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Control Towers in Logistics: An In-depth Exploration through Literature Analyses and Industry Case Studies

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Abstract

In the dynamic landscape of global commerce, effective supply chain management is crucial for business success. This research paper delves into the intricacies of supply chain control towers, exploring how these systems manage real-world business scenarios. The goal is to analyze diverse examples of supply chain control towers, sparking a discourse on their past approaches and future trajectories. The paper reviews theoretical foundations and practical aspects, employing case studies to provide updated insights. The research methodology involves an in-depth examination of a leading logistics company, 'ABC,' through a single-case study approach. Ethical considerations are prioritized in handling sensitive information.

The historical perspectives on control tower implementations reveal the evolution of these systems to address specific business needs. The findings highlight meticulously developed control towers with defined structures, responsibilities, and processes. These control towers utilize key performance indicators (KPIs) and IT solutions for continuous monitoring and improvement. The research also unveils future trends, indicating that control towers are perceived not only as tools for optimization but also as potential revenue sources. The study proposes the term "Integrated Control Hub" to characterize multifaceted functions, emphasizing the need for integration in logistics and supply chain management.

The paper concludes by discussing the commonalities and distinctions among the researched control towers, emphasizing their adaptive nature. It suggests practical applications for the future, focusing on data and process integration across supply chain functions. The author advocates for the acknowledgment of both logistic and supply chain control towers, emphasizing the importance of integrating these entities. The research provides valuable insights for industry practitioners, contributing to the ongoing discourse on the role and future of supply chain control towers.

Keyword: Control Tower, Logistics, Supply Chain Management, OBL, IBL, Warehouse

Introduction

In the ever-evolving landscape of global commerce, the effective management of supply chains has emerged as a critical determinant of success for businesses. The present-day economy is characterized by intricate networks of partners, diverse processes, abundant resources, and an overwhelming volume of information. To thrive in this complex environment, companies are compelled to implement and sustain supply chains that are not only agile and adaptive but also well-aligned with their overarching strategic objectives [Lee 2004]. Real-time information, accessible to all decision-makers, coupled with operational synchronization mechanisms and feedback loops, is indispensable to this end.

This research paper undertakes the challenge of unraveling the intricacies of supply chain control towers, seeking to understand how these systems deliver supply chain event management in real-world business scenarios. The overarching goal is to identify and analyze diverse business examples that illustrate past approaches to supply chain control towers and, subsequently, to spark a discourse on their future trajectories.

Through a meticulous examination of the current state of supply chain literature, the author aims to pinpoint knowledge gaps concerning control tower operations and their future evolution. Leveraging selected case studies and conducting comparative analyses within the logistics industry, this paper offers an updated perspective from the market. The findings are not only poised to contribute to the body of supply chain research and modeling but also serve as a valuable resource for supply chain managers, furnishing them with up-to-date practical insights into emerging trends in the configuration and development of supply chain control towers.

The structure of the paper is organized into distinct sections. The first section provides a comprehensive review of the theoretical and practical foundations of supply chains and supply chain control towers, dissecting the latter across three dimensions: organization, IT solutions, and processes. The second section elucidates the research methodology, detailing the selection of a logistic company engaged in different sectors supply chain solutions and the study of their services using Control Tower. The third section unveils the research results, characterizing the past and expected future of the control towers under scrutiny. The paper concludes with a discussion of the results and overarching conclusions, offering valuable insights into past and future practices in supply chain control tower operations.

Literature Review

The evolution of supply chain management (SCM) has been intricately intertwined with the dynamic and complex nature of contemporary business ecosystems. Early conceptualizations by Poirier and Reiter [1996], Aitken [1998], and Christopher [2011] define the supply chain as a network of interlinked organizations with a shared objective: achieving the optimal means of delivering products and services from suppliers to end-users. SCM, as articulated by the Council of Supply Chain Management Professionals [CSCM 2016], encompasses the planning, organizing, and controlling of all activities across sourcing, procurement, conversion, and logistics. It seeks to integrate and balance supply and demand within and across companies, fostering cooperative relationships with channel partners.

