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Towards Transformative Supply Chain Research and Practice: A Critical Systems Perspective

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ABSTRACT

The argument that the supply chain discipline needed to make an epistemological break with functionalism in favour of a systems approach was made by Mears-Young and Jackson (1997) but it has largely been overlooked. This paper seeks to address this oversight by demonstrating what a systems (multiparadigm, multimethodological) approach involves and means for supply chain theory and practice: the adoption of a broad range of paradigmatic perspectives, the juxtaposition and interplay of different perspectives and the creation of opportunities for understanding and action that offer the potential for transformational insight and change. Such a systems approach is demonstrated through the employment of three contrasting perspectives (objective-positivist, subjective-interpretivist and radical-critical) to the case study of the supply chain for personal protective equipment (PPE) in the United Kingdom during the first year of the Covid pandemic. This case study is complex and multifaceted and demonstrates well the urgent practical need for a systems approach to supply chain theory and practice as each supply chain perspective offers only partial insight and understanding. In summary, this paper seeks to advance supply chain theory and practice by articulating what a systems approach to it involves.

1 | Introduction

Many supply chain professionals, practitioners and researchers, have pragmatically turned to mixed qualitative and quantitative methods to deal with the messy problems of a volatile, uncertain, complex and ambiguous (VUCA) world (Creswell et al. 2007; Creswell 2009; Creswell and Poth 2018; Morgan 2007, 2014). In this paper, it is argued that supply chain practice and research need to shift beyond mixing methods to a mode of operation informed by critical systems thinking and practice, based on paradigm awareness and critical reflection.

It was established by Mears-Young and Jackson (1997) that the supply chain discipline unwittingly adhered to a functionalist paradigm that limited its practitioners to an operational role. Consequently, Mears-Young and Jackson (1997, 617) called for

an 'epistemological break' and 'an attitude of mind created using systems ideas …'. The effects of logistic's paradigmatic confinement had already been commented on by Christopher (1982, 1986) who had observed that the discipline was not able to realize its strategic potential to integrate between the functional areas of the firm and the firm and its environment. Sweeney, Grant, and Mangan (2015) looked to develop understanding of supply chain management (SCM) at a strategic level and found that 'while a high level of understanding of logistics and SCM concepts and principles appears to exist, there is significant room for improvement in terms of how to implement this thinking' (Sweeney, Grant, and Mangan 2018, 864). Progress and a partial epistemological break were made through the assimilation of a subjective orientation, emphasizing supply chain relations, on the back of which the Chief Supply Chain Officer ascended to the boardroom. However, along with such promotion comes

the expectation that Chief Supply Chain Officers will be able to address questions that go beyond operational and relational matters. Chief Supply Chain Officers urgently need the kind of systems-based, critically informed and multiparadigmatic approach that Mears-Young and Jackson suggested. In this paper, we look to take up the challenge of a 'revolutionary transformation' by adopting a critical systems thinking and practice-informed approach to SCM that would enable today's and future generations of Chief Supply Chain Officers to address the kind of complex and challenging questions they face.

Critical systems thinking and practice regard complexity to be 'at the core of most policy and strategy issues today. There are no simple solutions to complex problems. They are part of multidimensional 'messes' which cross boundaries and where technical, economic, organisational, human, cultural, and political elements interact' (Jackson 2022). It follows that critical systems thinkers argue the case for taking advantage of the variety of different approaches (Jackson 2010), in awareness of their different strengths and weaknesses, with a process for such practice being set out by Jackson (2020, 2021, 2022, 2023, 2024). A wide range of other academics and practitioners have written on the subject of methodological pluralism; see, for example, Brocklesby and Cummings (1995), Flood and Romm (1996), Gregory (1996), Midgley (1997, 2000), and Mingers and Gill (1997). We draw inspiration from this work in establishing what objective-positivist and subjective-interpretivist perspectives (Solem 2003) bring to SCM and add a radical-critical approach. The utility of these three complementary approaches will be explored through the case of the supply chain response to the United Kingdom National Health Service's (NHS) demand for personal protective equipment (PPE) in the year 2020, the initial period of the coronavirus pandemic. In this period, there was elevated public awareness of SCM particularly with regard to life-saving goods in general (Li and Dong 2022) and, in the UK, the Government's role in the procurement and availability of PPE. The case is multifaceted, and different perspectives (objective-positivist, subjective-interpretivist and radical-critical) offer insights on fragments of it, thus demonstrating that the combination of these approaches offers a more systemic understanding that is better able to capture the complexity of SCM practice than a singular paradigm approach. Hence, following the logic of a critical systems approach, we do not seek to reconcile these different perspectives on SCM into a single unified approach. Rather, we embrace and look to creatively work with pluralism in acknowledging the radically different ways of viewing the world and thinking about how best to design supply chains and operationalize them, to make explicit underpinning assumptions and to bring about improvement in the real world of SCM. Supply chain managers operate in a VUCA world, and respect for Ashby's law of requisite variety (Ashby 1956) compels us to build necessary complexity into our approaches. To this end, Jackson has provided much insight into how the difference between the different approaches makes a difference and how this can be managed in practice (see, e.g., Jackson 2021). So, although one supply chain approach may be initially dominant to address primary concerns, drawing in other approaches to address secondary concerns or to challenge dominant perspectives is also required from a critical systems-informed approach to SCM.

In summary, this paper seeks to advance supply chain theory and practice by articulating what a multiparadigm, multimethodological approach involves. The case of the supply chain for PPE in the United Kingdom demonstrates the need for urgency in establishing methods that support such an approach.

2 | Paradigm Perspectives on SCM

2.1 | Overview

A paradigm shift (Kuhn 1962) is a fundamental change in the basic concepts and experimental practices of a discipline. When a paradigm shift is referred to in the logistics and supply chain discipline, it is sometimes used to refer to a technical innovation. For example, the announcement in The Raconteur (McGreal 2017) that 'An emerging paradigm shift in supply chain management is allowing companies to become truly demand driven and achieve their planned service levels at lower costs from up to half the average stock and with no requirement for highly accurate forecasts.' Hailing a step change in technical efficiency as a paradigm shift rather misrepresents such a phenomenon but is revealing of the dominant objective-positivist paradigm on which the discipline is based. That is not to say, though, that there have not been paradigm shifts; there has been at least one change that meets the necessary requirements, and it was marked in a change in the naming of the discipline.

In modern usage, generally, logistics refers to the physical transfer of goods, usually involving transport and warehousing (for a comprehensive historical perspective, see Southern 2011), reflecting an underpinning mechanistic objective-positivist paradigm. Recognition of the limitations of such a perspective led, in the 1980s, to the argument that practitioners needed to focus more on the relational aspects of the discipline. This resulted in a more strategic focus on 'a total systems concept with a span of concern which ultimately encompasses all the movement and storage activities within the firm and its distribution channels. This means that those called upon to manage the activity must understand the total business and take a broader view of the impact of decisions made in one area which are likely to have systems-wide effects' (Christopher 1986, 52) and the coining of the term supply chain management by Keith Oliver in 1982 (Laseter and Oliver 2003). Professional bodies within the discipline were slow to mark the expanded role that their members had embraced with the Council of Logistics Management only becoming the Council of Supply Chain Management Professionals in 2005.

Given the time that has elapsed since the paradigmatic confines of the discipline were first recognized, it is hard to suppress the question, are enough changes being made quickly enough by supply chain professionals to deal with extant complexity? To demonstrate the need for urgency, let us take the example of resource allocation in a system that faces crisis and shortage. Trained supply chain professionals in the public sector often deal with such issues through modelling and multicriteria decision-making. Crucially, though, politicians and senior business leaders have a role in related decision-making

but leave supply chain professionals to carry the can when media interest is piqued. Indeed, the PPE crisis in the United Kingdom exposed supply chain professionals to public scrutiny at a time when a messy interplay of disciplinary knowledge, crisis management and political expediency were evident. Given such complexity, it is necessary to view the situation from different paradigm perspectives as each offers fragments of insight based on differing ontological and epistemological assumptions.

