Improving the holistic view of supply chain, relationship building and communication.	Cross-functional awareness	Personal
12	Cross-functional training	Training individuals about the various function's responsibility and accountability.	Cross-functional awareness	Personal
13	Mutual evaluation and reward system	The evaluation process that is consistent among functions and performance across functions is rewarded equally – building trust and goal alignment towards integration.	Organisational or goal alignment, holistic approach	Impersonal
14	Non-conflicting function objectives	Aligning cross-functional goals.	Organisational or goal alignment	Impersonal
15	Top management emphasis on the culture of collaboration and integration	Leadership influences behaviour with an organisation. The emphasis of top management to communicate and support towards collaboration and integration with a positive and supportive culture.	Organisational or goal alignment	Personal
16	Co-location	Internal supply chain functions located together, to enhance interactions between functions and better problem-solving.	Cross-functional awareness	Personal
17	Shared accountability	Holding functional managers accountable for organisation goals will enhance the integration of functions and this is linked to the alignment of goals.	Organisational or goal alignment	Impersonal
18	Incentivising	Rewarding both managers and employees for achieving shared goals to foster internal integration.	Holistic approach	Impersonal
19	Enterprise-wide computer systems	Shared information processing software such as enterprise resource planning (ERP) software, to align information across the supply chain.	Cross-functional awareness	Impersonal
20	Informal interactions	Interactions occurring outside of the working environment, including social get-togethers and team buildings.	Cross-functional awareness	Personal
21	Line managers' encouragement of positive attitudes between departments	Specifically, at lower levels, the interactions line managers have to fight for their turf, which could be perceived by employees as a negative attitude towards other functions, and behaviour could be matched.	Organisational or goal alignment, holistic approach	Personal

Note: Please see the article Wolmarans, I. & Niemann, W., 2023, 'Internal supply chain integration during disruption recovery: A case study in the South African liquor industry', *Acta Commercii* 23(1), a1150. <https://doi.org/10.4102/ac.v23i1.1150>, for complete reference list.

TABLE 2: Internal integration measurement indicators.

No.	Measurement indicator	Measurement aspect	References
1	Customer service	Operational	Basnet (2013:155); Flynn et al. (2010:60); Kang et al. (2018:1752); Kumar et al. (2017:816)
2	Responsiveness to change	Operational	Flynn et al. (2010:60); Kumar et al. (2017:817); Yuen and Thai (2016:35).
3	Cost reduction	Operational, financial	Flynn et al. (2010:60); Kumar et al. (2017:817); Mofokeng and Chinomona (2019:3); Yuen and Thai (2016:35)
4	Time	Operational, performance	Flynn et al. (2010:60); Kumar et al. (2017:817)
5	Quality	Operational	Flynn et al. (2010:60); Mofokeng and Chinomona (2019:3); Yuen and Thai (2016:35)
6	Delivery	Operational	Flynn et al. (2010:60); Kumar et al. (2017:816)
7	Flexibility	Operational	Flynn et al. (2010:60); Kumar et al. (2017:816)
8	Process efficiency	Operational	Flynn et al. (2010:60)
9	Logistic service performance	Operational	Flynn et al. (2010:60)
10	Relationship	Operational	Flynn et al. (2010:60); Kang et al. (2018:1752)
11	Improved product innovation	Operational	Flynn et al. (2010:60); Kumar et al. (2017:816)
12	Profitability	Financial	Basnet (2013:155); Yuen and Thai (2016:35)
13	Internal efficiency	Operational	Kumar et al. (2017:816); Mofokeng and Chinomona (2019:3)
14	Reduced stock out rate and/or availability	Operational	Kumar et al. (2017:817)
15	On-time order delivery	Operational, performance	Kumar et al. (2017:817)
16	Inventory turns	Performance	Kumar et al. (2017:817); Mofokeng and Chinomona (2019:3)
17	Forecast accuracy	Operational	Mofokeng and Chinomona (2019:3)
18	Market share	Financial	Yuen and Thai (2016:35)

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negative impact of disruption on the supply chain (Bode & Macdonald 2017:840; Macdonald & Corsi 2013:272; Messina et al. 2020:492).

The recovery stage is defined as the actions required, based on the discovery of disruption, to limit the impact of the disruption on the organisation or supply chain. Disruption recovery starts after the discovery stage as per the definition, and the implementing actions increase system performance closer to the pre-disruption condition or performance. This can be further broken into developing a response and implementing the response. As per the identification of disruption, the speeds of implementing the desired decision or actions are critical to disruption recovery.

The final stage of disruption management is the redesign stage. This stage entails documenting learning from the recovery stage and ensures review thereof for future learning. The redesign stage is when the performance is equal to the pre-disruption performance conditions. The redesign stage of SCDM can be divided into three distinct actions post-SCDR. These actions are to update existing SCDM plans and policies, to improve or change the trade's processes or tools, and last, to follow up with problematic suppliers (Bode & Macdonald 2017:839, 860, 863; Messina et al. 2020:501–503).

Antecedents to supply chain disruption recovery

The three antecedents, namely, readiness, supplier dependence and supply chain complexity, impact the disruption response speed and impact (Bode & Macdonald 2017:839). Readiness is the organisation's level of preparedness in dealing with disruption, thus creating a risk awareness culture. Many facets exist in the realm of readiness, which includes identifying potential risks of disruption, potential mitigating actions or strategies in dealing with the disruption and information processing tools required to deal with disruption when it occurs. Part of readiness capability building as an antecedent is the reflection of prior learning as part of the redesign stage of recovery (Bode & Macdonald 2017:843–844).

The second antecedent to disruption recovery and resilience is supply dependence. The dependence of having a selected few suppliers and losing leverage on suppliers could lead to supply disruption or other disruption associated with the supplier's inability or refusal to supply. The information requirement and processing intensify with the increase in dependency, which could ultimately slow down the disruption recovery process (Bode & Macdonald 2017:844). Last, is the supply chain complexity. Complexity, as previously mentioned, is driven by the globalisation of companies' drive to gain a competitive advantage through the scale of the economy, outsourcing and introduction of multiple suppliers to reduce costs. Through the increased complexity of the supply chain, information equivocality probability increases (Bode & Macdonald 2017:844; Scholten, Sharkey Scott & Fynes 2019:431). The SCD antecedents identified from literature align to the information processing

requirements during the disruption identification and recovery stages.