Lee [2002] underscores the strategic significance of SCM in gaining a competitive edge, highlighting the challenges posed by trends such as expanding product variety, short product life cycles, increasing outsourcing, globalization, and continuous technological advances. Amidst these complexities, the current key challenge for supply chain managers, as identified by Christopher and Lee [2004], revolves around the risks associated with the uncertainty of supply and demand, prompting a critical need for visibility and control mechanisms.

Supply chain visibility, defined by Heaney [2014], emerges as a crucial aspect of risk management. This visibility entails awareness and control over specific information related to product demand, orders, supply, inventory, physical shipments, and the status of events and milestones within the supply chain. Best-in-class companies, according to Debra Hofman of AMR Research Inc. [Blanchard 2007], share traits such as aiming for balance, increasing demand visibility, and isolating high costs.

The Supply Chain Control Tower emerges as a strategic response to these challenges, identified as one of the five key steps in managing the supply chain [Mena, Christopher, van Hoek 2014]. The concept aligns

with the top-ten emerging trends shaping global supply chain operations, including the rise of regional theaters of supply, customer segmentation, omnichannel retailing challenges, and global risk management through control towers [Cooke 2014].

E2open [2014] describes the Supply Chain Control Tower as a centralized, panoramic view of demand and supply-side trading network operations. It addresses critical business events such as supply disruptions, demand spikes or troughs, and natural disasters, necessitating cross-network visibility and the ability to execute plans across multiple tiers of the trading network. Built on the foundation of supply chain event management (SCEM) [Christopher 2011], Control Towers utilize technology, organization, and processes to capture product movement visibility [Greene, Caragher 2015].

The key function of Control Towers, as emphasized by van Doesburg et al. [2011], is to provide enhanced visibility for both short and long-term decision-making aligned with strategic objectives. The value derived from such solutions includes minimized time to problem resolution and easy access to performance metrics across the entire supply chain [Ball, Monroe 2012]. For supply chain leaders engaged in risk management, Control Towers enable a shift from reactive approaches to proactive anticipation [Cooke 2014].

Greene and Caragher [2015] emphasize that a Control Tower monitors, measures, and reports timing, efficiency, and service data in real-time, assisting customers in aligning and realizing strategic objectives. Building a Control Tower involves integrating technology, using appropriate metrics, engaging skilled expertise teams, and designing processes and organizational interfaces with all supply chain partners [van Doesburg et al. 2011].

To effectively operationalize a Supply Chain Control Tower, Shou-Wen et al. [2013] propose a system with five basic layers: Supply chain perception layer, Supply chain business layer, Information operation control layer, Information service platform, and Information manpower layer. This comprehensive system aims to collect, store, analyze data, diagnose problems, optimize solutions, and trigger and control actions in real-time.

In conclusion, the integration of Supply Chain Control Towers into SCM practices represents a critical response to the growing complexities and challenges in modern supply chains. With a focus on real-time visibility, strategic alignment, and proactive risk management, Control Towers serve as a cornerstone for optimizing resources, minimizing cycle time, and maximizing service within the intricate web of interconnected supply chain networks. The subsequent sections of this paper will delve into practical applications, industry-specific considerations, and the implications of implementing Supply Chain Control Towers in diverse sectors.

Research Methodology:

The research methodology for this study involves an in-depth examination of Company 'ABC,' a global supply chain company operating across various segments such as OBL, IBL, Warehousing, and Rail. The research was conducted between September and November 2023. Due to the sensitive nature of the information, the company's name is anonymized as 'ABC' throughout this paper.

1.1. Case Study Approach:

This research adopts a single-case study approach, focusing exclusively on Company 'ABC.' The choice of a case study design is particularly apt for gaining a comprehensive understanding of the organization's supply chain control towers across different segments and tiers. The study investigates how Company

'ABC' has designed and implemented multiple supply chain control towers to manage its diverse operations.

1.2. Data Collection:

a. Primary Data:

Internal Training and Project Presentations: Information was gathered through internal training sessions and project presentations conducted within the company. These sessions provided insights into the goals, organizational structure, processes, and tools employed in the supply chain control towers.

b. Secondary Data:

Internet Resources:Relevant information available on the internet, such as publicly accessible training materials and presentations, was reviewed to supplement the primary data collected. This ensured a comprehensive understanding of the company's control towers.

