

Operational Framework for a Collaborative Digital Supply Chain Centre: A Human-focused Hub in the North of England

Track: Operations, logistics and supply chain management Track

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Introduction: Industry 5.0 can be defined as a paradigm shift in the management of digital industrial transformation to achieve sustainable economic and socio-environmental development (Renda et al., 2022). Characterised by the seamless human-focused collaboration and the integration of artificial intelligence, the Internet of Things, big data analytics and blockchain technologies are poised to revolutionise supply chain management, offering unprecedented opportunities for efficiency, transparency and achieving common societal goals by providing an understanding of complex interactions and processes, facilitating the design of and participation in collective actions (Ghobakhloo et al., 2022). A collaborative, physical, and sector-independent environment can establish a desired architecture of stakeholder roles and value-creating interactions and drive the creation and mobilisation of valuable resources and assets among academia, public, and private organisations in various sectors and supply chains (Autio, 2022). However, there is no consensus on how a collaborative, human-focused, and sector-independent centre for digital supply chain excellence can be developed, managed, and sustained in emerging economies. This ongoing funded PhD project aims to answer the following research question: How can a human-focused and sector-independent centre for digital supply chain excellence be developed, managed, and sustained in emerging economies?

Literature Review: We conducted a systematic literature review adopting the PRISMA guidelines to ensure a transparent, structured and comprehensive approach (Kitchenham, 2004). A total of 60 academic peer-reviewed journal articles and 42 grey literature sources from 2016-2025 were analysed. Several structural frameworks have been used to investigate the opportunities, key failures, and success factors of supply chain collaboration and digitalisation in isolation through the lens of the Technology-Organisation-Environment Theory (Sun et al., 2020; Baabdullah et al., 2021), Dynamic Capability Theory (Zhang et al., 2024; Ricárdez-Estrada et al., 2025), Resource-based View Theory (Sciarelli, et al., 2021) and Socio-technical Interface Theory (Sony et al., 2020). For example, Ricárdez-Estrada et al., (2025) supplier 4.0 integration framework provided valuable insights into governing human-focused technology development clearly outlining strategy, shared common understanding, training and education, continuous digital maturity assessment as enabling mechanisms. The developed frameworks are based on limited quantitative data collected from specific industry experts and supply chain professionals from developing countries from the eastern region. The Technology-Organisation-Environment model and Socio-Technical Inter-Face System theories do not explicitly classify the major factors in the context of emerging economies of the western countries; they must be reevaluated in the context

of developing nations to fit their technological and socio-cultural settings (Mohtaramzadeh et al., 2018). Furthermore, the findings fail to collectively draw upon the barriers, success factors and opportunities within the technology, data, collaboration, legal, academic, and business-market ecosystems which are needed for a forward-looking agenda to address the prevailing environmental, critical socio-economic tensions and achieve operational excellence (Baabdullah et al., 2021). More case studies are needed to capture all the variables of interest especially when it comes to designing the architecture for Industry 5.0 (Sony et al., 2020).

Research Aim, Questions & Objectives: Through the lens of the Technology-Organisation-Environment Theory and Socio Technical Inter-Face System Theory, the aim of the study is to investigate how a sector-independent and human-focused centre for digital supply chain excellence can be developed, managed and sustained in the North of England collectively through the data, technology, collaboration, business-market, legal and academic ecosystems. Hence, the research questions are:

1. What is the current digital supply chain and innovation landscape in the North of England?
2. How can a sector-independent and human-focused digital supply chain centre be a collaborative environment for its purpose?
3. What are the opportunities, key successes, and failure factors, and how will they influence the development, management, and sustainability of the centre?

Objectives focus on the continuous development of the different versions of the conceptual model to provide a practical recommendation framework:

1. Conduct a critical literature review to formulate the first version of the conceptual model organically derived from academic and non-academic literature.
2. Develop the conceptual model through participant observation, observing the internal and external failures, success factors and opportunities of Northumbria University's Centre for Digital Supply Chain Excellence.
3. Re-model the conceptual model, further identifying and categorising key failures, success factors and opportunities through qualitative analysis.
4. Redesign the conceptual model through a focus group to provide a practical recommendation framework for developing, managing and sustaining a sector-independent and human-focused digital supply chain centre in emerging economies.

Methodology: To address the novelty of the research questions and the aim of the study, a pragmatic approach was adopted using a multi-method strategy based on an embedded, singular case study of a newly launched Centre for Digital Supply Chain Excellence attached to a higher education institution in the north of England to provide in-depth insights about the emergence of human-focused and sector-independent digitalisation (Mihai et al., 2022; Cui et al., 2022). Through conducting a critical literature review, the first version of the conceptual model has been developed organically, derived through academic and non-academic literature using databases like Google Scholar, Scopus, Financial Times, GOV.UK, etc.

Participant observation was conducted over a 12-month period, observing the internal and external activities of the Centre for Digital Supply Chain Excellence, including participating in team meetings, observing their events, and many other events and activities relevant to digital supply chains in the North of England. NVivo software was used to conduct a qualitative content analysis.

The themes through observation are presented via the second version of the conceptual model, which will be further developed through individual unit-level semi-structured interviews. Finally, a focus group of experts will be conducted to redesign the conceptual framework; this approach will enable the researcher to gather perspectives from different groups of actors in the centre's digital supply chain ecosystem, i.e., supply chain managers, IT specialists, and academics, and contrast these perspectives to increase validity, reduce bias, and obtain a more nuanced picture from the research results (Kunkel et al., 2022). Likewise, NVivo software will be used to conduct qualitative thematic analysis to provide a practical recommendation framework.