Research design and methods

This study used a single holistic case study to investigate the influence of ISCI during an SCDR period on a single organisation in the South African liquor industry (Merriam 1998:27; Stake 1995:2). This is an acceptable research design because of the investigation's relevance to regulatory-induced disruptions in 2020 and 2021 phenomena and its interrelationship with the context (Yin 2012:8). The method was used to analyse and describe a unique group of people's perspectives and interpret the topic within a specific organisation and industry in detail (Stake 1995:2; Starman 2013:3). The primary cross-sectional data were gathered through semi-structured interviews with various executive and senior managers within the case firm.

The unit of analysis in this study was a single firm within the South African liquor industry. The units of observation in the study were managers in different departments in the case firm. The ultimate sample size was determined using the data saturation principle (Guest, Bunce & Johnson 2006:74). This study included 15 participants representing all of the supply chain and support departments within the case firm. After the 12th interview, all of the codes were identified, and the primary themes were determined. Three further interviews were conducted to ensure that no new data or insights became evident to ensure data saturation, but no new substantial information was revealed.

Homogeneous convenience sampling was used in this study. This involves the purposeful selection of the organisation and individuals based on distinct similarities (Jager, Putnick & Bornstein 2017:6–7). The specific organisation within the liquor industry was academically and practically relevant for the following reasons. Firstly, it is one of the top five liquor industry companies in South Africa (Bosman 2020:7). Secondly, the organisation is also seen as Africa's leading producer and marketer of multiple liquor categories, such as wine, ready-to-drink (RTD), ciders and spirits (Bosman 2020:2). Thirdly, the organisation has a strong supply chain collaboration between functions as observed and evident in performance measures of the multinational and category organisation (Bosman 2020:2; MarketLine 2019:25). Fourthly, the organisation originated and was established in South Africa (MarketLine 2019:25). Fifthly, the organisation experienced disruption during the government-imposed alcohol sales prohibition in 2020 and 2021 (Smollan 2021). Lastly, it generated more than R26bn in the financial year 2018/19 (MarketLine 2019:25). This qualified as an appropriate sampled organisation based on the aforementioned criteria and the organisation's relevance towards the South African economy and liquor industry.

The individual participants were selected based on their conformity to similar traits (Etikan, Musa & Alkassim 2016:3). Firstly, they had to be part of the case firm's supply chain. The supply chain consists of departments reaching logistics,

operations, services, marketing and sales (CIPS 2020). Secondly, the individuals must have had at least 2 years of experience within the case firm to ensure sufficient knowledge of the industry and case firm. Individuals had to hold an executive or senior management position within the supply chain, as these roles are critical for the successful implementation of ISCI (Basnet & Wisner 2014:30). Table 3 shows the demographics of the study participants.

This study used semi-structured interviews to collect data. This data collection method was chosen because it allowed the researcher to delve deeper into the phenomenon's intricacies, specifically how managers interpret ISCI involvement during SCDR (Barriball & While 1994:330; Creswell 2012:218). After a thorough review of the current literature, a discussion guide was created. A pilot test was carried out with a senior manager from the case firm who complied with the inclusion criteria. Following the interview, a few minor changes were made to improve the discussion guide, which became part of the study's final sample. Fifteen (15) one-on-one interviews were conducted averaging 42 min in duration. After transcribing the interview recordings, the researcher stored the interview transcripts and recordings in a secure, online repository.

Thematic analysis was used to discover, organise and highlight relevant patterns in the data set (Braun & Clarke 2012:57). The researchers first familiarised with the data by listening to audio recordings while reading the interview transcripts. To establish a master code list, codes were developed and combined with *a priori* codes derived from the literature. The process of data coding began with the identification and labelling of text segments from the transcripts using the master list's codes. After the data had been coded, the master list of codes was reviewed to determine if any redundant or related codes might be combined as part of the refinement process (Braun & Clarke 2012:61). After that, the linked codes were

integrated into overarching themes, which were given descriptive names. The final themes were developed and evaluated to see if they adequately captured the data relevant to the study's research questions.

Several measures were used to establish the study's trustworthiness, including credibility, dependability, confirmability and transferability (Polit & Beck 2012:584). Credibility in this study was achieved through three processes. Firstly, through reiteration that the study was voluntary in nature. Secondly, by asking iterative questions to gain clarity on subjects. Last, by continuous summarising of understanding during the interview (Polit & Beck 2012:591; Shenton 2004:66–68). Conformity was accomplished by establishing a link between the data gathered and the research examined in the literature. This was accomplished through thematic data analysis, in which the primary themes and subthemes were discovered to guarantee that the participants' real ideas and experiences were portrayed rather than the researcher's (Polit & Beck 2012:585; Shenton 2004:72). Thirdly, the study's transferability was ensured by including a full description of the participants, the length and number of interviews done, the data collection methods used and the study's conclusions and limitations (Polit & Beck 2012:585; Shenton 2004:69).

Ethical considerations

Ethical clearance to conduct this study was obtained from the Research Ethics Committee of the Faculty of Economic and Management Sciences at the University of Pretoria (No. u19252910/2021). At the time of invitation, each participant was sent a consent form to read and complete before the interview was conducted. Before the start of the interviews, the anonymity and confidentiality of the participants' names and replies were also discussed and explained. Additionally, the participants' confidentiality and anonymity were protected throughout the study through the use of pseudonyms.

Findings

This study has identified three main themes linked to the research questions. These themes relate to the antecedent factors that impact ISCI, the mechanisms used to promote and sustain ISCI, and the measurements used to determine ISCI effectiveness during an SCDR period. This section discusses these themes and their connected subthemes, with descriptive quotations from participants and references to relevant literature. Table 4 illustrates the relationship between the subthemes, themes and research questions.