3. Ethical Considerations:

- Due to the sensitivity of the information, the anonymity of the company (referred to as 'ABC') is maintained throughout the research.
- Informed consent was obtained from the company before conducting interviews and accessing internal training materials.
- Any proprietary or confidential information has been handled with the utmost confidentiality and will not be disclosed in the research findings.

4. Secondary Sources' Study:

In addition to the primary data collection from Company 'ABC,' a secondary sources' study was performed. This involved a review of relevant literature and studies on supply chain control towers, including works by Scholtz [2004], Blanchard [2007, pp. 14-27], van den Bovenkamp [2011], Johnson, and Lauritzen [2015]. This secondary research aimed to provide a broader context, allowing for comparisons, validations, and a deeper understanding of industry practices and trends.

Table 1: The Research Company's characteristics

The gathered information	Company ABC		
Segment	IBL	OBL	Warehouse
1	2	3	4
Operates in	Multimodel	Multimodel	Warehouse spaces in plant and external.
The company's operations	At the core of its operational strategy, the company distinguishes itself through its expertise in In-plant operations and Just-In-Time (JIT) methodologies, offering end-to-end logistics	Specializing in Completely Built-Up (CBU) items. Renowned for its end-to-end solutions, the company orchestrates a seamless journey from the manufacturing plant to the end customer, utilizing a	Company boasts an expansive warehousing network spanning over vast area in India. Committed to blending traditional and modern practices, the company has meticulously defined Standard Operating

	solutions that span the entire supply chain spectrum—from suppliers to manufacturing plants.	strategic blend of road and rail modes. Furthermore, company's distinctive services, encompassing yard operations and plant dispatch operations, unveiling a comprehensive understanding of its commitment to delivering efficient, integrated logistics services across the entire value chain.	Procedures across all facilities to ensure quality output in the rapidly evolving logistics industry. Leveraging smart infrastructure, the warehouses feature advanced automation, including specialized vertical racks, Automated Dock Levellers, Heavy Duty Racking systems, and state-of-the-art Warehouse Management Systems with RF Hand-held Terminals. The integration of automated sorters, powered conveyors, and innovative concepts like "Warehouse on wheels" reflects a strategic shift towards increased efficiency, reduced man-efforts, and enhanced time management. Embracing cutting-edge technologies such as the autonomous mobile robot "Butler,"
The company’s demand markets	Global market	Global market	Global market
The company’s supply markets	Global- Mainly SAARC countries	Global- Mainly SAARC countries	Global- Mainly SAARC countries
The company’s major partner's or customers	Companies of Retail, Automobile, Hi-Tech., CD, e-Commerce, etc.	Companies of Retail, Automobile, Hi-Tech., CD, e-Commerce, etc.	Companies of Retail, Automobile, Hi-Tech., CD, e-Commerce, etc.

The company background and transitions	The company is a prominent 3PL (Third-Party Logistics) Solutions organization with a strategic focus on serving large clients within high-value sectors. Their expertise extends from the initial design phase to the seamless operation of intricate logistics processes. Specializing in catering to the unique needs of clients in industries characterized by substantial value, the company positions itself as a comprehensive partner capable of navigating and optimizing complex logistics challenges throughout the supply chain.	The company is a prominent 3PL (Third-Party Logistics) Solutions organization with a strategic focus on serving large clients within high-value sectors. Their expertise extends from the initial design phase to the seamless operation of intricate logistics processes. Specializing in catering to the unique needs of clients in industries characterized by substantial value, the company positions itself as a comprehensive partner capable of navigating and optimizing complex logistics challenges throughout the supply chain.	The company is a prominent 3PL (Third-Party Logistics) Solutions organization with a strategic focus on serving large clients within high-value sectors. Their expertise extends from the initial design phase to the seamless operation of intricate logistics processes. Specializing in catering to the unique needs of clients in industries characterized by substantial value, the company positions itself as a comprehensive partner capable of navigating and optimizing complex logistics challenges throughout the supply chain.
Control towers defined in supply chain	Central Control Tower created and for micro management, implemented it in dept with project level control tower for better planning	Central Control Tower created and for micro management, implemented it in dept with project level control tower for better planning	Central Control Tower created and daily montioring of all operations through control tower.

The investigation focused on the company outlined in Table 1, aiming to gain insights into their supply chain control tower practices and explore the trajectory of their development along with emerging trends in the future.