Golicic, Davis, and McCarthy (2005, 19–20) argue the case for a balanced approach of positivist and interpretivist research suggesting that 'deductive (typically quantitative) and inductive (typically qualitative) approaches to research provide different views of logistics and supply chain phenomena. Which approach provides better information? ... it depends on what you want to know about the phenomenon'. However, it can be argued that objective-positivist and subjective-interpretivist approaches alone provide a partial and inadequate explanation of supply chain decision-making and both neglect to consider the impact of power and politics. Hence, it is argued that there is a need for the inclusion of a radical-critical perspective to ensure a more systemic understanding and practice of SCM.

A complex array of happenings (Brexit, Covid, war, natural disasters, etc.) has made the notion of supply chain disruption widely familiar, and its implications are often that goods and services that we routinely expect to be readily available are not available, in short supply and/or cost more. In light of this, Shih (2020) argues that 'The challenge for companies will be to make their supply chains more resilient without weakening their competitiveness.' And both competitiveness and resilience will largely be evaluated on the basis of a narrow focus on effectiveness and efficiency. Such a narrow focus is to the cost of consideration of a broader range of relevant criteria and, indeed, it could be argued that a privileging of effectiveness and efficiency has actually contributed to some of the happenings that are stressing supply chains. For example, the global transport of goods from locations of cheap production has contributed to CO_2 emissions and global warming and, as the effects of this become ever more evident through flooding and fires, the imperative to include evaluation criteria, beyond effectiveness and efficiency, in managers' evaluations of supply chain designs becomes ever more important and urgent.

Let us now take a cursory look at what different paradigm perspectives involve and offer.

2.2 | An Objective-Positivist Perspective

The objective-positivist perspective on logistics and supply chain research has traditionally been dominated by a concern for architecture design and modelling. Such efforts are oriented towards providing answers to questions about:

- the number, location, capacity and type of manufacturing plants and warehouses to use;
- the set of suppliers to select;
- the transportation channels to use;

- the amount of raw materials and products to produce and ship among suppliers, plants, warehouses and customers; and
- the amount of raw materials, intermediate products and finished goods to hold at various locations in inventory.

Given the various elements and relationships involved in supply chain architecture design and modelling, it is perhaps not surprising that Vidal and Goetschalckx (1997, 2) argue that 'the most comprehensive strategic problem is the optimization of the complete supply chain'. Consequently, supply chain models have been developed to address the optimization problem that range from simple deterministic to stochastic incorporating a range of variables and associated activities reflecting complications arising from, for example, globalization, politic changes and natural risks. Given the plethora of supply chain models available and a tendency to ever more elaborate modelling, Hunt (1991) cautions that theory developed by following a quantitative route should be capable of generating predictive statements that can be tested by confronting the theory with real-world data about the phenomenon of concern. Such advice is also reflected in the good practice guides of professional associations for achieving '"optimized" configurations/designs and improvement interventions, which are easily commoditized and applied in an a-contextual fashion' (Adamides, Papachristos, and Pomonis 2012, 907).

From this perspective, supply chains are seen as having an identity separate from the social systems and actors giving them meaning. It is not surprising therefore that little, if any, attention is given to the role of the supply chain professional, be they a practitioner or researcher, as anyone could go through the same process and come up with the same findings and conclusions. The main concerns of practice and research from this perspective are efficacy, will the desired outcome be produced in controlled circumstances, and efficiency, is the desired outcome produced with minimal use of resources (Aastrup and Halldórsson 2008; Adamides, Papachristos, and Pomonis 2012). Golicic, Davis, and McCarthy (2005, 22) suggest that such concerns are reflected in the practice of deductive hypotheses testing to establish, for example, 'the significance and strength of proposed relationships among the variables expressed in the hypotheses (e.g., increased trust between trading partners increases relationship commitment)'.

Research from the objective-positivist paradigm relevant to the management of the PPE supply chain includes that of Abedrabboh et al. (2021) who have used publicly available COVID-19 hospitalization data for NHS England regions, to create simulations that enabled them to investigate the impact of three key factors on PPE security of supply. These factors comprise (i) the stockpiling start date, (ii) the time of the peak of a putative second wave and (iii) the amount of storage available for medical PPE.

2.3 | A Subjective-Interpretivist Perspective

Constructivist and interpretivist perspectives (Näslund 2002; Lewis and Suchan 2003; New 2004) focus on meaning and explanatory power. From an interpretivist perspective, a key objective is to view or experience the phenomenon from the stance

of different participants. Where appropriate and possible, this involves both recognizing multiple perspectives and making efforts to actively engage stakeholders in the exploration of different points of view on a focal issue. Sometimes, though, such extensive exploration is not possible and, for pragmatic reasons, the essence of a subjective-interpretivist approach may be pursued through a Hegelian dialectic, confronting a proposition from its opposite position. We found qualitative case study research involving an approach to PPE supply that was in sharp contrast to that of the official Government one to be particularly useful. As Ponelis (2015, p.537) summarizes:

> Qualitative research produces holistic understandings of rich, contextual, and generally unstructured, non-numeric data (Mason 2002) by engaging in conversations with the research participants in a natural setting (Creswell 2009). The defining feature of case study research is its focus on 'how' and 'why' questions (Myers 2009) and for this reason is appropriate for descriptive and exploratory studies (Mouton 2001). A case study can focus on describing process (es), individual or group behavior in its total setting, and/or the sequence of events in which the behavior occurs
>
> (Stake 2005).

Case study research typically combines multiple sources of data, such as interviews, observations and archival documents (Baxter and Jack 2008; Yin 2018). Such triangulation is important in the case of interviews, which are a popular and efficient way to collect rich data, but which may suffer from impaired reliability due to participants' retrospective sensemaking and impression management (Eisenhardt and Graebner 2007). By cross-checking with other types of data, case study researchers can overcome such drawbacks (Gibbert, Ruigrok, and Wicki 2008; Yin 2018).

This paradigm perspective also gives consideration to subjectivity in the research process itself and the researcher's role as an active participant (e.g., Adamides, Papachristos, and Pomonis 2012; Näslund 2002; Mangan, Lalwani, and Gardner 2004; Kovács and Spens 2005; Aastrup and Halldórsson 2008; Boyer and Swink 2008). Of particular concern is understanding how relationships with participants may shape findings (Corlett and Mavin 2018). Siggelkow (2007, 23) suggests that 'the persuasiveness of the arguments is greatly strengthened if serious attention is given to alternative explanations—and why these alternative explanations are unlikely to hold'. The implication is that researchers share their description and interpretation of the case with participants so that they get a voice in the write-up of the results (Creswell and Poth 2018) suggesting that the appropriate criterion here is explicability, or persuasiveness in the light of alternative stakeholder claims, concerns and issues. To this criterion, effectiveness, what is the desired outcome and whether will it be produced in the real world can be added as, through this paradigmatic lens, supply chains and associated practitioners, and researchers are seen as embedded in organizational, social and/or professional contexts with a focus on the subjective creation of meaning.

In January 2021, Hoernke et al. published a qualitative exploration of healthcare workers' (HCWs) experiences with PPE in the United Kingdom during the COVID-19 pandemic. They used a rapid appraisal methodology with three sources of data: telephone interviews with frontline staff, a policy review and media analysis.

2.4 | A Radical-Critical Perspective

To think critically involves a scepticism or suspension of belief towards particular statements, information or norms (McPeck 1981). Mingers (2000) encourages us to be sceptical about:

i. Rhetoric—This concerns evaluating whether peoples' arguments and propositions are sound in a logical sense (Hughes 1996). Do the conclusions follow from the premises? Are the premises themselves justifiable?

ii. Conventional wisdom—One of the most common assumptions is the taken-for-granted 'way we do things around here'. However, such ways may never have been the most appropriate way of doing things or may have become inappropriate because the situation has changed, or the approach does not reflect contemporary values, or neglects new ways of tackling problems including associated expertise.

iii. Authority—The idea that there is or should be one dominant or privileged position on a problem rather than a plurality of valid viewpoints. Problems are often highly complex with many different stakeholders (Checkland and Scholes 1990), so it is appropriate to seek understanding as to who stands to benefit or lose in different ways (Churchman 1968; Ulrich 1983).

iv. Information and knowledge—Is information being assumed to be value-free and objective or is it seen as the output of a social process involving people, processes, decisions and choices? Is some information being suppressed and, if so, by whom and for what purpose?