Theme 1: Internal supply chain integration antecedents during supply chain disruption recovery

Theme one relates to research question one, as it refers to the antecedents that determine successful ISCI during an SCDR period. The study has identified 12 important antecedents categorised into three subthemes: goal alignment, cross-functional awareness and power balancing.

TABLE 3: A profile of study participant.

Pseudonym	Position	Gender	Years of experience [†]	Length of interview (min) [‡]
P1	General manager	Male	30	54
P2	Group manager: Planning and procurement	Male	25	51
P3	Group logistics manager	Male	25	40
P4	Head of supply chain programme management office	Male	24	30
P5	Head of supply chain finance	Male	21	47
P6	Head of human resources (HR) supply chain	Male	19	48
P7	Head of manufacturing africa	Male	16	32
P8	Head of safety, health, environment, risk & quality (SHERQ)	Male	20	52
P9	Head of group engineering services	Male	25	53
P10	Group intrinsic manager	Male	21	43
P11	Group planning manager	Female	16	28
P12	Head of manufacturing SA	Male	20	41
P13	Group supply chain director	Male	25	42
P14	Technical processing solutions partner for supply chain	Female	11	36
P15	Category manager of whiskey and white spirits	Male	26	32

SA, South Africa.

[†], average = 22; [‡], average = 42.

TABLE 4: A summary of the research question and related theme with subthemes.

Research questions	Themes	Sub-themes
RQ1: What are the ISCI antecedents for SCD recovery?	Theme 1: ISCI antecedents during SCDR	<p>Goal alignment</p> <ul style="list-style-type: none"> • Strategic alignment • Company culture • Structural alignment to strategy • Service level agreements <p>Cross-functional awareness</p> <ul style="list-style-type: none"> • Clear roles and responsibilities • Shared and aligned key performance indicators (KPIs) • Information sharing and transparency • Understanding internal department capabilities and capacity • Ensuring the right skillset across the organisation <p>Power balancing</p> <ul style="list-style-type: none"> • Management ethos and construct • Trust
RQ2: Which ISCI mechanisms are used during SCD recovery?	Theme 2: ISCI mechanisms used during SCDR	<p>Personal mechanisms</p> <ul style="list-style-type: none"> • Cross-functional team meetings • Integrator roles • Information sharing <p>Impersonal mechanisms</p> <ul style="list-style-type: none"> • Performance indicator tracking • Standardisation • Planning and forecasting systems
RQ3: How is ISCI measured during SCD recovery?	Theme 3: ISCI measurements during SCDR	<p>Operational</p> <ul style="list-style-type: none"> • Customer service (OTIF) • Overall Equipment Efficiency (OEE) • Reliability • Forecast accuracy <p>Financial</p> <ul style="list-style-type: none"> • Cost of Goods Sold (COGS) • Sales revenue

Note: Main sub-themes are indicated in bold.

ISCI, internal supply chain integration; SCD, supply chain disruption; SCDR, supply chain disruption recovery; OTIF, on-time in full; RQ, research question.

Goal alignment

Goal alignment is focused on the cross-functional alignment of supply chain functions towards a common or shared goal. This focuses on the prevention sub-goal pursuit or a silo thinking mentality within a supply chain. Strategic alignment was identified as the initial antecedent of goal alignment amidst SCDR by 12 of the participants. Strategic alignment guarantees that the organisation's overarching supply chain strategy and objectives are understood and implemented by all supply chain functions. The objectives of each supply chain function are linked with the overall supply chain and business strategy based on their functional capabilities and operational responsibilities, as per the following quotation:

'I would say the strategy and how we would like to deliver on the strategy should be visible to everyone. And it should be clear, who's doing what, and then aggregate who's accountable for what. ... so obviously, you've got the business strategy, but how supply chain needs to deliver I think ... that strategy must also be quite clear, within the supply chain, as I mentioned who's, who's responsible for what and the needs the communication structures and decision-making structures ...' (P10, male, group intrinsic manager)

The second antecedent of goal alignment recognised by the participants in a time of SCDR is company culture. Four participants mentioned this. The company culture is the

environment created through shared values, relationships among co-workers and the standard to which employees are held accountable. This antecedent also enables supply chain readiness through driving risk assessments and reviewing risks and improvements. The following descriptive quotations illustrate this:

'So the first one is the culture or the mindset of people in the company ... you can have the best strategy that actually defines the end-to-end supply chain, but not the culture of thinking of it ... you cultivate a culture and mindset around it ... which is obviously encapsulated in the strategy.' (P7, male, head of manufacturing Africa)

'So, as part of a continuous improvement process, we have always gone back to our scenario planning to see how many hits we've come right with and what are the necessary adjustments that needs to be made ... we continuously make, take up those learnings and then adjust when we do the next scenario plan based on the learnings of the past outcome.' (P1, male, general manager)

One participant identified structural alignment to strategy as a goal alignment antecedent during SCDR. The structural alignment is achieved by ensuring an end-to-end responsibility by a single role or entity and not a segregated group of entities driving their own agendas within the supply chain, as illustrated below:

'Then very importantly an element I think a lot of companies miss is ... to change your structure to align ... in thinking and strategy ... So previously, you had a technical director, maybe a production director, maybe a logistics director, maybe a procurement director. And these all were different, where it was actually ... part of the supply chain. So the latest thinking is to bring it all together under one supply chain directly ... to have accountability under one umbrella' (P7, male, head of manufacturing Africa)

Two participants in the study focused on creating a service-level agreement (SLA) as an antecedent during an SCDR period. This promotes ISCI through the establishment of internal departmental agreements to manage and clarify the contact points where information or processes flow from one function to another, as described below:

'... [T]hat could typically be orchestrated by something like an SLA ... I think it just governs the way in which ... we work and in which we operate, and then ... everybody is clear on exactly where they are, where they need to slot in, and where they stand. ... and if anything goes wrong, how it should be treated?' (P11, female, group planning manager)

Cross-functional awareness

Cross-functional awareness refers to the understanding of functional teams' interdependence and how they can assist each other in achieving the desired goal as a collective. Five participants highlighted the need for clear roles and responsibilities during SCDR from both a functional perspective and an individual perspective. This prevents duplication of efforts by defining focus areas of responsibility and accountability. The following quotation describes that antecedent:

