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Downstream Product Innovation and Upstream Supply Chain Implications

The focus of this special issue builds on the previous work of Wilding and Wagner (2019) and seeks to advance knowledge with respect to understanding how radical shifts in downstream product innovation are influencing supply chain configurations (Birkel and Hartmann, 2019). Radical shifts in product/service concepts are occurring through disruptive technological trends (robots, internet of things, 3D and 4D printing, self-driving systems, artificial intelligence, bio and neurotech and virtual/augmented reality). Furthermore, in advanced manufacturing products such as cars, pharmaceutical products, telecommunications, computing, medical devices, energy, buildings, drones and robotics, a combination of “digital technology”, “sustainability blueprints” and “multi-partner” innovation is leading to a profound re-thinking of both product/service architectures and their supporting supply chains (Sogaard et al., 2019).

Whilst previous work has focused on product innovation, there has been a failure to address the implications of innovation changes on supply chain boundaries (Caputo et al., 2019). Through the reconfiguration this is bringing to entire product supply ecosystems (Adner, 2017; Jacobides et al., 2018). Horizontal boundaries and eco-systems, according to Santos and Eisenhardt (2005) are defined by both the scope of product/markets served and increasingly through negotiation between the firm and public organizations and end users. Whilst, vertical boundaries are defined by the scope of activities undertaken by each agent, involved in supplying the product and services in the industry value chain. The main point is that these boundaries are becoming more porous and expansive as more stakeholders are directly and indirectly shaping product development. Not just suppliers but also consumers, state and regulatory agencies, pressure groups and environmentalists. As well as regulatory pressures there is an enabling effect to be played by the state in supporting innovation service hubs, providing anchor innovation institutions, human resources and skills, cyber-physical infrastructure (i.e., 5G). With complex product innovation fragmentation this opens up opportunities for entrepreneurial capital and the next wave of innovators and start-ups.

As well as economic pressure to innovate firms are now having external triggers to meet sustainability and low carbon targets. Initiatives such as smart and resilient cities, green infrastructural corridors and clean air policies are leading to new conceptions of value, a long run value in use as well as the market exchange measures of value usually associated with measuring the impact of an innovation. For instance, the pressure to replace all internal combustion engines with electric vehicles, by as early as 2030 in some advanced economies such as Norway (Kley et al., 2011). Furthermore, such objectives require a fundamental re-thinking of supply chains as they provide the vital arteries supplying cities with urban logistics (i.e., human and freight mobility) as well as the goods and services needed to function.

Figure 1 presents a multi-stakeholder framework bridging the role of public and private agency and their influence on product innovation and its upstream implications in the supply chain. Moreover, this framework links together many of the themes and sub-themes emerging from the articles appearing in the special issue. Such simultaneous cooperation and competition between firms and state agents is common practice not only in the automotive industry (Ritala, 2012). For instance, we also see it in the supply chain of medical devices, pharmaceuticals, aerospace, the cyber-physical infrastructure such as 5G in the form of multi-partner initiatives (MPI's).

In terms of paper submissions, we had 21 papers submitted and had 10 papers accepted for our special issue. The main reason for rejection was that the papers were wrongly positioned and did not fit our supply chain specification, or that they deployed OR methods and relied too much on the mathematics and simulations, without anything empirical or convincing enough on the operational and supply chain aspects. Basically, their relevance to the SI or the journal was not there.

The papers are organized by their methodological approach. Firstly, we have the statistical and numerical papers. Paper 1. is focused on the following question: *Does supplier involvement enhance financial performance? The encapsulation effects of product modularity and smartness.* The underlying purpose of their study is to explore the relationship between supplier involvement and business performance.. Furthermore, this study includes product modularity and smartness as moderators to clarify the boundary conditions. The primary source of data was a survey of 136 high technology companies.

Paper 2. provides a novel *Eco-innovation analysis of OECD countries with common weight analysis in data envelopment analysis.* The focus of their work is on the harmful environmental impacts of manufacturing processes along with the scarcity of resources that convince firms and countries to more closely attend to their sustainable development issues. To measure the productivity of eco-innovative practices and programs in OECD countries, they proposed a novel common set of weights DEA model. This approach allowed decision-makers to evaluate all OECD countries on a consistent and fair basis to uncover their strengths and weaknesses. This study statistically evaluates the eco-innovation efficiency of the Economic Co-operation and Development (OECD) countries and track their changes with MPI during 2010-2018.