Through a radical-critical lens, supply chains are seen as dependent on the extant power relations of the social systems in which they are embedded. Hence, there is an ethical dimension that should compel supply chain professionals to question why supply chains are organized as they are, who benefits and how things ought to be suggesting relevant criteria of equity, are all stakeholder treated in a fair and just way, and ethics, are accepted moral principles being upheld. In recent years, there has been a concern for fairness and the use of power in supply chain relationships, but methodologically, these issues have been addressed from an objective-positivist perspective, for example, employing a game theoretic approach (e.g., Choi and Messinger 2016) or representing fairness preferences through alternative utility functions (e.g., Niederhoff and Kouvelis 2016) although there are notable exceptions.

Lachowicz and Donaghey (2021) provide a critical reflection on the Scrub Hub network of 127 groups that was formed in response to PPE shortages in the United Kingdom. The research began as an interview dialogue between the authors

(Lachowicz and Donaghey 2020); one of whom, Lachowicz, had been closely involved with a Scrub Hub group since its inception and that firsthand experience directly informed their analysis and critique. The research was also informed by Lachowicz and Donaghey's contextualization of the emergence of Scrub Hub at the time of the Covid crisis as a moment in which 'the state and neoliberal economy failed to meet people's basic needs, the powers-that-be temporarily lost control of "the narrative", and people organised to provide for themselves and for others, pointing towards alternative social realities'.

2.5 | Summary

The key features of the three paradigm perspectives can be summarized as follows:

- The objective-positivist perspective on logistics and supply chain research has traditionally been dominated by a concern for architecture design and modelling. This concern is expressed through the development of quantitative models giving the promise of complete supply chain optimization.

- A subjective-interpretivist perspective focusses on meaning and explanatory power with a key objective being to view or experience the phenomenon from the perspective of different participants including the researcher.

- A radical-critical perspective views supply chains as dependent on the extant power relations of the social systems in which they are embedded highlighting an ethical dimension that should compel supply chain professionals to question why supply chains are organized as they are, who benefits and how things ought to be.

Having set out a brief sketch of the three paradigm perspectives, they will next be employed to explore the supply chain response to the UK NHS's demand for PPE in the initial period of the coronavirus pandemic.

3 | Perspectives on PPE Supply

In this section, we adopt the following:

- an objective-positivist lens to help describe what the NHS PPE supply chain architecture was, with a focus on efficacy and efficiency

- a subjective-interpretive lens to explain how the problem of PPE supply might have been framed differently resulting in alternative supply chain architectures and responses, with a focus on explicability and effectiveness

- a radical-critical lens to develop an understanding of who benefitted, which might throw light on why the PPE supply chain was organized as it was, with a focus on equity and ethics.

First, though, it is necessary to provide an overview of how health care is provided in the United Kingdom.

3.1 | The UK NHS

The NHS provides care of two main types: primary care (general practitioner surgeries and community services) and secondary care (hospitals and specialists services). The work of the NHS is complemented by that of the social care system compromised of social work, personal care, protection or social support services to children or adults in need or at risk, or adults with needs arising from illness, disability, old age or poverty.

With a focus on financial savings secured through centralization, the Department for Health and Social Care and NHS Supply Chain are responsible for the procurement and distribution of many items of medical equipment and supplies, including PPE, to, among others, the 226 regional NHS trusts and to primary care providers across England (DHSC 2020b). In 2018, the Department for Health and Social Care created Supply Chain Coordination Limited, a company wholly owned by the Secretary of State for Health & Social Care, to manage NHS Supply Chain. Before the pandemic, Supply Chain Coordination Limited contracted out both procurement and distribution of PPE to external parties that, in turn, contracted with PPE suppliers. Although responsibility for managing PPE supply and stockpiles was dispersed across multiple public bodies and private sector contractors, to those at the local NHS Trust level, this level of complexity was hidden as, classic pull logic, they ordered items from NHS Supply Chain and orders were fulfilled and delivered by NHS Supply Chain.

At the start of the coronavirus crisis, very little was known about how the virus was transmitted, but it quickly became apparent that PPE was needed to protect staff in both the health and social care systems. Medical-grade PPE products required to protect against transmission included films (aprons, body bags and clinical waste bags), eye protection, face masks, gloves, gowns and scrubs, and chemicals (hand hygiene, general purpose detergent). To ensure the right type and quantity of PPE was available to the NHS, during a period of unprecedented supply chain volatility when global demand outstripped supply, was a messy complex problem for NHS Supply Chain. In the next sections, we will look at insights offered by the aforementioned three paradigm perspectives on how this problem was addressed.

3.2 | An Objective-Positivist Perspective

In this section, we focus on the UK Government's design and construction of a supply chain architecture to satisfy NHS demand for PPE. Due to a lack of access to primary data regarding Government decision-making, this description will be based on official accounts of the modelling and design process.

When a system has never been stress tested, it is easy to assume that it is robust and efficient; such was the case with the NHS Supply Chain for PPE. In 2018, the Department of Health & Social Care's performance management regime did not include any targets related to the resilience of supplies to the NHS and the operating model was not designed to respond to a pandemic (DHSC 2020a, 6). Consequently, the availability of PPE supply

was not in question but the prioritization of financial savings was, which meant that over 80% of PPE supplies were manufactured in China (DHSC 2020b, 13). That said, NHS Supply Chain did have a stockpile available to it of approximately 400 million items of PPE, as part of the Pandemic Influenza Preparedness Programme (PIPP) (NAO 2020a, 6). The stockpile was owned and managed by Public Health England, which contracted Supply Chain Coordination Limited to manage this stockpile, which then subcontracted to a subsidiary of a US healthcare giant the responsibility for storing PPE and, when directed by Supply Chain Coordination Limited, distributing it to health and care providers.

Given the ample availability of PPE stocks prior to the pandemic, the need for a demand model for PPE had not been raised and there was little recorded information about how social care settings were securing or using PPE. Consequently, at the start of the pandemic, the Department for Health and Social Care developed a model at speed using several assumptions based on Public Health England guidance, which were tested with clinical staff and end-users. Although these assumptions were proven to be more conservative than the actual usage data, the model gave an agreed and sense-checked basis for procurement until actual data could be collated and analysed. Such modelling, though, was complicated by PPE being necessary in settings that had never before had need for such items and, as the pandemic evolved, the Department for Health and Social Care was supplying emergency PPE to 58 000 different settings, including care homes, hospices, primary care providers such as GPs, community care organizations, coastguards and prisons (DHSC 2020a).

The pandemic not only caused unprecedented levels of demand for PPE, but it also caused disruptions in Chinese manufacturing and supply as market competition increased, trade restrictions were implemented, and commercial flights were grounded (WHO 2020). At the same time, it was reported that suppliers holding stocks were unable to get an indication from the Government of where PPE was most needed. Giving evidence to the UK Parliament's Health Select Committee, on 17th March 2020, Simon Stevens, head of NHS England, said the country had enough protective equipment 'in aggregate' but acknowledged that not all of it had got to the right areas, blaming a distribution issue (Neville and Hughes 2020). It is, perhaps, relevant to note that ownership of the company responsible for storing and distributing PPE had changed to a French company (Davies 2020a) and, in March 2020, the British army had to be scrambled to the company's warehouse to help organize the distribution of PPE (Davies 2020b). In his statement, Sir Simon Stevens also made it clear that further supplies would be needed to cope with an outbreak that would last months and, in order to meet such demand, domestic production of the essential items would have to ramp up (Neville and Hughes 2020). Consequently, the Government called for an increase in domestic production and, on 18th March 2020, the Cabinet Office issued information and guidance on public procurement regulations and responding to the pandemic. The guidance noted that, under regulation 32(2)(c) of The Public Contracts Regulations 2015, public bodies are permitted to procure goods, services and works with extreme urgency, including the use of direct awards to suppliers without any competition (Cabinet Office 2020). Between March and mid-April 2020, the Department for Health and Social Care predicted that the PPE required across health and social care for the next 90 days was a far greater volume of some items than was held in the PIPP stockpile (NAO 2020a).