'So there needs to be quite a clear RACI [*responsible, accountable, consulted, and informed*] chart in terms of responsibility, accountability, and who needs to be informed. And who's the relevant stakeholders and the different processes in the supply chain ... from procurement right through to production and primary transportation said in terms of getting the product to ... your sites.' (P5, male, head of supply chain finance)

Five participants acknowledged that shared and aligned key performance indicators (KPIs) were important amidst an SCDR. This antecedent ensures that the same objective is pursued using specific function measurements and that each function shares in goal achievement through cross-functional awareness. The following quotations demonstrate the antecedent:

'... I think defining a common objective for everybody is an important requirement, number one, number two, making sure that every department's KPIs are aligned towards achieving that goal but also recognise the functionality of that department is also critically important ...' (P1, male, general manager)

Nine participants recognised the need for high level of information sharing and transparency during SCDR. The timeous sharing of transparent and clear information will eliminate ambiguity and uncertainty of information conveyed from one supply chain function to another. The ensuing quotations define antecedent:

'... [Y]ou need to create an end-to-end communication channel. Create a collaborative view and alignment in terms of a common goal. There will be trade-offs within an environment, and these trade-offs might or will only be addressed through proper communication and prioritisation.' (P5, male, head of supply chain finance)

'I would say ... transparency, so the different business units knows what's going on. And what's on the roadmap, in the pipeline of the different ... teams ... And we've been working hard to be transparent.' (P14, female, technical processing solutions partner for supply chain)

Understanding internal department capabilities and capacity were also identified as antecedents during an SCDR period. Two participants specified that this allows different functions within the supply chain to understand what each function's output capability is and what inputs are required for the function to be a success. The following quotation brings forth this viewpoint:

'... I also think understanding ...the other faculties as to how that supply chain works is key, ... so in marketing, ... we get very close as the supply chain, the product development teams to try and make sure we are capable of having a discussion around, ... the technical components of dry goods, the technical side of production, understand the capacity limits, that you ... have a real understanding of what they contending with.' (P15, male, category manager of whiskey and white spirits)

Ensuring the right skillset across the organisation was identified as an antecedent during SCDR by two participants. This enables each function with the right skills and capabilities to execute and achieve the desired goal and ensures that cross-functional integration is attained. The following quotation supports the views:

'... [I]f you look at how we drive within supply chain ... from an HR perspective in making sure that the right people with the right skill set, ... capabilities, to achieve our key objectives within ... [*the*] supply chain.' (P6, male, head of HR supply chain)

The last antecedent mentioned by one participant was stakeholder engagement throughout an SCDR period. This enables all stakeholders to understand the impact relating to integration among supply chain functions. It allows them to give their input on how it can be improved and enables them to assist each stakeholder when disruption periods occur. The descriptive quotation below elaborates on the antecedent:

'... [I]mportant one is when you do your stakeholder analysis or your stakeholder engagement, make sure that you get the views of your stakeholders because they will have a view of your integration and what it means to them and how it would impact him which is good, because they'll share the journey, but another side is that you would also want him to know the risks. So if any of those risks plays itself out, then instead of your stakeholders, you know, standing sideline, they themselves would have an idea of how they could help you through that process.' (P12, male, head of manufacturing SA)

Holistic approach and management

The holistic approach and management sub-theme describes the management responsibilities required to ensure that a holistic view is taken when managing the supply chain to ensure successful ISCI amidst a period of SCDR. The first antecedent identified by eight participants was management ethos during SCDR. This can be best described as the manner in which management leads and controls the holistic supply chain. The two important factors mentioned were that integration is a leader-led intervention. Leadership should not entice a power asymmetry between the various supply chain functions within the organisation but ensure that all functions are dealt with equally. The ensuing two quotations illustrate this antecedent:

'So firstly, I think there would have to start from the top-down strategy. So your supply chain director, in our example, would be the person that would have to set the tone about priorities and integration, then secondly, it would come down to the leadership teams that have to be in sync following that strategy.' (P7, male, head of manufacturing Africa)

'... [Y]ou could end up with one function dominating and the function that dominates could ... result in ... sub-optimal overall supply chain or listed performance of the supply chain, you could end up with cultural or functional misalignment, that basically leads to a collapse of your supply chain.' (P13, male, group supply chain director)

One participant believes that trust among supply chain functions must exist holistically and be applied with transparency to allow for ISCI in a time of SCDR, as per the following quotation:

'... [I]s to create that transparency, you essentially need to have some trust amongst the different business units ...' (P14, female, technical processing solutions partner for supply chain)

Fourteen (14) participants insisted that the speed of execution or intensity of focus to ensure these ISCI antecedents are in place amplifies during a period of SCDR:

'... [D]uring a disruption period, ... you've got a game plan, but that game plan is impacted by the disruption itself. So things like speed would ... happen much faster. When you collaborate, you would have stricter cut off times, ... instead of just having ... long discussions and agreement, ... you're forced to make a decision based on the information that you know, at that given time. You're also ... forced to, to think about what could and could not happen and make a decision based on not ... just information and facts but also on gut feeling ...' (P12, male, head of manufacturing SA)

The findings corroborate with the current literature as sub-goal pursuit and silo thinking prevention are achieved through goal setting and sharing (Golgeci & Gligor 2017:478–480; Vermeulen et al. 2016:3). Shared goals are further supported by the cross-functional awareness antecedents. These antecedents are important to ensure that functional capabilities and roles are firmly understood to achieve shared goals and solve cross-functional problems (Basnet & Wisner 2014:30–31, 33; Golgeci & Gligor 2017:478; Turkulainen et al. 2017:294). A holistic management approach and goal alignment are both a leadership-led requirement to which trust is an important antecedent to integrate various supply chain functions to ensure cohesion and focus (Golgeci & Gligor 2017:478; Mofokeng & Chinomona 2019:4). The introduction of SLA's and stakeholder engagement expands the ISCI antecedent literature of goal alignment and cross-functional awareness, respectively, during SCDR. The identified ISCI antecedents during an SCDR can be linked to the identified SCD antecedents in the literature of readiness, supplier dependency and supply chain complexity (Bode & Macdonald 2017:839). These links are evident in the descriptive quotations provided and clarify how ISCI integration feeds into SCDM to ultimately reduce the disruption recovery period.