Research Findings

1. Historical Perspectives on Control Tower Implementations

The establishment of the supply chain control towers by the researched company was prompted by distinct business needs, each tailored to meet specific and evolving requirements. In the case of Company 'ABC', this initiative dates back approximately 10 years. During this period, the company strategically expanded its presence, collaborating with numerous service providers for manpower and vehicle support. Centralizing their operations at a dedicated office, they formed a specialized team responsible for monitoring all facets of the supply chain. This proactive approach enables the timely identification and mitigation of potential abnormalities, contributing to operational optimization and cost reduction by eliminating inefficiencies.

As a result, control towers have been meticulously developed, featuring well-defined organizational structures with designated responsibilities, streamlined processes, and clearly outlined business objectives. Company 'ABC's control tower, in particular, is strategically centered on the oversight of shipments and inventory, encompassing value-added services. Operating around the clock, seven days a week, the Control Tower closely monitors all shipments. Within a logistics service provider department, a dedicated team ensures proactive management of shipments. The Control Tower's perpetual availability is dedicated to promptly identifying and addressing any anomalies in the operational process, allowing for immediate intervention when necessary.

Broadly, the examined supply chain control towers are tasked with comprehensive responsibilities, including continuous process monitoring, measurement, assessment, and the implementation of corrective and preventive actions. They play a crucial role in addressing customer tickets and resolving issues, while also providing detailed reports to both internal and external partner organizations to catalyze improvement processes. The efficacy of this control mechanism hinges on the strategic utilization of key performance indicators (KPIs). Table 2 showcases the implemented Key Performance Indicators (KPIs) within the researched organization.

While each control tower employs Key Performance Indicators (KPIs), their alignment is tailored to the specific focus of the respective control tower. In the analysis of the three cases, distinct KPIs are identified, reflecting the varied concentration of each control tower on different processes and areas within the supply chain. Despite this diversity, all KPIs consistently gauge process parameters directly or indirectly associated with time efficiency, cost-effectiveness, and customer satisfaction.

Table 2. KPIs implemented in the researched company's control tower

Company	**'ABC'**		
Operations	**IBL**	**OBL**	**WAREHOUSE**
KPIs	Order Lead Time	Logistic delays	Inventory Turnover
	Production Throughput Time	Shortage	Inventory Reach
	Production adherence to schedule	Damage	Aging Stock / Blocked Stock
	Weekly Volume Reports	Delivery Performance	Number of exceptions
	On Time Performance	Delivery Reliability	Responsiveness
	Confirmed Line Item Performance	Weekly Volume Reports	Resources Availability
	Responsiveness	Responsiveness	Manpower Planning
	Resources Availability	Resources Availability	
	Carrier planning	Carrier planning	

In all examined cases, the supply chain control towers have consistently been supported by dedicated IT solutions facilitating integration, coordination, and orchestration of partners within operational processes. Company 'ABC' employs a distinctive in-house WMS/YMS/ERP system, designed to generate alarms and various dashboards based on comprehensive data. This system offers a holistic view of all shipments, with special attention to those requiring immediate attention due to incorrect statuses, missed due dates, carrier exception, and other anomalies. The in-house ERP system is a comprehensive software solution for global logistics management, enabling real-time monitoring and control of traffic flows across the supply chain.

It operates as a web-based service, integrating transport, warehouse, and financial management modules at a cost-effective rate compared to traditional supply chain software. Additionally, the company utilizes tools such as Live-Chat for online communication, Support Tickets for order-related communication and complaints registration, MS Office tools (primarily Outlook, Excel, and Word), and a call center tool for call distribution and management information provision.

In summary, the investigated supply chains demonstrate resilience by evolving and adapting to dynamic market changes, encompassing shifts in products, customer demands, and competitive landscapes. The partnerships within these supply chains are undergoing transformation through various means such as mergers, acquisitions, spin-offs, strategic alliances, and greenfield investments. These transformative changes necessitate corresponding adjustments in control tower functions, processes, and organizational structures. This prompts a critical question: What lies ahead for the future of supply chain control towers?