The study aims to utilise a systematic selection of interview partners adopting a purposive sampling technique for both semi-structured interviews and the focus group. Criteria for experts' selection used will be: (1) should hold strategic or academic positions in supply chain management area, or (2) should be aware of the recent advanced technological trends such as blockchain technology, artificial intelligence and big data analytics and (3) should have exposure/work experience in supply chain management. Literature reveals similar sampling techniques and criteria were used in the previous studies of Bag et al., (2020) and Chavalala et al., (2024).

Findings: A systematic literature review methodology was used for the identification, selection, and evaluation of human-focused and sector-independent digitalisation literature addressing a novelty within literature. Notwithstanding, it was found there is a need to investigate the opportunities, key failures, and success factors of a sector-independent and human-focused Centre for Digital Supply Chain Excellence in the North of England collectively through data, technology, collaboration, the business-market, and the legal and academic ecosystems. The first version of the conceptual model was developed by a critical literature review which was further redeveloped through participant observation. Subsequently, key results from the participant observation are discussed.

In this case, a sector-independent and human-focused Centre for Digital Supply Chain Excellence integrating advanced technologies collaboratively throughout supply chain operations can foster operational, environmental and social opportunities. Risk management and better human-driven decision-making as the operational themes, alongside facilitating circular economies and waste management as the environmental-related themes and social inclusivity and public service innovation as the social themes. It is noticeable that regulation and policy, digital maturity, cost, interoperability and financial plausibility are the top failure factors within the technology ecosystem that may impede such environments. Moreover, the top enablers include return on investment, interoperability, training and development, stakeholder collaboration, and external funding.

Moreover, the case highlights cultural suitability, financial and time constraints, stakeholder commitment, trust and intellectual property as the top failure factors to impede the collaboration ecosystem of the centre. Auditing, long-term collaboration, universal key performance metrics, communication and platform integration were found to be the key success factors for the centre to be a physical collaborative environment.

It was identified that the centre, through their academic ecosystem, can inform more effective Industry 5.0 government policies, improve the quality of education and skills, and provide interdisciplinary research opportunities with greater access to industry data. Leadership issues, ownership obstacles, communication, and financial constraints were the key themes of the academic ecosystem failure factors affecting the centre's ability to bring academics to the industry

and foster industrial collaboration. The centre has identified informal and formal contacts, CEO duality, risk analysis, financial auditing, and investors as the primary success factors in facilitating innovation within industrial collaborations.

In terms of the data ecosystem, lack of data ownership, data sharing, and standardisation were identified as the core failure factors to the Centre for Digital Supply Chain Excellence enabling a seamless flow of data, fostering cross-sector collaboration, and enhancing the overall responsiveness and adaptability of supply chains. Key enablers were identified, including robust privacy governance, proactive analytics, comprehensive auditing processes, access control and ammonizing data. Liabilities, consent management, intellectual property rights, and the comprehensive regulation and policy were identified as significant legal ecosystem barriers to the effective development of the human-focused and sector-independent digital supply chain ecosystem. Key enablers emerged, including third-party authentication, the establishment data standardisation frameworks and professional support. This will reduce transaction and governance costs in the centre's supply chain relationships and promote more efficient, transparent, and inclusive supply chains.

The case helps make claims that the centre's business-market ecosystem is crucial for the centre to license their innovative technologies and increase the scalability of human-centric designs. Failure factors to the centre's commercialisation of its technology and market entry include insufficient supply and demand for the centre's services, inadequate market research, limited data sharing, lack of knowledge, and pricing limitations. Key success factors highlighted were marketing strategy, flagships and testbeds, the online presentation of successful case study examples, and the diversification of income streams and product offerings to ensure the Centre's value proposition resonates with business needs and they gain a centrality positioning in the UK's digital supply chain ecosystem.

Potential Contributions: Tangible sustainable benefits could be attained by incorporating the principles of the Technology-Organisational-Environmental and Socio-Technical Inter-Face Systems Theory while designing the integration architecture. Most of the existing design architecture for human collaboration and digital integration considers techno-economical aspects of design. However, for an open system such as Industry 5.0, to be successful there should be equal consideration of socio-technical perspectives. As far as the authors know, this is the first study that combines the human, social, and technological ecosystems into a new field, linking the Technology-Organisational-Environment Theory and the Social Technical Inter-Face System Theory in context to an emerging economy. The academicians and professionals will benefit from this study as it provides a different perspective from existing literature.

It will aid the UK government and local authorities in their digital levelling-up initiatives, contributing to the government's supply chain strategies. The insights gained from this research and the proposed framework may assist managers and decision-makers in taking more realistic actions toward the adoption of human-focused I5.0 initiatives. This pioneering study will detect guidelines to inspire senior managers to guide organisations and improve their understanding of the ways in which collaboration with a human-focused and sector-independent Centre for Digital Supply Chain Excellence can be strengthened to enhance democracy in access to technology and assist the next industrial resolution. Additionally, the framework developed for one centre in a higher education institution can be generalised to other digital supply chain centres, whether they are dependent on or independent of the higher education sector.

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