Theme 2: Internal supply chain integration mechanisms used during supply chain disruption recovery

The second theme answers the second research question of the study. This research question focuses on the mechanism used to enable ISCI during the SCDR period. These mechanisms are also referred to as management tools. The findings revealed six mechanisms categorised into two main sub-themes, personal and impersonal. The following discussion outlines each mechanism with supportive quotations by the participants.

Personal mechanisms

Personal mechanisms are associated with action and management tools that require direct individual interaction between functional counterparts. This mechanism's greatest benefit is the real-time information share and elimination of equivocality of information, as clarification and decision-making can be made immediately.

Cross-functional team meetings were identified by all of the participants as a mechanism to ensure ISCI in a time of SCDR. These cross-functional meetings are driven by involving all relevant stakeholders from different supply chain functions, thus ensuring alignment across the supply chain and real-time information share and processing. The following quotation substantiates the mechanism:

'... I think there's ... several forums ... in place and that drives different ... activities, there's ..., for me the overarching one, which would be your supplier review that needs to ... co-ordinated from a, from a general perspective, what is the strategy? And then does it align so your whole S&OP process out of your supplier review ... so does your supply side align to your demand side. And then obviously, within each unit, you also have separate forums... or functions to coordinate the links between the different units ... I think there's ... a lot of meetings that are set up to ... coordinate different activities, and then these obviously, the different executional elements to support that as well.' (P11, female, group planning manager)

The second personal mechanism identified by three participants is the use of integrator roles throughout an SCDR period. This mechanism uses individuals or a group of individuals to align and bridge activities across different supply chain functions. These mechanisms assist the information flow and alignment amongst different supply chain functions. The ensuing two quotations illustrate the use of integrator roles:

'... [P]roject management team ... Their job is to really bridge marketing and supply and ... there's a project manager that brings people together in part a structured way ...' (P15, male, category manager of whiskey and white spirits)

'And then the third component is where they play a fundamental coaching staff, mentoring role that you typically position through communities of practice ... specialists interact with your day-to-day operations and people in the day-to-day operations to ensure that you get more seamless transfer of knowledge.' (P13, male, group supply chain director)

Three participants stressed the importance of effectively sharing information, as this mechanism is the core foundation of successful integration and coordination. This aligns with the IPT lens used and the literature, as information sharing plays an important role in reducing the uncertainty and equivocality to implement ISCI during SCDR, as per the following quotation:

'And one of the things again that helped us through the integration was the ... communication. So you hear me coming a lot to that, because that ... was absolutely core foundational, if I look at the commonalities between the looting and the COVID pandemic, we were sitting on CMT [*crisis management team*] is with the board of directors, at eight o'clock in the morning, at one o'clock in the afternoon, at seven o'clock in the evening, at 11 o'clock at night, on occasions, four times a day ...' (P8, male, head of SHERQ)

Impersonal mechanisms

Impersonal mechanisms are management tools that do not require direct interaction between individuals. These mechanisms are essentially driven by indirect contact systems

such as standard operating procedures, performance tracking systems, and planning systems or computer programmes.

Seven participants identified the performance indicator tracking as a critical integration mechanism in the time of SCDR. This mechanism allows supply chain leadership and operational teams to track performance indicators of the supply chain functions against the set target without directly contacting function individuals directly. This is illustrated in the following quotation:

'...[T]he second mechanism would be the performance measurements. So ... after you have got a full alignment of what needs to happen, and how it would all be integrated, you then have a performance management system to track it on a monthly basis or weekly basis through the performance objectives.' (P8, male, head of SHERQ)

Alignment on standards was mentioned as a mechanism that can be used for integration by one participant. This mechanism ensures process and execution alignment through a codified standard set up by experts and executed by operational teams to ensure that the desired outcome is achieved during an SCDR period. The codification of standards also safeguards your intellectual property, as per the following quotation:

'The intellectual property or IP that allows you to produce your goods allows you to either import seamlessly or to code to ensure that this the supply chain macro processes are maintained and sustain the expertise that lie with that needs to be codified. Because the qualification of expertise, you translate into, in essence, your ability to execute your day-to-day operations through standard work instructions, there are many mechanisms, embedded work instructions, key performance indicators, whatever the mechanisms are, that you choose. So that's the one component that's critically important.' (P13, male, group supply chain director)

The last mechanism mentioned by four participants is the use of planning and forecasting systems. The importance of this mechanism during SCDR is to align the whole supply chain on an execution plan, after which each function would support by executing the desired output. The following quotation indicates the working of the mechanism:

'So your planning systems you use is important but also your and then and that again, it starts from a demand populated system that can take your demand and translate that into executable plans ...' (P3, male, group logistic manager)

The findings align with the current literature, as cross-functional meetings align supply chain functions and ensure that information flow is achieved across the supply chain. The role of an integrator does bridge the gap between functions through information sharing and operational output alignment (Turkulainen et al. 2017:291). Information sharing, performance tracking and planning system integration support the ISCI, as this aligns with the goals and objectives of the supply chain (Basnet & Wisner 2014:30–32; Golgeci & Gligor 2017:478–480; Turkulainen et al. 2017:295; Wlazlak et al. 2019:1708).

