

# RESEARCH IN LOGISTICS AND SUPPLY CHAIN MANAGEMENT IN AN ERA OF DIGITAL TECHNOLOGY: A FORECASTING STUDY

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## **Introduction**

There has been considerable development in literature on logistics and supply chain management (L/SCM) (Sachan and Datta, 2005; Christopher, 2016). Supply chain management (SCM) can be defined as an integrative activity linking key tasks and processes to various levels to form a coherent, high-performance business model that takes into account the strategic dimension of process-integration designed to satisfy customers (Roussat and Fabbe-Costes, 2008). According to Charvet et al (2008), who carried out bibliometric research on the subject, SCM is studied in a cross-disciplinary way. It is distinct from logistics insofar as the latter is “the technology of mastering flows of goods and materials that a firm sends its customers, transfers between or within its production units, and receives from its suppliers.” (Fulconis and Paché, 2011, p. 172).

SCM and logistics take into consideration issues in oversight and optimisation of flows and stock, coordination of stakeholders within a chain, incorporation of these players, decision-making, the governance and structuring of multi-stakeholder chains, and sustainable development (Sachan and Datta, 2005; Charvet et al, 2008; Georgi et al, 2013). Considered key factors in firms' competitiveness (Porter, 1980; Christopher, 2016), the fields of L/SCM have been the focus of reflection in innovation in digital technology for several years (Kim, 2000). Nevertheless, it is difficult to determine which direction innovations should take to support the workings of L/SCM, especially in an era of digital technology when innovative solutions develop rapidly and the economic climate requires market players to weigh up opportunities to invest in one digital innovation or another (Clausen et al, 2016).

To begin with, a review of published writings underlines a wide range of digital innovations that could support L/SCM in relation to digital development. Yet the vagueness of this proliferation of innovation in digital technology highlights the need for a forecasting study that could improve understanding of L/SCM issues regarding digital innovation. The question that our research puts forward is as follows: What challenges can we imagine in tomorrow's logistics and supply chain management in the light of innovation in digital technology? To answer this question, we used an original forecasting method. The procedure was divided into four rounds. Its results and related discussions are presented in this paper.

## **Innovation in logistics and supply chain management**

For several decades, interest in logistics and supply chain management (L/SCM) as fields of research has grown prolifically (Sachan and Datta, 2005; Charvet et al, 2008; Georgi et al, 2013). Alongside it there have been reflections on external conditions that affect firms and prompt them to become more agile to meet different customer requirements (Georgi, 2013). In a highly competitive, globalised world, innovation is a means by which firms adjust to changes in their environment (D'Aveni, 2010; Hitt et al, 2012). Innovation refers to new products, procedures or systems that change markets or create new ones. The drive to innovate is not new, but gaps between theory and practice have been observed: “Today, logistics sees itself as a dynamic procedure of just-in-time production. But in practice it manages immobility: parcels waiting to be collected in warehouses” (Ballot, 2016). Against this backdrop, the diversity of digital innovations creates research opportunities. Blockchains, the internet of things, artificial intelligence and so forth support the development of tomorrow's L/SCM (Hazen et al, 2014; Wang et al, 2016) but also tend to bring about obscurity for researchers and firms: What direction should be taken? What challenges underpin tomorrow's L/SCM? Moreover, it is difficult to discuss what a firm seeks to achieve strategically without knowing what it could accomplish objectively, given its capabilities and environment. We share the idea according to which a strategic vision can only be

decided upon in the light of a panorama of possibilities (Ansoff, 1965; Gozé-Bardin, 2008; Seraidarian, 2008). So while innovation can set a firm apart from its competitors and keep it competitive, it can only be effective and differentiating through foresight and openness regarding the future possibilities that interest a firm the most. This approach based on forecasting and openness requires an overview of current possibilities: a starting point from which speculation on the future becomes possible (Roussat and Fabbe-Costes, 2008; Gozé-Bardin, 2008).

### **Forecasting Approaches**

Gaston Berger coined the term *prospective*, meaning forecasting, to refer to approaches through which possible future scenarios can be identified. Forecasting aims to discern future challenges in an exploratory way. There are several forecasting methods in management studies: the Delphi method, the Prodin method and profession-forecasting (*prospective métier*) (Scouarnec, 2008). Since the profession-forecasting method generally focuses on a particular line of work, we used the Delphi and Prodin methods in this study.