Paper 3. explores *The application of digital twin technology in operations and supply chain management: A bibliometric review.* This is the first study that employs bibliometric and network analysis on the research stream of the concept of the digital twin in operations and supply chain management to capture evolutionary trends, literature communities and future research proposals.

Secondly, we have the interview, case study and qualitative papers. Paper 4. *Characteristics of supplier performance measurement systems in collaborative innovation projects: the role of the purchasing*

department emphasises that in the wake of the growing popularity of the Open Innovation approach, leveraging suppliers as external sources of innovation has attracted increasing interest from scholars and practitioners. As limited attention has been paid to the role that performance measurement plays in this process. Their paper aims to fill this gap, by illustrating how companies measure the performance of the suppliers that they involve in their innovation projects, and what role the purchasing department plays in a more effective design. They have interviewed project stakeholders from nine different organizations acting as focal companies in the supply chains of various industries. We complement this on-field information with a vast amount of data collected from secondary project documents.

Paper 5. is entitled *E-Mobility Ecosystem Innovation – Impact on Downstream Supply Chain Management Processes. Is India Ready for Inevitable Change in Auto Sector?* advances our knowledge and understanding of the specific reasons why developed countries could easily start implementing innovative alternative fuel vehicles (e.g., Electric Vehicles or EVs). Whilst to many scholars the EV revolution in developing countries looks so far-fetched to be achieved, with respect to infrastructure and downstream activities, Serohi suggests the steps that can be taken to effectively address these issues. They provide a case study focused on Tesla in India.

The focus of Paper 6. is *Eco-innovation in the Upstream Supply Chain: Re-thinking the Involvement of Purchasing Managers*. Their study aims to explore and understand what fosters the participation of purchasing departments and identify the drivers and difficulties encountered during the development of eco-innovation within firms. The authors adopt a qualitative methodology that provides tools to study complex phenomena. In-depth interviews with highly knowledgeable respondents from multisectoral organisations were completed to enable the authors to explore the eco-innovation process within firms.

In Paper 7. *Investigating Barriers to Demand-driven SME Collaboration in Low-volume High-variability Manufacturing* an exploratory study of seventeen suppliers within the European Union aerospace industry. The readers of the paper will learn about the barriers which impede demand-driven SME collaboration within manufacturing supply chains, interrelationships between these barriers and suggestions about how to remove them. Whilst SME cluster managers will find managerial implications particularly interesting as they help them to overcome collaboration concerns and better prepare their members for Industry 4.0. The main source of data is 17 in-depth interviews with senior executives in the aerospace industry.

Thirdly, we have the mixed methods approach which is growing more popular in the supply chain discipline. In Paper 8. *Digital Project Driven Supply Chains: A New Paradigm* the authors explored the potential of the use of 4IR (4th Industrial Revolution) technologies in the Architectural, Engineering, Construction and Operation and Maintenance (AECO) value chain, more particularly their use in evolving digital project driven supply chains. It was concluded that these technologies can completely revolutionise AECO supply chains, and catapult the discipline into a completely new paradigm.

In Paper 9. *How frugal innovation shape global sustainable supply chains during the pandemic crisis: Lessons from the COVID-19* the authors provide a detailed overview of the drivers of the frugal oriented sustainable global supply chain. A focused group approach was used to identify the drivers and this was further validated them using existing literature published in international peer-reviewed journals and reports. They then adopted total interpretive structural modelling (TISM) to analyse the complex relationships among identified drivers.

Paper 10. looks at: *Episodic supply chains at times of disruption*. The paper introduces and explains the idea of temporal supply chains, specifically linking the idea to the introduction of metal additive manufacturing. The idea of temporal supply chains points to indirect links among supply-chain parties and conflicts based on how firms undertake similar supply chain activities, rather than align in the supply chain. Oberg combined interviews and secondary data, along with seminars attracting approximately 600 individuals operating in metal additive manufacturing, which forms the empirical basis for the paper.