On 10th April 2020, the Government published its COVID-19: Personal Protective Equipment (PPE) Plan (DHSC 2020a, 21), which stated that, in addition to overseas procurement, it was 'pursuing a brand new "Make" strategy of encouraging UK manufacturers to produce PPE. There has been limited UK manufacture of PPE to date and so new supply channels for materials to make PPE have been sourced at pace in order to enable new manufacturing to commence'. In addition, the Government stated it would 'welcome support from other manufacturers who wish to offer their production facilities where they can meet the required specifications for use by the NHS and care sector' (DHSC 2020a, 22). In support of these declarations, the Department for Health and Social Care established an eight-stage process to assess and process offers of support to supply PPE including checks on suppliers' equipment against the Government's PPE specifications and to undertake due diligence on suppliers. In addition, a high-priority lane was established to assess and process potential PPE leads referred by Government officials, ministers' offices, MPs and Lords, senior NHS staff and other health professionals.

In May 2020, NHS procurement directors were told, in a letter from the Department for Health and Social Care official Jonathan Marron and NHSE/I chief commercial officer Emily Lawson (Marron and Lawson 2020), that: 'It is vital that the UK Government procures items nationally, rather than individual NHS organisations compete with each other for the same supplies, to protect the health of NHS staff and patients across the whole country.' Although exception was made for trusts working with 'new, local or small suppliers' in a way that 'does not conflict with national procurement' and donated goods. The espoused rationale for the move was to prevent local stockpiling of in-demand equipment by those trusts with strongest purchasing departments and largest budgets and 'the best commercial terms through volume' (Hignett 2020).

The initial PPE plan was replaced, on 28th September 2020, by the Government's PPE Strategy Stabilise and Build Resilience (DHSC 2020b). This document elaborated on efforts to

1. improve the resilience of the Department for Health and Social Care's supply chains through a detailed category-by-category approach involving a combination of stockpiling, strengthened relationships with strategic suppliers, broadening the diversity of the supply base nationally and internationally and potentially contracting with suppliers to hold extra manufacturing capability for use in the event of a crisis

2. ensure the identification, isolation and replacement of non-compliant PPE.

The September strategy celebrated the response to the earlier plan's call for PPE support with the Government receiving over 24 000 offers of support from more than 15 000 suppliers and emphasized the prioritization of 'deals with companies that could provide large volumes at pace' (DHSC 2020b, 26). The growth of the domestic supply base was regaled as transforming the

ability to respond to a future crisis, providing greater resilience and also having the wider benefits of creating jobs and the potential for user-based product innovation. Furthermore, the centralized nature of the PPE supply system was highlighted as important to ensuring that Value for Money (VfM) was 'secured through sound and legally compliant procurement processes' (DHSC 2020b, 10).

An overview of the revised PPE supply chain architecture is shown in Figure 1. The Department for Health and Social Care Buy, UK Make and NHS Supply Chain were responsible for procuring PPE. Once PPE was procured and had been received, it was stored in the warehouses of a logistics company in Daventry (a town located in the midlands of England with good access to the main North–South motorway). Some PPE was also stored in overflow storage and container storage; it was predicted to take 48 hours for requested stock to be available to pick from the Daventry warehouse with deliveries being made from the warehouse 7 days a week directly to NHS Trusts and other healthcare and social providers.

Despite the official proclamations of PPE supply and the steps taken to provide a supply chain architecture to ensure supply met demand, it quickly became apparent that not only were frontline NHS workers not getting the PPE they needed to keep them safe but also there were serious questions being raised about PPE procurement and the transparency of associated decision-making. We will turn to alternative paradigm perspectives to shed light on these concerns.

3.3 | A Subjective-Interpretivist Perspective

In this section, the issue of PPE demand and supply is addressed through a subjective-interpretivist lens where the relevant criteria are *explicability* and *effectiveness* given alternative

stakeholder claims, concerns and issues and the case, in this instance an event, of the formation of Frontline.Live.

In May 2020, when it was clear that demand for PPE was outstripping that supplied through the official NHS supply system, NHS procurement directors were told that PPE would be procured on a national level to reduce competition for supplies. As the guidance on the centralisation of PPE procurement exempted donated goods to trusts (Marron and Lawson 2020), much effort was put into meeting unsatisfied demand through this alternative route and the formation of Frontline.Live is one such case of this. The development of this case was based on secondary document review and phenomenological interviewing. The goal of the phenomenological interview is to gain a first-person description of some specified domain of experience, where the participant(s) largely set the course of the dialogue (Cope 2005). In this instance, an online interview was conducted on 05/04/21 by a member of the research team with Katz Kiely, the founder of Frontline.Live, and James Bebbington, Frontline.Live's partnership lead. The first part of the interview was spent on explaining the researcher's background and the reasons for conducting the research. This discussion allowed the researcher to explain the purpose of the study and to discuss informed consent including confidentiality, anonymity, voluntary participation, the option to withdraw at any point and details on the University's approval of the research (the cover letter and informed consent form given to participants). At this point, the researcher also requested permission to record the conversation for transcription, and clarified that an account of the interview would be provided to verify accuracy and that notes would be taken. Following the interview, the researcher reviewed their notes and the interview recording was transcribed over several days. The transcript was shared with the participants, and they were asked to indicate any inaccuracies, misunderstanding or content they were unhappy with. Following approval, the transcript was
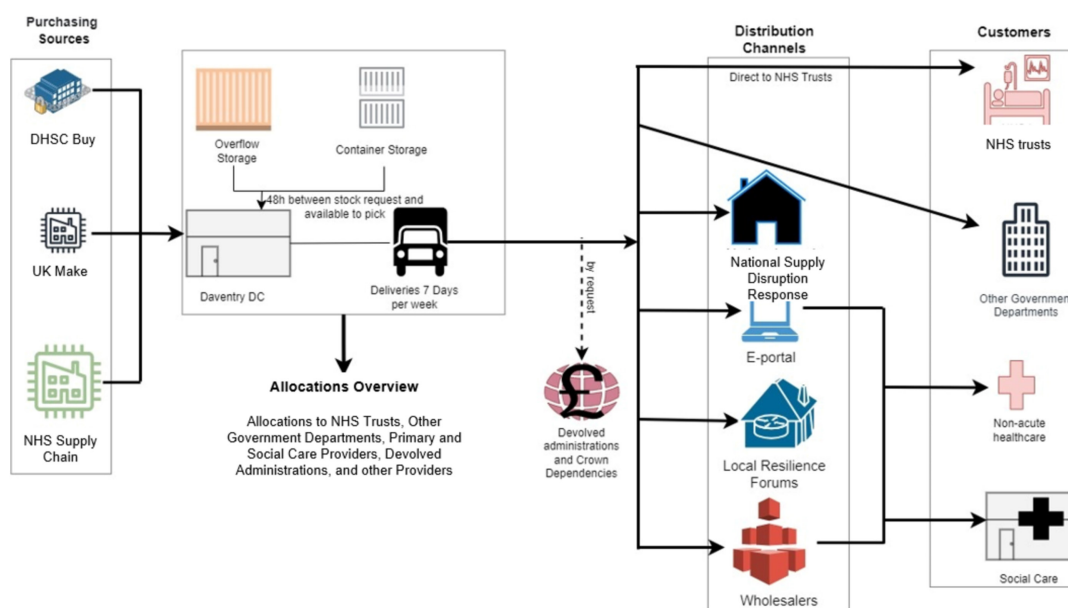

FIGURE 1 | PPE supply chain architecture for UK health and care systems (based on DHSC 2020b, 22). [Colour figure can be viewed at wileyonlinelibrary.com]

read and reread to gain an appreciation of the story, thereby becoming intimate with the account (Senior et al. 2002). Memos were captured as reflective notes on the issues identified (Patton 1990) and, during this process of immersion and sense-making, a textual analysis (Smith and Osborn 2008) was performed, where potentially significant excerpts were highlighted and potential themes were identified. The themes were colour coded and clusters of text relating to each theme were highlighted throughout the transcript. The themes were then ordered in a way that gave chronological sense to the formation of Frontline.Live.

