

Promoting resilience in medicine supply chains: An exploration of the role of contracting

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Abstract

Research on supply chain resilience identifies strategies and underlying capabilities for responding to disruptions, including sourcing strategies. However, we still know little about how contracting decisions, specifically, influence resilience. We explore the role of contracting through a qualitative case study of medicine procurement in the English National Health Service. We find that tendering and contracting practices tend to promote resilience based on redundancy, rather than on adaptive capabilities to cope with unforeseen disruptions. We extend prior research by positioning contracting interventions into the emerging discourse over the engineering and ecological perspectives on supply chain resilience.

Keywords: supply chain resilience, contracting, medicine procurement

Introduction

This paper explores how contracting processes and practices can help promote supply chain resilience. Geopolitical tensions, the latest example of which is the ongoing conflict in Ukraine, international trade barriers, and the COVID-19 pandemic have disrupted supply chain operations in many sectors, resulting in increased costs and reduced availability of supplies (Van Hoek, 2020). This has created a sense of urgency internationally to improve resilience of critical supply chains, including health and medicine ones (Craighead et al., 2020; Harland et al., 2021).

We seek to understand the role of contracting in building the resilience of medicine supply chains in the UK context. Medicine shortages have been a pressing problem internationally even before COVID-19 with significant negative effects on patients' treatment and welfare and costs of care (FDA, 2019). The pandemic exacerbated these challenges for certain drugs key to the pandemic response (e.g. from paracetamol products to medicines used in Intensive Care Units) triggering government interventions to mitigate shortages (de Vries et al., 2021). In line with these developments, and prompted initially by its preparations for exiting the European Union (Brexit), the UK

Government has identified multiple measures for improving resilience in medicine supply chains. Alongside measures to build strategic stockpiles of critical medicines and to examine the feasibility of manufacturing reshoring, the government, in coordination with relevant public agencies, initiated a review of tendering and contracting practices in secondary care (i.e. hospital) settings.

Research on supply chain resilience has identified several strategies and underpinning capabilities such as those based on redundancy and flexibility (Ali et al., 2017; Sheffi and Rice, 2005). The literature stresses two diverse perspectives on resilience (Wieland and Durach, 2021): (a) an engineering view, which emphasises the ability of organisations to bounce back to a steady state following a disruption, and to resist or absorb shocks, and (b) an ecological view, which emphasises flexible responses to unforeseen events and the ability of focal firms to transform their supply chains in the face of change. Research at the intersection between strategic sourcing and resilience (e.g. Pereira et al., 2014) appears to emphasise the engineering view in its examination of how procurement and supply management influence the ability of buying organisations to resist and /or recover fast from disruptive events. Strategic sourcing decisions under consideration typically include the number of supply sources available (single vs. multiple sourcing) and the geographical spread of suppliers (local vs. global sourcing).

Although contracting plays a central role in strategic sourcing, little is known about how it can contribute towards resilience in supply chains. Contracting decisions, both before a contract is agreed (e.g. tender design, contract award criteria and payment design) and during contract execution (e.g. supplier performance monitoring) can influence supplier behaviour (Selviaridis and Van der Valk, 2019) and supply market dynamics more generally (Jia and Zhao, 2017). And yet, prior research on supply chain resilience has underplayed the role of contracting in promoting resilience. We bridge this knowledge gap by exploring, both conceptually and empirically, the links between contracting and supply chain resilience. Specifically, we seek to answer the following research question (RQ): *How do decisions regarding the contracting process, contract design and contract execution influence supply chain resilience?*

Literature review

Supply chain resilience

Supply chain resilience is broadly defined as the adaptive capability to maintain some functionality while responding to unexpected disruptions and subsequently recover to the original state or better (Ali et al., 2017; Mena et al., 2020). However, it remains an elusive concept in the field of supply chain management (SCM) (Scholten et al., 2019). Recently, Wieland and Durach (2021) sought to improve clarity on what resilience entails in SCM by arguing that there are two broad perspectives: engineering view and ecological view. The former has its origins in the field of engineering where resilience is conceived of as the ability to resist shocks, maintain fundamental functions in the face of external interference, and bounce back to the pre-disruptive state (Davoudi, 2013). The ecological view originates from ecology where resilience is conceived of as more than resisting change; it entails embracing inevitable change brought on by unexpected events, being adaptable to absorb external shocks (i.e., transformation), and rapidly recovering from their adverse impact (Dovers and Handmer, 1992).