2. Charting the Course: Futuristic Trends in Supply Chain Control Towers

The spokesperson from Company 'ABC' has delineated forthcoming minor and major changes for the control tower. As a vital service provider to Business Unit Leaders (BUL) and Project Managers (PM), the control tower continually adapts to the evolving requirements driven by market dynamics, shifts in products, and changes in the competitive landscape. In response to these dynamic factors, the control tower undertakes adjustments in its activities, organizational structure, and aligns processes, ensuring a seamless fit with the evolving needs of BULs and PMs. This adaptive approach extends to the refinement of functionalities within IT tools, reflecting the commitment to staying agile in the face of changing business landscapes. These iterative adjustments are considered as minor changes, collectively contributing to the control tower's responsiveness to the dynamic demands of its stakeholders.

The representative further elaborated, stating, "As smaller companies venture into markets, they often face challenges in accessing expertise, managing time efficiently, and achieving the necessary volume to utilize or oversee a cost-effective, high-quality transport solution. In contrast, larger service companies, representing a diverse range of businesses, already possess established business contacts, robust infrastructure, and extensive experience. Beyond cost-effectiveness, control towers also offer additional advantages such as quality assurance, troubleshooting, and more. The Control Tower (CT) stands as a pivotal component within our comprehensive service offering, extending outsourcing benefits to clients. This includes areas such as IT platforms, purchasing power, vendor management, logistics partner's invoice verification, among others. As the field of IT continues to innovate, the influence and efficacy of control towers within our services only strengthen."

In summary, companies envision the activities of control towers not only as a means for cost and time optimization but also as a potential revenue source in the future. The control tower is increasingly viewed as a differentiator, enhancing the company's offerings in the market and serving as a source of value addition for customers. This perspective is poised to expedite the ongoing trend of building and advancing control towers within the industry.

The discernible distinctions among types reveal a fundamental truth: the entirety of supply chain processes lacks full integration. While certain control towers concentrate on internal company process integration, others emphasize interfaces with supplier partners. The quest for an integrated control tower in logistics and supply chain management necessitates a comprehensive reengineering effort across the entire corporation.

In summary, it can be asserted that the three scrutinized supply chain control towers exhibit both similarities and differences, as outlined in the detailed comparison presented in Table 3 below.

Table 3. The commonalities and distinctions among the researched control towers

Company	**"ABC"**		
Operations	IBL	OBL	WAREHOUSE
Creation & Development	1. The control towers were established in response to a specific business need. 2. The control towers brought value added to the companies and have undergone continuous development.		
Organization	The organizational structures were built with defined responsibilities, processes, and business goals.		
Control tower: responsibility and task	The control towers are responsible for process monitoring, measurement, assessment, corrective and preventive actions, responding to customer tickets and/or issues, as well as reporting to internal and external partner organizations to initiate improvement processes.		
Control mechanism	The control mechanism relies on key performance indicators (KPIs) and control limits. When KPI values exceed or fall below the control limits, corrective and preventive actions are initiated.		
IT solution	The control towers are supported by a dedicated IT solution that enables integration, coordination, and orchestration of partners in the operations processes.		
Future	The control tower's activities are seen as a potential source of revenue, not solely as a means of cost and time optimization		
Business focus	demand and supply flows balancing, network performance key metrics analysis	shipments flows	shipments and inventory including value added services
Working time	24 hours a day and 7 days a week	24 hours a day and 7 days a week	Working Hours
Future	Focus is on transfor-mation and synergies	Establishing agile processes and utilizing adaptive IT tools is essential to address the evolving needs of internal customers.	The "Unified Service Advantage" strengthens the service offering, providing outsourcing benefits to customers and establishing a competitive advantage.
Term Used	Logistics control Tower	Logistics control Tower	Control Tower

For future practical applications, the author proposes that the control tower service can operate at various levels. Beginning with performance monitoring using Key Performance Indicators (KPIs), it can progress to controlling interparty processes and extend further to configuring partnerships and executing dynamic network changes. The author suggests that the development of the control tower service should focus on integrating data and control mechanisms across these primary function areas while introducing new

operational levels. To remain attractive and competitive in the market over time, a higher level of data and process integration is crucial between different processes in the supply chain, such as supply and inbound logistics and outbound logistics. Simultaneously, operating at a higher level is necessary to facilitate dynamic changes in the network.