The following interview excerpts contain words/phrases that some may find offensive but they have been retained for the purpose of authenticity.

3.4 | Seeing the Problem and Structuring a Response

Early in the pandemic, it soon became apparent that NHS workers were not getting the PPE they needed to keep them safe and, in March 2020, there were over 25000 mentions of PPE shortages on Twitter (Kiely 2020). Given that approximately 1.3 million people were employed in the NHS and Community Health Services at the time (NHS Digital 2020), personal accounts through friends and family members of PPE shortages were common. Such was the case with Katz Kiely, with a friend telling her:

> yeh, I'm a nurse and I have to go into hospital and there's no masks.

For Kiely, this essentially made the problem a human one. Rather than seeing the problem from a traditional supply chain design perspective as the Government had, as founder and CEO of the company Beep and an expert in open-innovation and culture change, Kiely adopted a different perspective:

> ... looking at digital systems that empower people is my big stick. So, having realized, actually two things, one is this terrible need where people are going into work, putting their lives at risk and all of the fear that involves. On the other side, there is load of mad buggers like me who were finding ways around it ... well, we will make stuff.

Kiely conceptualized the problem as one of there not being enough connections between those with a need and those that could supply a product to meet that need. In viewing the problem in this way, there was a refocusing on how those expressions of need and supply response could be amplified, rather than dampened. Kiely recognized that the digital domain could serve this purpose:

> I've always been fascinated by using digital to break down the barriers between people, to empower people, to connect people ... every company I've had has been ultimately agile, flat, no hierarchy.

Kiely began with the vision of creating a digital map that could be populated by geolocated Twitter requests for PPE, so everyone could see what was needed where. Only someone with such experience could see the potential for a digital response to the PPE problem, and it did imply a different knowledge and skills set to that of a more traditional supply chain response. Not only did Kiely have such vision but also the necessary connections to people with the knowledge and skills to create and support a digital supply chain platform that was innovative, scalable, decentralized and real time:

> I'm very well connected and that connection spans because of works across different sectors, public and private, I could just see the connects so I've got this great network and it was about mobilizing them. But I think, you know, at the end of the day it was because everybody wanted to do something to help.

3.5 | Speed of Response

Kiely was not sure if her vision of a digital platform for PPE could be realized in the necessary time frame, especially with no available funds. She reached out to Duncan Wilson, Professor of Connected Environments at The Bartlett Centre for Advanced Spatial Analysis at University College London, on 25th March 2020:

> I get in contact with Duncan ... and said I want to build this system that does this and he asked me lots of very difficult questions, because that's what he does and we ended up meeting and I did not know whether I'd hear back from him. Midnight, I got an email from him and he'd already got a team on it ... thinking about feasibility. So, that was the beginning of a kick ass scramble where a way, I've got no idea how we managed to get that much done in that amount of time, that we ended up having about 45 volunteers at one point at the high point of people looking for supplies getting the word out there, putting together partnerships, building the technology ... it was chaos, organized chaos ... and the kind of chaos that works because you have got a really, really clear purpose.

The knowledge and skills base of the team not only grew but also diversified as the demands of the task emerged. Along with this though, came an awareness of the resource implications of the undertaking if it was to be successful:

> There were experts involved in building the digital platform ... But, for the platform to do any good, it was recognised that it needed reach ... Mainstream newspapers both tabloid and quality press, provided advertising space. The involvement of media and PR companies The Fourth Angel and Fifth helped with the latter giving access to News International and

related media outlets such as The Times which gave Frontline a full page spread in prime position. Ocean Outdoor, working with Voodooh, offered space in huge Digital OOH billboards across the UK. Twitter, was the main social media channel, LinkedIn, with its many, active professional groups, also gave helpful support and SnapChat ran a two week national campaign for Frontline.Live.

Kiely and her associates mobilized an ecosystem of technical experts, data specialists, social media gurus and digital story-tellers as citizen volunteers to build Frontline.Live, a real time decentralized platform that connects those in need of PPE with those companies and communities that make it at speed. The Frontline.Live platform was launched on 14th April 2020, a significant achievement that defies normal development timelines:

> the truth is that so long as you are clear about the fact that actually it is good for everyone who gets involved in these things ... when there's a kind of bigger picture thing underneath then you can make the impossible happen.

3.6 | Operational Complexity

Frontline was designed for simplicity of use—NHS workers could simply Tweet their needs, tagging #frontlinemap, detailing what equipment they were lacking and the postcode of their workplace. The supply side was completely based on donations from suppliers and community groups with no exchange of money being involved. Based on decentralization, the group of volunteers was

> pretty self-organising. And that's also reflected in the nature of the platform itself—there's no central logistics hub gathering up PPE resources and parcelling them out.

However, the matching of demand with supply for PPE was not a simple process as there was the complication of ensuring that the PPE provided was fit for purpose and up to certified standard. Rather than being defeated by such complications, Kiely viewed these as necessary points of learning:

> there's a lot of documentation that we had to match and one of the issues that we certainly faced towards the end of last year, beginning of this year was people wanting to make donations of things that just did not match up to the right stuff. But there was ... one of the things that did actually happen was that there was enough documentation around the necessary specification that things could be checked against that accurately.

When a lack of necessary knowledge and necessary learning was identified, it was dealt with in a proactive way. Thus,

this created variety in Frontline.Live's knowledge and skills base and its ability to absorb environmental and process complexity:

> what we did to make absolute sure was we did not pretend that we knew everything because we did not ... our solution for all of these things and it seemed like the most sensible way forward, if you do not know something, you find a person who does and bring them into your ecosystem.

Those knowledge and skill needs, though, became evident at different times through the creation and development of Frontline.Live:

> something that actually we left too late was to find our logistics partner which when we sat down eventually when we had time to think and looked at the system, what we were missing and logistics was the thing that came out and I ended up getting in touch with a friend of mine, who talked to the CIO of the delivery company and literally within a week, I think, we had a partnership with them. And they were like 'yeh, we are in. Of course, we are happy to deliver things, why would we not?' So that was something that we just missed in our chaos which was a bit silly really. I'm just thinking about what else, what else? I wish we'd had more time but then we did not.

Frontline.Live partnering with other organizations was a key feature of the effort to ensure NHS staff had the PPE they needed to stay safe and this included organizations both large, such as Unite the Union, and small. Towards the end of 2020, Kiely found more and more people that were doing variations of a theme:

> Most of whom were sourcing PPE from other situations or had raised money for it and sending it to people but without the direct contact. And we started to form some partnerships with them, which actually made things ... err I was going to say better but that's not really what I mean but in certain ways they were smoother and certainly it made sense that we were working together rather than apart.

In the first 3 months of Frontline.Live being operational, 1500 requests were received (Pietras 2021) and Frontline.Live indicated that, within the first 7 months, £500 000 worth of time, services and support were donated to make the platform exist and deliver the activities discussed. In addition, 500 000 units of PPE were donated free (financial value not calculated). By way of comparison, in the first full year of operations (from 25 February 2020 to 24 February 2021), the Department for Health and Social Care distributed over 8.7 billion items of PPE predominantly for use by health and social care services in England (DHSC 2022). Although the scale of the two operations is clearly not comparable, it is worth a note of caution, as the items supplied by Frontline.Live were what was requested,

a pull model, whereas we have no information about whether the PPE supplied by the Department for Health and Social Care satisfied unmet demand as it was operating a push model.