As the discourse on the relevance of engineering and ecological perspectives of resilience begins to gain traction in SCM, one of the key questions arising relates to their (possible) roles in dealing with different types of disruptive events. For instance, are both views relevant for coping with high impact, low frequency (HILF) extreme events, e.g., natural disasters and pandemics (Gunasekaran et al., 2015; Namdar et al., 2018)? Can a

single organisation reflect both views in its strategies and capabilities? A curious development is that supply chain resilience has widely been defined in line with the ecological perspective but empirics have largely leaned towards the engineering perspective (Wieland and Durach, 2021). For example, focus has been on capabilities in as far as they enable shock resistance and maintaining functions through advance preparedness (Brandon-Jones et al., 2014). Nonetheless, some of the capabilities enable adaptation (e.g., flexibility). Thus, conceptually disentangling ecological from engineering resilience does not appear to be straightforward.

Key resilience capabilities identified in the literature are redundancy, flexibility, agility, collaboration and visibility (Ali et al., 2017; Hohenstein et al., 2015). However, there is a lack of consensus about their status conceptually or their importance. For example, some researchers see agility as a component of flexibility arguing that speed of response is a necessary condition for flexibility to pay off (e.g., Fang et al., 2013). In addition, there is some evidence that visibility does not significantly improve resilience (Wieland and Wallenburg, 2013) and speculation that it may not be relevant when dealing with HILF (Vanpoucke and Ellis, 2019).

Overall, resilience capabilities underpin strategies which can be adopted in advance of a disruption, or to “stop the bleeding” in response to a major disruption (Cohen et al., 2020). Advance strategies appear to be generally associated with redundancy – for instance, having a diverse supply base and maintaining buffer stocks. Response strategies are largely associated with flexibility e.g., sharing risk, costs, and gains with suppliers (Cohen et al., 2020).

Buying organisations must invest in resilience to overcome disruptions. The strategic sourcing literature identifies similar resilience capabilities as those in the wider SCM literature to be crucial for the sourcing function (Pereira et al., 2014). However, investing in all resilience capabilities is too costly (Ali et al., 2017) and buyers must make trade-offs in allocating scarce resources to maximize outcomes (Robinson and Sahin, 2006; cited in Mentzer et al., 2008). Accordingly, research has examined how different strategic sourcing decisions (e.g. single vs. multiple sourcing) help in resisting or recovering fast from supply disruptions (Pereira et al., 2014).

Contracting

Contracting is a key means for governing and managing inter-organisational relationships in supply chains, alongside relational governance mechanisms (Cao and Lumineau, 2015). Contractual governance refers to “explicit, formal, and usually written contracts” (Vandaele et al., 2007, p. 240). Formal contracts constitute legally binding agreements that specify the roles, responsibilities and tasks of contracting counterparts for a given exchange (Klein-Woolthuis et al., 2005).

The contracting literature has advanced a *process* view of contracting (Lumineau et al., 2011), meaning that contracting decisions and practices are conceptualised as a series of interconnected stages with input and output dependencies (e.g. Selviaridis and Spring, 2010). First, the *pre-contract stage* includes all the decisions and tasks that are required to define needs and requirements and search for suitable suppliers. The design of tenders and supplier assessment and selection activities are relevant examples in this category. Second, the *contract design stage* refers to decisions and practices associated with the design of contractual provisions and clauses, negotiations and contract agreement and sign-off. Third, the *contract management stage* concerns decisions and activities in relation to the execution of the contract. Key aspects include systems for measuring and managing supplier performance and supplier relationship management practices.