During a disruption recovery period, 14 participants acknowledged that the mechanisms' frequency and

intensity of application would increase. Adding short-term focused crisis management team meetings will be introduced until the supply chain has recovered from the specific disruption. This aligns with the literature, as the intensification in the execution of the mentioned mechanisms assists with the execution speed of SCDR plans, preventing long-term disruption impact (Ivanov et al. 2017:6160, 6166–6167; Ivanov & Rozhkov 2020:388). Quotations below demonstrate the impact:

'Think of the disruptive period. It's just the frequency increases of equilibrium, the management, the communication side frequency, ... will step up to much shorter intervals, what is much more frequent. And then the systemic side, I think it's the same. It's just I think the rules that drive that system will be slightly ... changed and the priorities and so on ...' (P4, male, head of supply chain programme management office)

'... [P]ending on the nature of the function. We are now pulling a CMT or management team together, that in essence supersedes all decision-making authority whilst we deal with the crisis and the CMT ...' (P13, male, group supply chain director)

Theme 3: Internal supply chain integration measurements during supply chain disruption recovery

The third research question focuses on ISCI measurements during SCDR and is addressed in theme three. Seven measurement indicators were identified and are divided into two sub-themes of operational and financial measurements.

Operational

Operational measurements are the measurements directly linked with the firm's functional outputs or deliverables. These measurements can be measured instantly and indicate a function or supply chain's effectiveness in their process management. Customer service in the form of on-time in full (OTIF) was recognised by 14 participants as the most important operational measurement that indicates effective ISCI. This measurement was described as the ultimate indication of ISCI. This requires all functional areas to execute their operational requirements to fulfil the customers' needs, which is the shared goal. This was also highlighted to be the most important during an SCDR period. The following quotations describe the measure:

'... OTIF would probably be the one thing that would indicate ... that everything's working in an integrated way because then it means you ... you're servicing your customers requirement, when they wanted ... that's probably the one that will show it's working as it should work in ... any type of setup.' (P11, female, group planning manager)

'... [S]o we are customer facing business. So customer service for us, it's a good measure of ... recovery during the disruption ... Are we on time in full ...' (P12, male, head of manufacturing SA)

The second operational measurement highlighted by one participant is overall equipment efficiency (OEE). This is specifically focused on operational site measurement, as OTIF determines different supply chain functions' integrated synergy; this measurement indicates integration between

departments from an operational site perspective. This would indicate that site-level departments are aligned and working in an integrated manner in a time of SCDR, as illustrated by the following quotation:

'Another good measure of collaboration would be a strangely enough OEE ... All the inputs and outputs of any manufacturing system is principally encapsulated by overall equipment effectiveness. Yes and in addition, why is it a good measure for integration? It's a good operational measure. But it's also a good measure from a technical and an expertise perspective to say, is our equipment up and running? Are we utilising capacity? Are we running at speed? What is the quality first time right quality and so on and so forth? Yes ... we need to go and dissect and figure out what we can do to improve the overall system output. So all measures that measure overall system output, whether it be manufacturing or logistics or procurement, whatever the case may be, those are good indicators of whether you are collaborating whether your operating system is allowing you to optimise the entire system, rather than just blocks or components of the system.' (P13, male, group supply chain director)

The third operational measure mentioned by eight participants was reliability during an SCDR period. This refers to the ability to produce and deliver the correct product and quantity repeatedly as per the original plan through your manufacturing plant to your customer. The following quotation explains this viewpoint:

'And the fourth one would be your ... production, stability and adherence? ... did you achieve your volume attainment? And did you achieve your adherence and your MPs adherence to four-week plan stability?' (P2, male, group manager: planning and procurement)

The fourth measurement, forecast accuracy, plays a critical role in the aforementioned measurement. Two participants highlighted this measurement, as it would predominantly indicate the integration between your planning and sales department. The integration between these two functions would set out the demanding goal for all other supply chain functions to fulfil, as per the following quotation:

'... [F]orecast accuracy ... Then at least it means everyone's aligned in terms of ... where they're heading. And working towards ... that goal ... it means everyone's always working ... in an integrated way ...' (P11, female, group planning manager)

The last operational measurement was indicated as a departmental survey which is categorised as an informal measurement. This measurement is predominantly focused on the perception of functional role players or supply chain staff. This essentially aligns the supply chain and/or supply chain function on what could be required to improve integration in a time of SCDR, as per the following two quotations:

'... [S]o we've got ... a survey ... that we sent to all our partners, business units. ... the project will set up different KPIs ... and then they ... will have the different stakeholders rank it or score it ...' (P14, female, technical processing solutions partner for supply chain)

'And well, the one which springs to mind is the OAQ, which is the organisational effectiveness questionnaire, it's done across a

variety of measures to measure if an organisation's effective or not ... Are you deploying the right behaviours to become an effective organisation? It's ... done through an anonymous survey, we get results by division by departments, and then you get a breakdown, or what are the drive factors.' (P15, male, category manager of whiskey and white spirits)

Financial

Financial measurements are directly associated with cost and profitability. These measurements link your operational outputs with financial value and drive the bottom line. The first financial measurement, as stated by six participants, is the cost of goods sold (COGS). This measurement is a strong indicative financial measure of integration during SCDR. It would reveal any form of wasteful or inefficient activity across a supply chain. These wasteful expenditures or costs associated with inefficiencies would increase the cost of the product produced and delivered, thus increasing the cost once it is sold and decreasing the profit margin. The quotation below supports and explains the measure:

'Another one is cost ... cost of goods sold. Cost of goods sold, encapsulate encapsulates all the direct and indirect costs in the organisation. If any part of the chain is not up to or it's not functional, not operational, then you'll see it there ...' (P13, male group supply chain director)

The second financial measurement, as portrayed by two participants, is sales revenue. This measurement results directly from product availability in the market during an SCDR, as per the OTIF measure. When the product is not available on time and in full in the market, you lose the opportunity to make a sale, as per the following quotation:

'... So the most important is that at the end of the day, you will always measure sales. Because that's our livelihood ...' (P3, male, group logistics manager)

The measurement findings are aligned with the current literature because the OTIF encourages ISCI to ensure customer satisfaction (Basnet 2013:155; Flynn et al. 2010:60; Kang et al. 2018:1752; Kumar et al. 2017:816). Forecast accuracy determines the stability of a supply chain and the desired goal to be achieved (Mofokeng & Chinomona 2019:3). The COGS addresses both reductions in cost and profitability through direct and indirect expenses associated with product delivery (Basnet 2013:155; Flynn et al. 2010:60; Kumar et al. 2017:817; Mofokeng & Chinomona 2019:3; Yuen & Thai 2016:35). The findings also expanded the current literature on ISCI measurements as reliability because of adherence to plans and forecasts, departmental surveys, and sales revenue have not been identified before as measurement indicators for ISCI during a period of normality or disruption.