3.7 | Politicisation of the Supply Chain

Fundamental to the operational success of Frontline.Live was data transparency. The fact that there were shortages of PPE was well-covered in the media but revealing shortages in real time had the potential to be a political issue:

> And so I wanted to make sure we could get the real story from Frontline and originally that was going to be on Twitter so the plan was that nurse, doctor, porter whoever it was could send a Tweet with a picture of themselves with Frontline map so that we could pick it up with the post-code so that we could double-check it was actually a place that might need PPE and what it was they needed so that we could put them on the map. Then we realized the political nature of it … so we had to amend the platform so that people could actually report these things anonymously and I think that over that first wave something like 80% of all of the requests we got through were anonymous.

Although items in the media about lack of PPE could be disregarded as political, evidence of real need in the NHS could not be so easily brushed aside and it was this kind of real evidence and transparency that Frontline.Live's operational model was built around. The existence of a real-time platform detailing PPE shortages represented a difficult challenge for the incumbent Government as it raised questions about accountability and the use of public funds. Allegations subsequently emerged that some NHS Trusts managers and Government bodies had tried to stop the flow of stories about the lack of PPE by taking disciplinary measures against staff who went public (Drury 2020). Awareness of this, caused Frontline to change its media strategy:

> The face of the first campaign was a surgeon, someone senior in their career and with enough clout to speak out loud and proud. However, on realising that 87% of requests were from people who chose to remain anonymous the focus shifted to the key message of 'Stay Safe, Not Silent'. The trade union, Unite in Health, was another partnership that really helped with credibility and with getting the word out about the platform.

Recognizing the need to amend how shortages were reported to Frontline.Live in response to political concerns was not the end of the matter though as it also impacted on partnership working as

> Some of the biggest social media platforms declined the chance to help, citing the project as too political.

Just as Kiely had reached out to other members of her network in realizing her vision for a digital PPE platform so too had she reached out to the Government but without a response:

> Just imagine what it would have done for their brand, if you can call a government a brand, if they had embraced everybody. If they had set up like a virtual innovation network and gone 'yeah let us try that … it's a living lab'. Come on guys, lets get your heads together. Why would you not do that?

3.8 | Future Developments

Kiely described Frontline.Live as 'like the little ships of Dunkirk on steroids' and predicts that such a digital platform response will be needed in the future:

> I think we should all be aware that from here on in, everything should be built to be able to respond quickly in crisis because this is not going to be the last one of these … whether an environmental crisis or an economic crisis or a social crisis or a health crisis. These things are going to become more and more prevalent and frequent.

Given time, the focus of those involved with Frontline.Live has shifted from immediate delivery and operation to making the platform versatile and robust:

> the first wave was so chaotic that actually we just made it happen. You know it wasn't robust in any, it wasn't replicable but we had a vision that actually we just wanted to make stuff happen. So, we were improving as we are going and so it's only been since we have had time to stop and think that we have actually made the platform really robust enough to be able to be easily replicable.

Making the platform available in other contexts of need, though, brings with it certain challenges:

> one of the things, interesting, I think that we have learnt certainly is the conversations that have been had so far … is trying to get our communications messaging right so that people understand just how adaptable the platform is because I think that they see it in English and they see the forms in their current state with their current items and do not realize just how quick and easy it will be to turn that into an alternative language or to change the items that are listed to be more effective. And I think that has been a bit of a barrier to being more effective to pursue the barrier to rolling it out into other circumstances.

The longer term development of Frontline.Live led, in 2020, to the award of charitable status and partnerships with organizations, such as the Red Cross, to support roll-out in areas of need:

> The Frontline model can be replicated quickly in response to any future shocks with the open source platform, toolkit and digital playbook lives on Github, freely available for anyone to pick up in response to any future pandemic or natural disaster ... what we have got is an open source platform that could be repurposed for any crises anywhere.

The concluding statement on why Frontline.Live is important comes from the platform's webpage (Frontline. Live 2022):

> Centralised systems and traditional procurement frameworks are not agile enough to respond quickly in times of crisis. Makers, innovators and community activists need to be empowered to act at speed when need arises.

> Real time insights from the frontline are too often silenced as bad PR.

> We believe real-time, open data from the frontline is crucial; to ensure systems are robust and, more importantly, so frontline workers and citizens stay safe.

Kiely and Bebbington provided a compelling narrative on the formation of Frontline.Live that demonstrates situated critical thinking (Gallagher 2011, 53), and it is perhaps worth remembering at this point that the relevant criteria for judging the value of a subjective-interpretivist lens are how well it addresses issues of *explicability* and *effectiveness* given alternative stakeholder claims, concerns and issues. Perhaps, though, there is the need for a more critical approach to explore PPE supply and this will be the focus of the next section.

3.9 | Radical-Critical Perspective

In this section, the issue of PPE demand and supply is addressed through a radical-critical lens where the relevant criteria are *equity* and *ethics* in the light of extant power relations.

Adamides, Papachristos, and Pomonis (2012) adopt a critical realist perspective (Bhaskar 1979) to supply chain research. They suggest that knowledge cannot be understood independently of the social actors involved and focus on cultural attributes such as issues of power and control (Faria and Wensley 2002). In addition, the transformative paradigm implies the pursuit of social justice (Mertens 2007) and, to this end, we seek methods to reveal the influence of power and politics about supply chains. Methods appropriate to this include the process of boundary critique, which is often associated with the work of Ulrich (1983) and Midgley (2000). With respect to SCM, boundary critique involves asking questions about whose interests are served by supply chain designs and whether this is appropriate given the espoused aims of the system if reflected on in ethical *ought* mode. Such reflection commonly involves stakeholders in assessing who is involved in and benefits from a particular system design and who ethically ought to be involved and benefit (e.g., Gregory and Ronan 2015; Gregory et al. 2020; Midgley, Munlo, and Brown 1998; Stephens, Taket, and Gagliano 2019; Torres-Cuello, Pinzón-Salcedo, and Midgley 2018). When it comes to the issue of PPE, given concerns regarding confidentiality, we were required to employ boundary critique in a retrospective evaluative mode and to go beyond official accounts of decision-making by harnessing the power of investigative journalism and newspaper reporting. Newspapers 'reflect social and cultural values of a certain place and time and often contain unique information that cannot be found anywhere else' (Tanacković, Krtalić, and Lacović 2014, 2). In addition, it is worth noting that newspapers traditionally reflect political party allegiances and, as the medium through which many people get information about current affairs, they can influence public opinion and perceptions of reality.

In this research, searches of the newspaper database Lexis were conducted for the period 01/01/20–31/12/20. Various search strings were trialled, and the search string 'personal protective equipment' or 'PPE' and 'suppl*' was found to yield the most relevant results across the range of sources. However, the selected search string was found to be problematic in including results relating to the academic degree PPE (politics, philosophy and economics) with some link to 'supp1*', and these results were excluded from the analysis. Two researchers independently carried out a search on the agreed search strings and then compared each other's results leading to a reconciled set of findings (see Table 1).

The findings were analysed across four search groups based on political orientation (Conservative vs. Labour/Liberal) and format (broadsheet and former broadsheet aka the quality press vs. tabloid aka the popular press). The groupings were designed to reveal whether political orientation or format affected the presentation and stance taken on the Government's management of the PPE supply chain, but no significant effect was found although the search did reveal that there were comparatively fewer articles published on the topic in the Conservative broadsheets than those favouring Labour or the Liberals and comparatively more articles on the topic published in Conservative tabloids than those of a less right orientation.

TABLE 1 | Newspaper search summary.

	Conservative	Labour/ Liberal
No. of broadsheet publications[a]	2	1
No. of broadsheet articles	71	79
No. of tabloid publications[a]	3	2
No. of tabloid articles	30	5

[a]Counting daily and Sunday versions, if there is one, as a single publication.