In addition to being conceptualised as a process, contracting is also studied as an *outcome* (Selviaridis and Spring, 2010). This view emphasises the content of a formal contract, as the (temporary) embodiment of the defined exchange characteristics e.g. specifications, expected performance levels, the payment mechanism and any performance-related incentives. Stated differently, the focus is on the provisions and clauses included in formal contracts and their functionality in managing the buyer-supplier relationship (Cao and Lumineau, 2015).

Traditionally, contracts have been seen as control devices whose main purpose is to safeguard parties against opportunistic behaviour of counterparts and other commercial and operational risks associated with the exchange (Schepker et al., 2014). Examples of contractual clauses serving as financial and legal safeguards include (early) termination clauses, penalties for under-performance, and allocation of decision rights to manage externalities (e.g. Roehrich and Lewis, 2014).

More recently, research has stressed that, beyond control, contracts can fulfil coordination and adaptation functions (Roehrich et al., 2020; Schepker et al., 2014). Contracts can be used to coordinate buyer-supplier relationships by invoking provisions related to information sharing and inter-firm communication, performance review, and resource allocation and delineation of roles and responsibilities (Poppo and Zenger, 2002). Contracts also serve as adaptation devices by allowing for exchange adjustment in the face of uncertainty and change. Examples of adaptation-oriented provisions include clauses for review of pricing and resource investment levels, contingency planning and renegotiation of contract terms when unforeseen disruptions occur (Selviaridis, 2016).

Summary and analytical framework

Taken together, a process perspective on contracting (emphasising key stages) and a focus on the content and multiple functions of contracts offers a useful framework for analysing how contracting decisions and practices can contribute to supply chain resilience. Drawing on recent literature, we distinguish between an engineering and ecological view of supply chain resilience and discuss key strategies and capabilities stressed in prior literature accordingly. Our aim is to analyse how contracting decisions relate to supply chain resilience strategies and to explore underlying capabilities associated with the engineering and ecological perspective, respectively. Our empirical study, which we report and discuss in the following sections, offers important insights to this end.

Research method

Our research setting is the English National Health Service (NHS). We studied the system of medicine supply in secondary care and the efforts of the Department of Health and Social Care (DHSC) and the NHS to embed resilience goals and metrics in tenders and supply contracts following Brexit and the pandemic. Procurement of secondary care medicines in England is largely centralised. The NHS Commercial Medicines Unit (CMU) is a national body responsible for setting up tenders and negotiating (framework) contracts on behalf of NHS hospitals. Medicine procurement professionals typically reside in the Pharmacy unit of the hospital and handle tactical and operational sourcing tasks such as order management and stock control. They are supported by Regional Pharmacy Procurement Specialists (RPPSs) who, among other things, share information about forthcoming supply issues and help hospitals to search for alternative products or suppliers when shortages occur. The DHSC has overseeing responsibility for medicine supply and coordinates closely with CMU (buyer side) and suppliers (e.g. manufacturers and wholesalers) to manage supply risks and shortages.

Given the scant empirical research on the role of contracting decisions in promoting supply chain resilience, we adopted a single case design (Yin, 2009) to explore in-depth how contracting can contribute to resilience in a real-world setting. Case-based research is suitable when the aim is to explore contemporary phenomena and develop theoretical insights in context (Voss et al., 2002). Our qualitative research approach allowed us to understand and map the involved actors and their interrelations, and examine in detail the links between contracting and supply resilience.

We followed a criterion sampling approach (Patton, 2002) to select our case. Specifically, we chose to study the NHS medicine procurement system because DHSC and the CMU have recently embarked on a review of tendering and contracting practices in the English NHS with the stated objective to strengthen resilience of medicine supply chains. This provided a timely opportunity to track the changes in contracting processes and practices in efforts to embed resilience objectives and to identify the relevant tensions and challenges. We focus on secondary care because governments and public health agencies, as the main buying organisations, have direct control over contracting decisions in this setting (as compared to primary care contexts).

We collected data through 21 semi-structured interviews with the key stakeholder organisations. Specifically, we spoke to DHSC officials, CMU managers, a regional pharmacy procurement specialist, and representatives of manufacturer and wholesaler associations in the UK. We also interviewed pharmacy procurement teams in three hospitals, NHS pharmacy experts and local and regional commissioning bodies. The interviews were recorded and fully transcribed. Our interview guide covered multiple themes including causes of supply issues and shortages, the status and limitations of the medicine procurement system, and how tendering and contracting practices are currently being revised to improve resilience in medicine supply chains.