Conclusion

Discussion of findings and theoretical implications

This study explored the role and influence of ISCI during SCDR, specifically related to the case firm in the South African liquor industry. The findings of the study are

presented in three sections to answer the three research questions with the addition of an ISCI framework for SCDR. These sections relate to: (1) the antecedents for ISCI, (2) the mechanisms used to achieve ISCI and (3) the measurements used to evaluate the effectiveness of ISCI, all during an SCDR period.

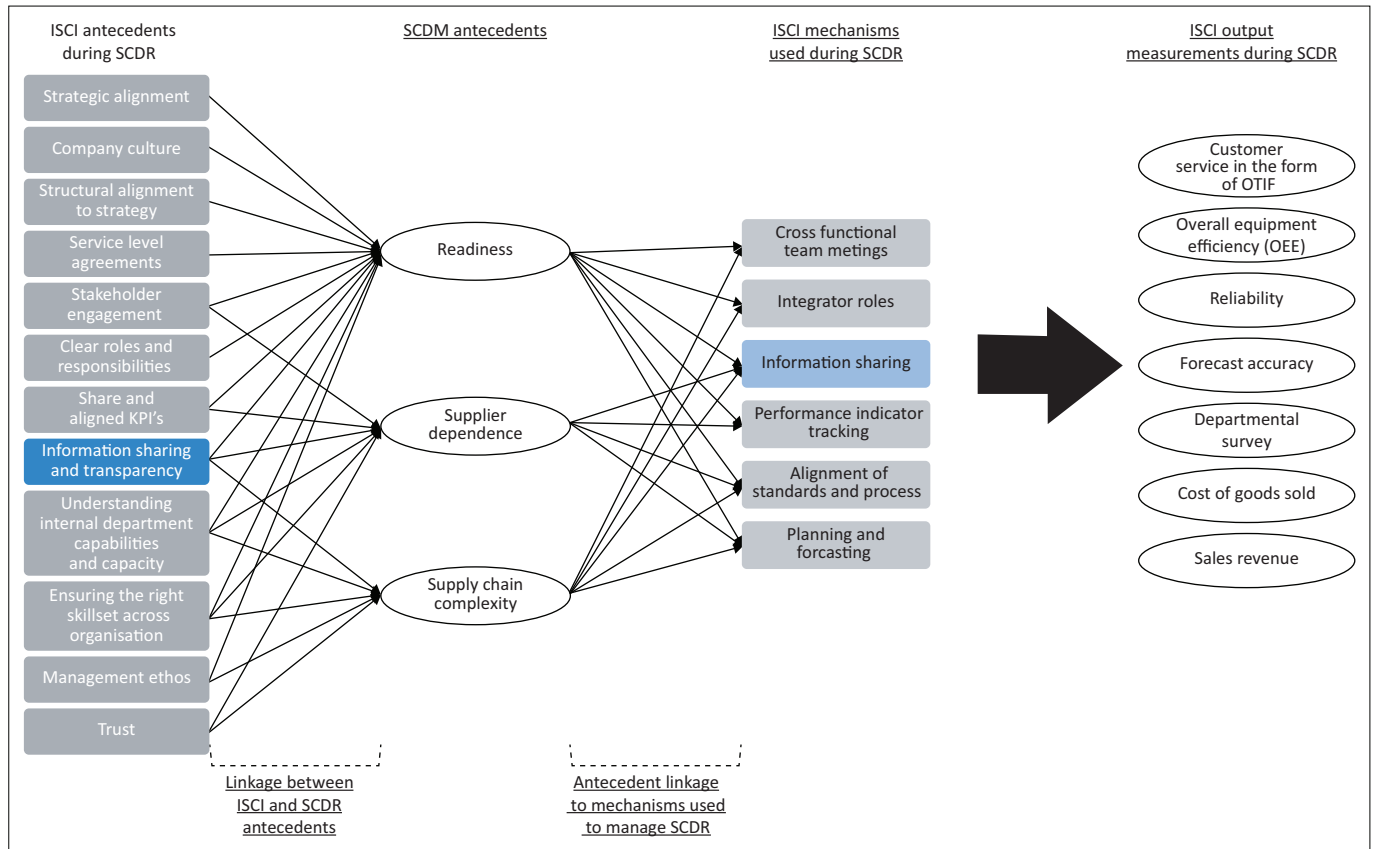
The first research question explored which antecedents are important to ensure effective ISCI during an SCDR period. Categorising these antecedents into three overarching themes summarised the impact of each antecedent on the overall requirement of ISCI during a disruption period and in the disruption recovery phase. The alignment of goals across the supply chain eliminates the sub-goal pursuit by supply chain functions and breaks the silo mentality within the supply chain, which supports the literature (Golgeci & Gligor 2017:478–480; Vermeulen et al. 2016:3). Eliminating silo thinking aids the supply chain in identifying disruptions in different functions or throughout the supply chain sooner, which lessens the disruption impact on business continuity because faster recovery responses can be implemented to adapt to the circumstances. This increases the supply chain's readiness to respond to disruption and supports the literature (Bode & Macdonald 2017:839; Ivanov et al. 2017:6160, 6166–6167; Ivanov & Rozhkov 2020:388). Cross-functional awareness supports goal alignment antecedents by encouraging employees to engage with one another across the supply chain. This enables all levels of the organisation to understand the diverse challenges and opportunities across different functions. This would enable cross-functional learning on shared problems and cross-functional support in problem-solving and process improvement. Cross-functional awareness antecedents ensure a better understanding of internal supplier dependence and supply chain complexity, whether driven by product, process or geographical complexities. The last section of antecedents relating to the holistic management approach drives the overall strategies that need to be implemented during an SCD and functionally supports the goal alignment antecedents.