The headlines of the articles revealed by the search were then subjected to a thematic analysis based on Attride-Stirling's (2001, 388) method: 'Thematic networks systematize the extraction of: (i) lowest-order premises evident in the text (Basic Themes); (ii) categories of basic themes grouped together to summarize more abstract principles (Organizing Themes); and (iii) super-ordinate themes encapsulating the principal metaphors in the text as a whole (Global Themes).' Again, two researchers independently coded the data and undertook a thematic analysis, before comparing their findings and reconciling their findings to one set of themes and network analysis (see Figure 2).

It can be seen from Figure 2 that there was considerable concern expressed in the press that those who should have benefitted from the system (NHS staff) were not able to access the PPE that they needed. By mid-April, though, it was widely reported that the Government had received more than 8000 offers from suppliers of PPE and a Department for Health and Social Care spokesperson said 'all offers were prioritised based on volume, price, quality and lead time, with proper due diligence carried out on contracts' (Good Law Project 2020). However, Kate Hills, the founder of Make It British, which promotes brands that manufacture in the United Kingdom, said the Government was ignoring the behind-the-scenes contract manufacturers in favour of household names that play well with the public as well as sourcing from overseas (Davies 2020c). Long-established suppliers of PPE, such as the company Arco, reported that there was a lack of responsiveness to offers of help (Arco 2020). Just weeks after the call to business, it was reported that companies contacting the NHS procurement portal received an automatic response that read: 'The Government are now in a position where they have sufficient contracted supplies to meet demand, and the total volume of offers they have is far greater than any foreseeable future requirement' (Metro 2020).

It also emerged that the award of many contracts had not resulted in a viable product and the need for rigour in the Government procurement process became increasingly evident as reports emerged of manufacturers repackaging as

their own products from another manufacturer of an inferior quality and of used gloves being repackaged as new (Global Trade Review 2020). At the same time, concern was expressed about a lack of transparency that was hiding cronyism and corruption. Given the scale and frequency of such allegations, it is, perhaps, worth referring to Meadow's wise words that 'Purposes are deduced from behaviour, not from rhetoric or stated goals' (Meadows 2008, 14). Although it is hard to deny that the primary purpose of the system was to supply PPE, given the architecture of the system that was set-up, one cannot help but wonder whether secondary purposes of 'a system to divert public resources to affiliates of the Government' came into play. To determine the veracity of such a proposition, it is worth summarily reviewing investigations by the National Audit Office (NAO), the United Kingdom's independent public spending watchdog.

In the period under consideration, the NAO published two relevant reports: Investigation into government procurement during the COVID-19 pandemic (26 November 2020) (NAO 2020b) and The supply of PPE during the COVID-19 pandemic (25 November 2020) (NAO 2020a). The NAO reported that:

1. PPE accounted for 80% of the number of contracts awarded (over 6900 contracts) and 68% of the total value of contracts awarded (£12.3 billion).

2. Although the Department for Health and Social Care established a process to assess and process offers of support, contracts were awarded to 71 suppliers, worth £1.5 billion, before this process was standardized.

3. Leads referred by government officials, ministers' offices, MPs and Lords, senior NHS staff and other health professionals through the high-priority lane were considered more credible or needed to be treated with more urgency. Forty-seven out of 493 suppliers through the high-priority lane obtained contracts compared with 104 out of 14 892 through the ordinary lane. The sources of the referrals to
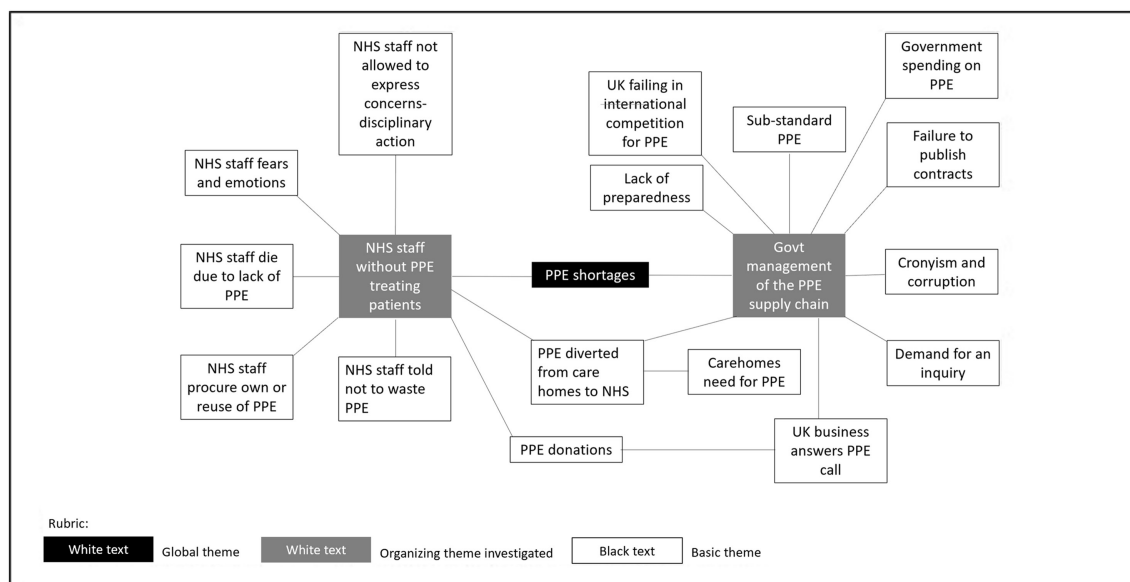

FIGURE 2 | Thematic network analysis of PPE supply newspaper headlines in the period 01/01/20–31/12/20.

the high-priority lane were not always documented in the case management system.

4. In a selected sample of 20 contracts, examples were found of failure to document key decisions, for example, why a particular supplier was chosen or emergency procurement used, and risk, for example, conflicts of interest. It was also found that multimillion-pound contracts were awarded after work had already been carried out and that, in such cases, the risks of underperformance were increased.

5. Guidance recommends that contract information be published within 90 days of award (Crown Commercial Service 2015). Of the 1644 contracts worth more than £25 000 awarded up to the end of July 2020, only 25% were published within the 90-day target.

In mid-December 2020, an inquiry by the Public Accounts Committee of the vUK Parliament held two evidence hearings, one involving representatives of medical and care associations and one involving senior officials at the Cabinet Office and the Department for Health and Social Care. Evidence given on the high-priority lane from The British Medical Association and the Royal College of Nursing stated that these organizations did not have access to the high-priority lane, even though they would have been able to put forward credible leads. The British Medical Association noted that suppliers who had contacted them also tried the normal channels of reaching the Government but had 'hit a brick wall'.

On the basis of its inquiries, the Public Accounts Committee published a report in February 2021, which claimed that (UK Parliament 2021):

> Government faced significant challenges in having to work at pace, using emergency procurement procedures, in a competitive international market. However, its failure to be transparent about decisions, publish contracts in a timely manner or maintain proper records of key decisions left it open to accusations of poor value for money, conflicts of interest and preferential treatment of some suppliers, and undermines public trust in government procurement and the use of taxpayers' money....

Investigation of how PPE contracts were awarded extended to the courts. The Good Law Project and EveryDoctor took legal action over more than £340 m in contracts awarded to PestFix, a firm that supplies pest control products, and a contract worth about £252 m to the hedge fund Ayanda Capital. The campaigners said the Department for Health and Social Care 'prioritised suppliers including PestFix and Ayanda because of who they knew, not what they could deliver'. Mrs Justice O'Farrell ruled that although the use of the high priority lane was unlawful, she found that both of the companies' offers 'justified priority treatment' (BBC 2022). Other political parties to the ruling Conservative Government took a different view:

- Labour's deputy leader Angela Rayner called for an independent investigation to 'get to the bottom of how £3.5bn of taxpayers' cash were handed out in crony contracts and ensure it can never happen again' (BBC 2022).