We triangulated and augmented our interview data by reviewing and analysing more than 35 documents, notably a sample of CMU tenders and contract templates and NHS reports on medicine procurement in England. Data coding and analysis focused on how changes in contracting decisions and practices influence supply chain resilience and its diverse perspectives.

Case analysis and findings

The case analysis focuses on how the English NHS and specifically the CMU have revisited their approach to medicine procurement and contracting to improve the resilience of medicine supply chains in the UK. COVID-19 and the consequences of Brexit triggered the proliferation and adoption of a “supply resilience” discourse within the DHSC and the NHS, in line with a wider political debate over sovereignty and security of supply. As part of DHSC’s strategic initiative to improve resilience, the NHS has launched a review of its tendering and contracting practices in secondary care in coordination with industry and other relevant stakeholders. We focus on planned and /or realised changes in contracting practices along the three stages we have defined: pre-contract activities, contract design and agreement, and contract management.

Pre-contract activities

Our analysis suggests that the ongoing revisions in the design of tenders and contract award criteria are in line with a shifting emphasis towards supply resilience. Before the COVID-19 pandemic and Brexit, the main priority was cost based on product prices that the NHS was willing to pay. Although cost efficiency and low prices are still relevant goals and unlikely to be undermined moving forward, the CMU and medicine procurement experts at regional and local (hospital) level recognise that performance

objectives related to supply security and resilience are also crucial and should also drive contract award decisions.

Before the pandemic, supplier selection criteria put little emphasis on supply risk aspects and contract award decisions were disconnected from past supplier performance. In other words, poor quality or delivery performance played a very limited role in re-contracting decisions. Our analysis of a sample of CMU tenders for both generics and patented medicines over the past ten years indicates that supply security-oriented award criteria had progressively been undermined. Examples of supplier assessment criteria removed from past tendering documents include “assessment of supply base risks” and “delivery performance”. There is, however, evidence to suggest that this trend is currently being reversed given a concerted effort within the NHS to revisit and strengthen supplier selection criteria. CMU interviewees stressed that, moving ahead, contract award decisions will be based on past supplier performance in terms of product availability and quality. Recent tenders have also incorporated a requirement for suppliers to demonstrate that they have business continuity and contingency planning capabilities and are able to anticipate and manage risks in their supply chains. Two additional assessment criteria are under consideration: a) asking suppliers to maintain a sufficient level of buffer stock and, b) the ability of suppliers to diversify their sources of active pharmaceutical ingredients (APIs) and other critical input materials such as excipients.

Besides contract award criteria, the NHS and the CMU have revisited the design of tenders specifically in terms of how frequently they issue tenders (tendering frequency) and how long they award framework contracts for (contract duration). Before the pandemic, the length of a framework contract was typically two years, with a further two-year extension option for some innovative and patented products (“branded medicines”). For generic medicines, the NHS has been applying lot-sizing practices to mitigate any negative consequences of long-term contracts. Specifically, three lots of contracts for generic medicines are typically awarded for differing lengths of time and, if possible, to different suppliers. This helps to increase bidding opportunities all year round and instigate competition between suppliers. A similar logic is used for branded medicines that are substitutable for the treatment of certain conditions (e.g. heparins, fertility medicines, insulin analogues and products for severe asthma) where a “tranche” system applies: tenders and contracts for the specified tranches are issued biannually and on a rolling basis for different regions in England.

The NHS has also started to experiment with more frequent tendering (e.g. every 4-8 months) and shorter-term contracts, especially for generic medicines. Multiple interviewees suggested that this approach can be more effective in promoting diversity of supply and market competition. Representatives from industry, in particular, noted that lengthy contracts and infrequent tendering hurt production and supply capacity. Restricted bidding windows, coupled with low prices and tight profits margins for generic products, often incentivise manufacturers to drop out of the market thereby creating imbalances between demand and supply.