In summary, we have had a healthy and diverse range of submissions to this agenda breaking special issue of SCM:IJ. As always we appreciate the excellent support and wise counsel of Prof. Wagner in taking this initiative through its full life-cycle from conception to final issue completion.

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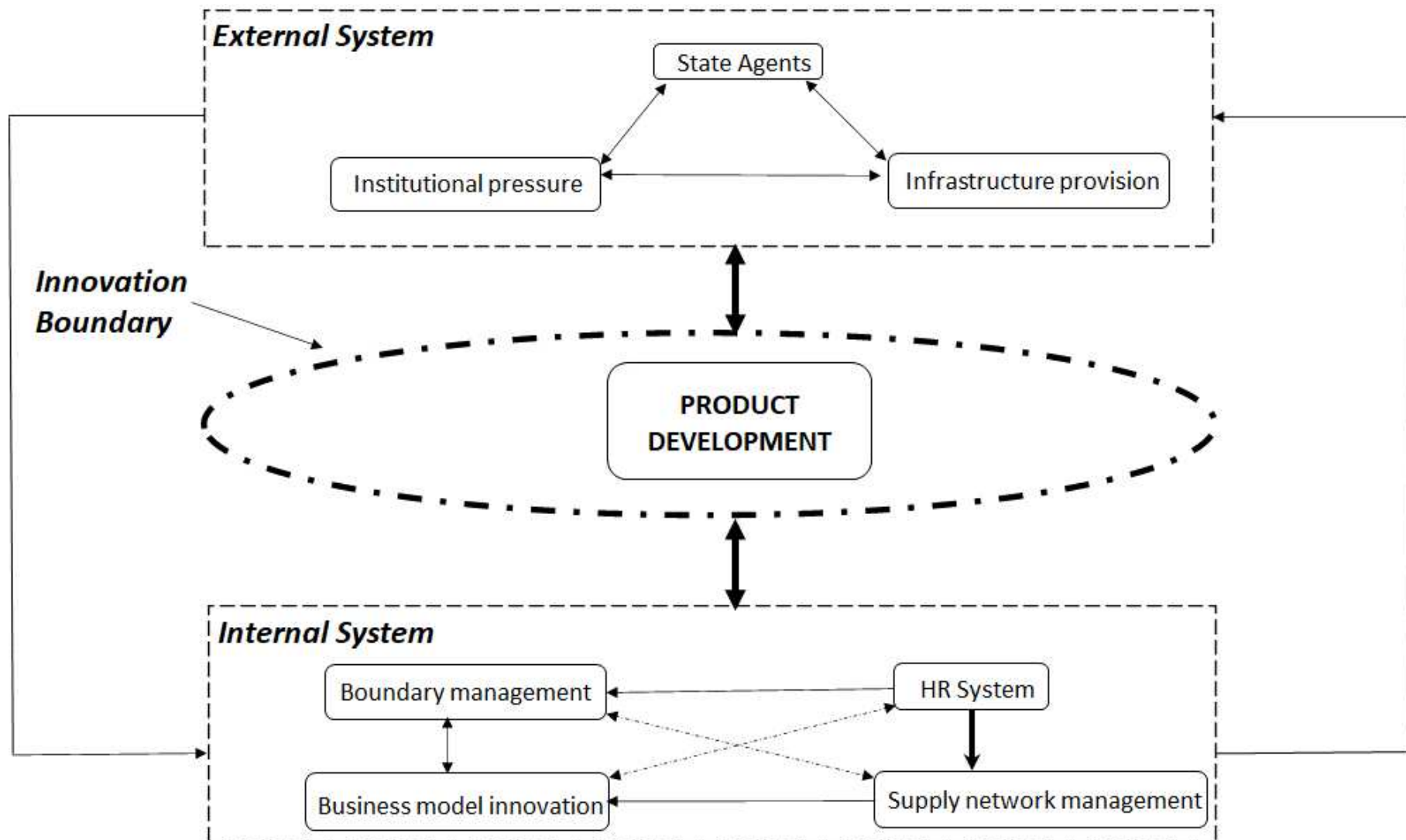


Figure 1: Stakeholder Product Innovation-Supply Chain framework