- Liberal Democrat health spokesperson Daisy Cooper described the ruling as a 'damning judgement' and said: 'Not only did the Conservatives give their mates privileged access to lucrative Covid contracts, they did it unlawfully' (BBC 2022).

The focus of the NAO reports and that of the Public Accounts Committee is largely a functionalist one emphasizing how systems and procedures might be better designed to provide a more resilient supply chain in future with better value for money. However, the notion that the system was badly designed and operated and the need for lessons to be learnt are relevant only if officially espoused declarations of purpose are accepted.

3.10 | Towards Transformative Supply Chain Research and Practice

Each of the different paradigm perspectives offers a significant fragment of insight on responses to the PPE supply problem. In the midst of chaos, the most defendable response was to revert to the dominant objective-positivist logic emphasizing the need for efficacy and efficiency, which was what the Government espoused in its various reports of procurement processes and management of the PPE supply chain during the crisis. The emergent deficiency of the Government's response, though, led to the creation of Frontline.Live, involving a different skills set to traditional SCM, a creative way of thinking and more transparent decision-making. In adopting a different approach to the supply chain norm, there was a necessary focus placed on explicability and effectiveness. The focus on the latter hints at a need for accountability, particularly with respect to the Government's response, but we have seen how the Government appeared to use an objective-positivist logic to pursue a supply chain design that fell short on equity and ethics. Does this matter, though, for the supply chain profession? Given the urgency and the politics surrounding the PPE case, is it a not to be repeated exception to the norm or are there generalizable lessons to be gleaned from it? Certainly, the case may seem extreme but many are forecasting that in our VUCA world, we face a deluge of messy problems necessitating that we learn and do better in future. Being able to compare and contrast the insights offered by the different paradigm perspectives is important to this learning because, as Romm (1998) argues:

> If we feel responsible for the impact of our ways of 'knowing' in the world, we have a duty to consider at least whether, in the social arenas in which we find ourselves, our styles of knowing are becoming unnecessarily restrictive (Romm 1995) ... it is worthwhile (at least) to consider, in arenas deemed appropriate, the possibility of working with the disjunctions and inconsistencies highlighted as different domains of inquiry are juxtaposed.

TABLE 2 | Constitutive rules for a range of generic supply chain approaches.

	Supply chain evaluation and design: Constitutive rules for a generic …		
	Objective-positivist approach	**Subjective-interpretive approach**	**Radical-critical approach**
Uses	Hypothesis testing and quantitative model building to achieve optimisation against functional criteria	Stakeholder engagement and qualitative model construction to surface different perspective of the design of supply chains and associated claims, concerns and issues, and/or challenge a proposition with its deadliest enemy	Boundary critique to assess which stakeholder groups are (not) involved in decision making about supply chains, and systemic and systematic assessment of which stakeholders bear costs and/or take benefits associated with different supply chain designs and arrangements
Involves	• Quantitative models aiming to capture the nature of the situation or optimal supply chain design are constructed, enabling us to gain knowledge of the real world • Models are used to learn how best to improve the supply chain and for the purposes of design • Quantitative analysis can be useful since systems obey laws • The process of intervention is systematic and is aimed at improving goal seeking and viability • Decision-making and implementation of supply chain design is best conducted on the basis of expert knowledge	• Qualitative models are used to structure debate about different possible supply chain designs and arrangements (quantitative analysis may be useful in a subordinate role) • The process of inquiry is systemic and is aimed at exploring purposes, alleviating unease and generating learning • Decision-making and implementation of supply chain design is best conducted on the basis of stakeholder participation	• Qualitative models can be used to support structural analysis of the situation and can reveal who the advantaged and disadvantaged are for different possible supply chain designs and arrangements • The process of inquiry is systemic and is aimed at engaging both the affected and involved in decision-making about supply chain designs in awareness of associated costs and benefits • Quantitative analysis may be useful to capture particular biases in existing supply chain arrangements • The process of intervention is systemic and is aimed at ensuring fairness and is conducted in such a way that those negatively affected begin to understand how they can challenge existing supply chain arrangements and associated decision-making regarding the distribution of costs and benefits and/or be liberated from their affects
Offers	Models to describe or design supply chain architectures which can be optimized against specified quantitative criteria	Different perspectives on supply chain problems resulting in alternative supply chain architectures and responses	Understanding of which stakeholder groups benefits from or bear the cost of different supply chain designs and arrangements
Evaluation criteria	Efficacy and efficiency	Explicability and effectiveness	Equity and ethics

Supply chain professionals, both practitioners and researchers, are responsible for the impact of their way of knowing and should be compelled to look beyond accepted objective-positivist and subjective-interpretivist approaches to entertain possibilities beyond the norm of the supply chain discipline. It is part of the responsibility of the supply chain profession to consider whether its way of seeing issues of concern might be unduly restrictive and limit what are seen as options for action. We have sought to demonstrate in this paper that adopting a broad range of paradigmatic perspectives and working with the juxtaposition and interplay of different vantage points of inquiry can create opportunities for understanding and action that offer the potential for transformational insight and change. This is not merely an academic exercise; it is an immensely practical action.

In operationalizing such a transformative approach, with full respect to the usefulness of the System of Systems Methodologies (SoSM) (Jackson and Keys 1984), we do not follow this lead in proposing a system of supply chain methodologies. As the SoSM has been interpreted in a rather mechanistic way by some, we look to follow Jackson's later writings and to promote a more flexible approach to pluralism. We propose that supply chain managers look to the lessons that have been learnt from systems in approaching complexity and operationalizing pluralism. Here, we propose that inspiration might be drawn from the activities outlined in Jackson's EPIC approach (Jackson 2020, 2021, 2022, 2023, 2024):

- Explore the procurement context as a situation of interest with associated primary and secondary issues

- Produce a strategy to manage supply chain complexity informed by the insights and learning gleaned by viewing the situation and supply chain design options through the lens of the different paradigm perspectives

- Intervene flexibly to operationalize the strategy and associated supply chain design in the light of emergent issues and concerns

- Check on progress by evaluating learning gained about the management of the supply chain through the employment of a variety of evaluation criteria and agree next steps.

Our consideration of supply chain approaches is limited to three contrasting perspectives. In order to honour a commitment to pluralism, we suggest that the production of a strategy should be based on consideration of a range of supply chain approaches, in their most generic form. To support this we follow Jackson (2003), who set out the constitutive rules for a range of systems methodologies with different paradigmatic commitments, by seeking to do similar for the supply chain perspectives that we outline (see Table 2) and hope that this table will be added to in due course.

3.11 | Concluding Reflections

The research presented in this paper seeks to demonstrate the worth of adopting a multiparadigm perspective and also the practical feasibility of this. That is not to deny though that much work is still needed on how supply chain approaches can be developed to work synergistically to provide greater insights on messy supply chain problems. For example, Dula and Grössler (2021) find that, if supply chain members have social preferences, such as fairness concerns, they will experience a reduction in their utilities, which could potentially explain different evaluation of performance. Dula and Grössler provide a basis for looking at supply chain designs as involving radical-critical value-based decisions and the tools to evaluate the effects of such decisions to inform discussion of social preferences regarding fairness concerns about who ought to benefit. In this way, we start to see how supply chain approaches based on the synthesis of different paradigms can be employed to inform inquiry and decision-making about supply chains designs a priori rather than in evaluative-reflective mode as is the case in this research.

Following the pandemic and PPE crisis, a heightened public awareness of procurement practices and SCM is evident. This paper is a response to this interest and Mears-Young and Jackson's (1997) call for an 'epistemological break' with functionalism. Having demonstrated the theoretical and practice possibility of a systems-based multiparadigmatic approach, we conclude by making a call for public interest to be served by educating future generations of supply chain professionals to adopt such an approach and to subject their supply chain designs to difficult questions not only about whether they meet efficacy and efficiency criteria but also about explicability, effectiveness, equity and ethics.

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