Contract design

Our analysis also suggests that changes are planned with respect to the design of key provisions included in framework contracts. A key issue refers to the approach for incentivising suppliers to meet their product availability and quality targets. Traditionally, medicine contracts have included financial penalties for failures to supply but there was no commitment from the hospitals to buy a minimum amount from suppliers. Thus, cost control and reduction provisions for the buyer were emphasised. Interviewees from hospital procurement teams admitted that contracting practices have thus far been cost-

focused given the priority on affordability and low prices. In line with the shifting emphasis towards supply resilience, the NHS currently seeks to transition to a “value-based” approach to medicine procurement and supply management. According to CMU representatives, moving away from a focus on cost towards value orientation means that pricing for medicines must reflect a lot more accurately supplier processes and capabilities conducive to supply risk management and resilience. For example, supplier investments in data analytics, improved forecasting capabilities and safety stock maintenance and management can help justify higher prices, insofar as such investments and extended supplier responsibilities improve supply security. Interviewees also mentioned the prospect of embedding more positive supplier incentives in contracts, e.g. performance-based rewards and minimum volume commitments.

Contract management

We find that contract management is a largely neglected area by the NHS medicine procurement community. Before the recent shift of emphasis towards resilience, very little attention had been given to systems and processes for measuring and monitoring supplier performance. This might also explain why past supplier performance had hardly been considered when making contract award decisions. Contract management was focused on biannual reviews of prices to ensure affordability and value for money.

Our data shows that the NHS has acknowledged these limitations and is planning to improve its contract execution and supplier relationship management practices. CMU interviewees, for instance, stressed the need to cultivate a performance culture in contract management by introducing supplier-managed key performance indicators (KPIs). These would help to monitor and manage requirements for supplier redundancy (e.g. capacity and stock levels) and supply continuity more generally. Perceived necessary changes also include more frequent performance reviews going beyond pricing in order to identify opportunities for performance improvement. While some interviewees noted the need to develop more collaborative supplier relationships, we also find that there is potentially a tension between a shift towards more frequent (re)tendering and shorter contracts on the one hand, and closer supplier relationships on the other. In addition, short-term contracts come with the risk of not satisfying suppliers’ break-even point which is usually a year or so, thereby reducing supplier returns.

Contracting and resilience in medicine supply chains

The findings above show a clear intent and significant efforts to revisit NHS tendering and contracting practices in line with shifting priority towards resilience in medicine supply chains. We found that changes are either planned or have already been implemented in multiple areas including contract award criteria, tender design, the design of contractual provisions, contract execution and supplier performance management. We furthermore highlight the NHS’s strategic intent to shift from a cost- to a value-based approach to medicine procurement, which arguably has the potential to strike an improved balance between affordability and supply security requirements.

Overall, these findings offer insights with respect to how contracting decisions can contribute to resilience. Considering the different views of supply chain resilience (engineering vs. ecological), furthermore, helps us to understand better the rationale for, and goals of, the NHS tendering and contracting practices in focus. Table 1 summarises the key findings of this analysis and shows that the changing contracting processes and practices seem to emphasise an engineering perspective on supply chain resilience, based on redundancy and associated capabilities. This is evident, for example, when analysing contract award criteria under consideration (e.g. API source diversity and requirements

for buffer stock), the rationale for more frequent (re)tendering and shorter-term contracts, and the introduction of KPIs to monitor supplier capacity and stock levels. In comparison, there is little evidence to suggest that NHS contracting is seen as a means to foster the development of capabilities in medicine supply chains that help to transform operations in response to unforeseen disruptions, in line with an ecological view of resilience. Emphasis on supplier investments (e.g. in forecasting and data analytics), adaptation-oriented provisions and collaboration with suppliers could be interpreted as efforts contributing to this end, but overall our findings underline a concern for (more) redundancy in the supply chain.