Research question two examined the required mechanisms of ISCI during SCDR. All of the personal and impersonal mechanisms identified during the study essentially aim to fulfil three requirements. The first is to process and interpret all of the collected information. The second requirement is to eliminate any potential uncertainty or ambiguity in the information received. This supports the literature, as personal mechanisms, both cross-functional team meetings and integrator roles, ensure that ambiguity in the information is eliminated. This is achieved by ensuring that the same interpretation is reached and that alignment is agreed upon before communication is sent to the supply chain (Bartnik & Park 2018:1282; Fan et al. 2017:64; Turkulainen et al. 2017:291). Impersonal mechanisms such as performance indicator tracking, standardisation and planning, and forecasting systems improve information accuracy, timeliness and conciseness to eliminate information uncertainty, as confirmed by the literature (Bartnik & Park 2018:1282; Turkulainen et al. 2017:291). After information uncertainty

and equivocality have been eliminated, the third requirement that need to be fulfilled by the mechanisms is the creation of recovery action plans. With the focus on ISCI during SCDR, the main focus of recovery would be focused on the recovery actions that can be addressed within the supply chain. These actions would include process recovery, which focuses on planning capacity, production, distribution and structural recovery, focusing on redirecting logistics and production to backup facilities to increase capacity. This also confirms the literature (Ivanov et al. 2017:6163).

The third theme focused on the measurements that would indicate successful ISCI during an SCDR period, addressing research question three. Customer service, as measured by OTIF, was identified as the most important measurement. This metric reflects ISCI as the ultimate output of planning – in collaboration with sales, marketing and procurement functions – from manufacturing to distribution. The other operational measures identified could be viewed as functional stage-gate measures to achieve OTIF. On-time in full directly affects sales revenue as a financial measure. Sales can take place only when the product is available for purchase. The primary financial metric of COGS indicates good functional integration, indicating optimal functional output across the supply chain. The measurements not only indicate good ISCI during SCDR as an output but also serve as disruption trigger indicators. This would be part of the SCDM discovery stage, which occurs before the recovery stage. The measurements are critical because failing metrics determine what required recovery actions must be taken by the ISCI mechanisms as supported by literature (Macdonald & Corsi 2013:272).

From the study's findings, information sharing and communication have been identified as both antecedents and mechanisms for the successful implementation of ISCI during an SCDR period. This supports the literature of the IPT model in that when uncertainty in the supply chain has been experienced, the greater the need for accurate and timely information collection and processing becomes (Galbraith 1974:28). Information sharing as a mechanism is important not only in terms of the communication mediums used, such as email and meetings, but also in the determination of which type of mechanism would be more suitable in ensuring the elimination of equivocality and uncertainty, using personal or impersonal mechanisms, which also aligns with the literature (Turkulainen et al. 2017:291). This would align with the need for definite and reliable information as an ISCI antecedent during SCDR to drive goal alignment, cross-functional awareness, and a holistic supply chain management approach. Figure 1 proposes a framework for ISCI during SCDR. The linkages between ISCI and SCDM antecedents are indicated. The mechanisms that manage the antecedents are illustrated through separate links. The ultimate measurements of ISCI during an SCDR period are demonstrated as a culmination of the antecedents and mechanisms implemented. This framework expands the literature, as the linkages between the ISCI and SCDM



ISCI, internal supply chain integration; SCDR, supply chain disruption recovery; SCDM, supply chain disruption management; OTIF, on-time in full; KPI, key performance indicator.

FIGURE 1: Internal supply chain integration and supply chain disruption recovery linkage framework.

antecedents towards ISCI mechanisms and measurements have not been documented before.

Therefore, the importance of ISCI is critical to executing in an organisation's SCDR processes, plans and policies. Internal supply chain integration improves the overall supply chain visibility and information flow and is hyped during disruption periods, which decreases the reaction time during an SCD period. This enables supply chains to return to normality faster and ensures that business continuity is not interrupted for extended periods. High supply chain resilience is thus a result of successful ISCI's influence on SCDR.

Managerial recommendations

Organisations need to understand the importance of managerial influence on successful ISCI implementation and SCDR. Managers need to be aware that they are responsible for setting the standard of the desired environment of inclusivity to drive ISCI and the reaction response time during SCD. It is important for managers to continuously drive ISCI by focusing on the antecedents, mechanisms and measurement to improve and sustain the general performance of the supply chain and to ready the firm for any potential disruption that could impact business continuity. Through a continuous drive of ISCI, the disruption recovery period is shortened, and the impact is smaller.

Second, this study has shown that the antecedents, mechanisms and measurements become more important during an SCD period. To recover faster from an SCD, management needs to increase their way of work intensity in terms of information gathering and execution speed. More frequent and focused cross-functional meetings must gather and process information quicker and communicate recovery execution plans faster to the rest of the functional and employee levels. Managers hence need to act distinctly and decisively to fast track recovery and ensure integration amongst supply chain functions.

Last, the impact of information management on both the implementation of ISCI and SCDR is critical. Managers need to ensure that all measurements set out must be value adding, as this would be the first point of information collection. If the measures are misaligned to the desired strategic goals, the right triggers will not be activated to show disruptions within the supply chain. This would lead to failure to acquire definite and specific information in a timely manner, which would impact both the recovery response time and ISCI effectiveness.

Limitations and directions for future research

This study presents three main limitations and future research proposals. The first is the limitation of generalisability of the findings to the broader liquor industry, as only a single case firm was studied. Future studies can focus on increasing the

number of firms and participants to improve the generalisability of the study. Second, the focus of this study was based on a singular developing country's context. This study could be used as a foundation for more ISCI during SCDR-related research in other developing countries or as a comparison between different developing countries in the future. Lastly, the study did not indicate the importance of the antecedents or mechanism for ISCI during SCDR in this study. Future quantitative studies can be conducted to determine the nature of these constructs and evaluate the relationships between the antecedents, mechanisms and measurements including possible moderating factors that can affect the strength of the relationships. A quantitative study can also assess the relevant importance of each subtheme of ISCI during SCDR.

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Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

Authors' contributions

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Data availability

The data that support the findings of this study are available on request from the corresponding author, W.N.

Disclaimer

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