Discussions

The research findings align with the existing knowledge in the field of supply chain and supply chain management as presented in the literature review section. However, it is noteworthy that the control tower system is not yet extensively described and defined in the literature, despite its prevalent use in business practice. In the business environment, there are organizations, job functions, IT tools, and processes commonly referred to as "control towers." This observation is corroborated not only by the findings from the this study but also through the analysis of reports and research on Internet materials.

Furthermore, the author advocates for the acknowledgment of both logistic control towers and supply chain control towers, emphasizing the importance of integrating these entities. This proposal aligns seamlessly with insights from various business reports. The imperative requirements for supply chain visibility, collaboration, and network redesign, as highlighted by Koperdraat and Dietaren (2012), underscore the pressing need for end-to-end visibility and immediate operational efficiency feedback for demand, supply, shipments, and reverse processes, as posited by Piest (2014). To achieve cross-chain, cross-enterprise integration, a forward-thinking approach is advocated, facilitating the connection of control towers into a collaborative network, referred to as the 'Cross Chain Control Center' by Piest (2014). This echoes a similar requirement articulated in Polish literature by Chaberek (2000) as the 'integration function of logistic center.' Additionally, van Doesburg (2011) emphasizes that many control towers still maintain a limited scope, either from a supply chain or functionality perspective. The potential benefits could be augmented through an expanded supply chain scope, the inclusion of additional supply chain partners, or an elevation of the concept from operational to a more tactical level.

Based on the examination of the case of company ‘ABC,’ the author suggests the term "Integrated control hub" to characterize its multifaceted functions, encompassing both logistics and supply chain control tower operations. This distinctive approach is not explicitly documented in the reviewed publications. The author raises a pertinent question about the absence of control towers in demand-supply processes and purchase processes. Integrating control functions for logistics and supply chain management could potentially yield synergistic effects, leading to cost and time reductions.

Conclusions

The comprehensive analysis of literature and business sources underscores the favorable reception and versatility of the term 'control tower' in the business landscape. However, its usage varies among companies, each employing it under distinct circumstances and for diverse functions. A discernible trend emerges, focusing on the establishment of control towers to enhance visibility and foster collaboration and agility within the supply chain. These control towers, spanning various industries, serve as a manifestation of the value added by corporate businesses. Positioned strategically, they provide transparency to corporate business processes, facilitating decision-making in alignment with the overarching business strategy. The findings from case studies and interviews seamlessly align with these theoretical assertions. The researched cases unveil diverse operational models within the realm of Supply Chain business, each necessitating a dedicated system and processes to govern the primary flow of the conversion process

within the supply chain. This intricate control system mandates robust support from IT solutions tailored to specific business requirements. In essence, the control tower emerges as a sophisticated system comprising collaborative teams endowed with requisite knowledge and experience, adhering to defined processes, all underpinned by advanced IT solutions.

In the dynamic landscape of business evolution, control towers necessitate continuous adjustments, reengineering, and development. Looking ahead, the business demands adaptive control towers capable of maintaining control over the supply chain during periods of transformation. Brand owners are presented with three distinctive options for their product's supply chain management:

1. **Develop Their Own Control Tower:**

Brands can opt to establish and manage an in-house control tower, providing direct oversight and control over their conversion processes.

2. **Offer Control Towers as a Service:**

Alternatively, brands may choose to integrate control towers as part of their service offerings, perhaps within a comprehensive 3PL/4PL service package, extending the benefits to their clients.

3. **Purchase Control Tower Service:**

Brand owners also have the option to procure control tower services from specialized service providers, allowing them to leverage external expertise while focusing on their core competencies.

By elucidating the prevailing processes, tools, and organizational structures within supply chain control towers, this article offers a significant and timely update from the market, shedding light on experiences, potential solutions, and best practices. It affirms that, notwithstanding the limited literature publications on the subject, control towers not only exist but also thrive and evolve within the market. The distinctive value of this research lies in its findings, revealing:

- The conceivable levels of engagement for control towers across various business capabilities.
- The potential mechanisms guiding the transformation of control tower roles.
- The plausible directions for the future development of control towers.

The research is grounded in literature analyses and focused case studies with comparative analyses within the logistics industry exclusively. Consequently, it is important to note that the findings cannot be extrapolated to draw conclusions or represent trends on a global scale within the industry or across diverse sectors. The scope of the research is intentionally confined to the logistics domain, ensuring a nuanced understanding of the specific dynamics and practices within this particular sector.

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