Table 1 – How NHS contracting practices are revised to promote supply chain resilience

	Pre-contract activities	Contract design	Contract management
Supply chain resilience: engineering view	<p>More frequent tendering to maintain sufficient number of suppliers in the market</p> <p>Revised supplier selection criteria e.g.</p> <ul style="list-style-type: none"> - Diverse API sources - Supplier business continuity planning - Supplier past performance - Buffer stocks 	<p>Financial penalties for supply failures</p> <p>“Value orientation”: price reflects supplier obligations to maintain buffer stock and invest in data analytics and forecasting capabilities</p> <p>Shorter-term contracts</p>	<p>Performance monitoring for supplier redundancy (stock and capacity)</p> <p>Supplier-managed KPIs to ensure supply continuity</p> <p>Frequent performance reviews for prompt corrective actions</p>
Supply chain resilience: ecological view		Price adjustments	Collaborative supplier relationships allowing for adaptation

Discussion and conclusions

In this paper, we have sought to explore and understand how contracting processes and practices can promote supply chain resilience. Our analytical framework considers contracting decisions along three key stages and distinguishes between the engineering and ecological perspectives of supply chain resilience. Our empirical study has identified multiple areas of contracting practices with the potential to contribute to resilience. We show that NHS tendering and contracting practices have been revisited accordingly, in response to the COVID-19 and Brexit challenges facing medicine supply chains. For instance, the changing contract award criteria stress more past supplier performance and capabilities to identify and manage supply chain risks. Contractual provisions are also being revisited to align better with the supply resilience imperative – the transition towards a value-based contracting approach is a notable development in this respect.

More importantly, our findings suggest that the emphasis is still on contractual control and safeguarding rather than on the capacity of formal contracts to help coordinate and adapt exchange relationships. This implies that an engineering view of supply chain resilience underpins the revised tendering and contracting practices, which places value on redundancy and robust supply chain designs. We found very little evidence in support of the ecological perspective: how public contracting can incentivise the development of supply chain capabilities for adaptation and transformation in the face of unforeseen disruptive events. One interesting finding in this regard was the suggestion that embracing collaborative supplier relationships is largely in conflict with frequent tendering and short-term contracts to ensure market completion and diversity of supply options. Such seemingly conflicting goals could be resolved by embracing an expanded view of supply chain resilience, one that highlights capabilities for adaptation and transformation. We

speculate, however, that this tension might be emphasised because of the regulatory limits on buyer-supplier relationships in the public sector and the prevalence of the engineering view of resilience. A key question arising is whether, how, and to what extent, contracting can enable the feats of transformation and even exploitation of opportunities associated with the ecological view (Wieland and Durach, 2021). Our contention is that, above all, a cultural shift is required before contracts can be leveraged as a tool for building ecological resilience: contracts must be seen primarily as devices for coordination and adaptation in line with a relational contracting ethos of collaboration and strategic flexibility (Collins, 1999; Schepker et al., 2014).

Our study contributes to prior research in two ways. First, we extend the supply chain resilience literature by focusing on the functionality of contracting. We show that tendering and contracting practices can contribute to supply chain resilience and analyse the links between contracting decisions and diverse resilience strategies based on the engineering and ecological views. Second, the research adds to our understanding of sourcing strategies for resilience. Our conceptualisation of contracting practices vis-à-vis the differing purposes and capabilities underlying supply chain resilience offers a novel conceptual framework for understanding and explaining contracting-based interventions to improve resilience. These interventions extend beyond supplier strategies and address contract design and execution as two critical areas of managing supplier relationships.

The study also presents policy and managerial implications. NHS efforts to embed resilience goals in contracting appear to over-emphasise redundancy and control mechanisms that help to anticipate and mitigate “known” supply risks. More attention should be paid to contracting practices that support strategic flexibility and fast adaptation to unforeseen disruptions. Our findings also highlight weaknesses in contract execution and supplier relationship management activities. Investments in performance data collection and analysis systems and the establishment of contract management teams within the NHS would be helpful in addressing these weaknesses.

The research examined ongoing changes in contracting practices, meaning that it has not been possible to study their performance effects. Further research is needed to evaluate the impact of contracting decisions on resilience outcomes. Although our case-based research limits generalisability, our framework captures all relevant contracting decision areas and opens up opportunities for future research e.g. modelling and assessing the effect of tendering frequency and contract duration on supply resilience outcomes.

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