The Delphi method is “a method of enquiry that [...] seeks to reach a consensus by asking questions individually to members of a group, using a series of questionnaires that incorporates the members’ opinions gradually and summatively. [...] Through this repetitive procedure, each group member can reassess their own opinion in the light of other group members’ opinions, but without feeling pressured to do so” (Rousseau, 1996, p. 28). The method assesses experts’ intuition and knowledge (Oble, 1992) in order to “know the future” (Rousseau, 1996) by picking out and ranking priorities or factors discerned, by casting light upon any areas of uncertainty, by clarifying cutting-edge trends, by discussing theoretical change in a given environment and by weighing up chances of risk (Rousseau, 1996; Schmidt et al, 2001). Inspired by the Vatican method, it aims for a consensus in the face of divergence among expert opinions through three general principles: anonymity, feedback and data extraction (Oble, 1992). The approach is mainly applied through successive questionnaires in a repetitive procedure that includes questions that are generally open-ended in an initial phase, then, in a second phase, closed questions based on quantitative measurement scales (such as a Likert scale). It requires considerable time and effort, generally spread over several months, so can be considered “the precise opposite of an expeditious method” (Rousseau, 1996, p.42). Given how onerous this empirical procedure can become, the mini-Delphi method emerged as a way to reduce the number of repetitions. Devised in the 1970s, it abolishes the partitioning of experts and puts forward anonymous voting with live vote-counting alongside the entire panel in the same location and with short-lasting debates between participants, especially in regard to extreme positions (Oble, 1992). In the same perspective aiming for group dialogue, the Delphi method with Régnier’s Abacus takes into account a focus group, this time incorporating a qualitative dimension in the voting process, where qualitative scales (generally a coloured scale of attitude with a midpoint) are used instead of quantitative scales (Oble, 1992). These two variations of the Delphi method tend to incorporate dialogue between experts in a repetitive process (Oble, 1992), partly in line with another forecasting method: the Prodin method. The Prodin method is a highly interesting approach but remains little-examined in published writings. It is a dynamic forecasting method focussing on the analysis of change. Bergadaà and Coraux (2008) uses it to identify the skills that sellers may need in coming years, or a concept (management of risk perceived by consumers in purchasing situations), in the light of a customer-salesperson-manager dialectic (Bergadaà and Coraux, 2008). In relation to the traditional Delphi method, there are three especially interesting points in this approach that can be underlined: first, the use of separate focus groups; second, the benefit of using different groups according to forecasting stages; and third, impetus for sharing the results with a readership of researchers (science conferences) and practitioners (report for firms).

Whatever the forecasting method used, a panel of experts should be put together. This panel should be made up of competent participants specialising in the emerging topic to get closer to the truth of the matter. The panel should be composed of a diverse range of experts bringing a wealth of viewpoints and distinctive contributions (Rousseau, 1996). Each of these methods offer different advantages but a combination of them all that keeps the strengths of each one could bring further benefits. Such a methodology would be original. It would therefore be both relevant and inventive to

apply this methodology to tomorrow's L/SCM: a forecasting method that combines several tried-and-tested procedures.

### Methodology

To respond to the research issues, an exploratory approach can be adopted, for which our forecasting method should prove relevant. Through discussions with recognised experts, our forecasting study can identify issues and scenarios that are currently unknown. This applies to tomorrow's L/SCM: the field needs to clearly identify developments likely to affect its stakeholders so it can better adjust to future challenges. To begin with, we reviewed published writings concerning innovation and the future of L/SCM to carry out the forecasting study. Focussing on academic and professional journals, our review brought 350 articles together. We identified nine main topics, which together made up a panorama of current reflections on the future<sup>1</sup>.

This initial work formed the starting point for carrying out our forecasting study. After acquiring a database of logistics stakeholders held by institutional organisations, a committee was put together to select, from this list, 128 L/SCM experts (researchers and practitioners) potentially interested in tomorrow's logistics. Through a questionnaire of open-ended questions, these experts are asked about nine topics identified in the review of published writings. The following chart (**Figure 1**), based on four phases, or rounds, summarises the method used.

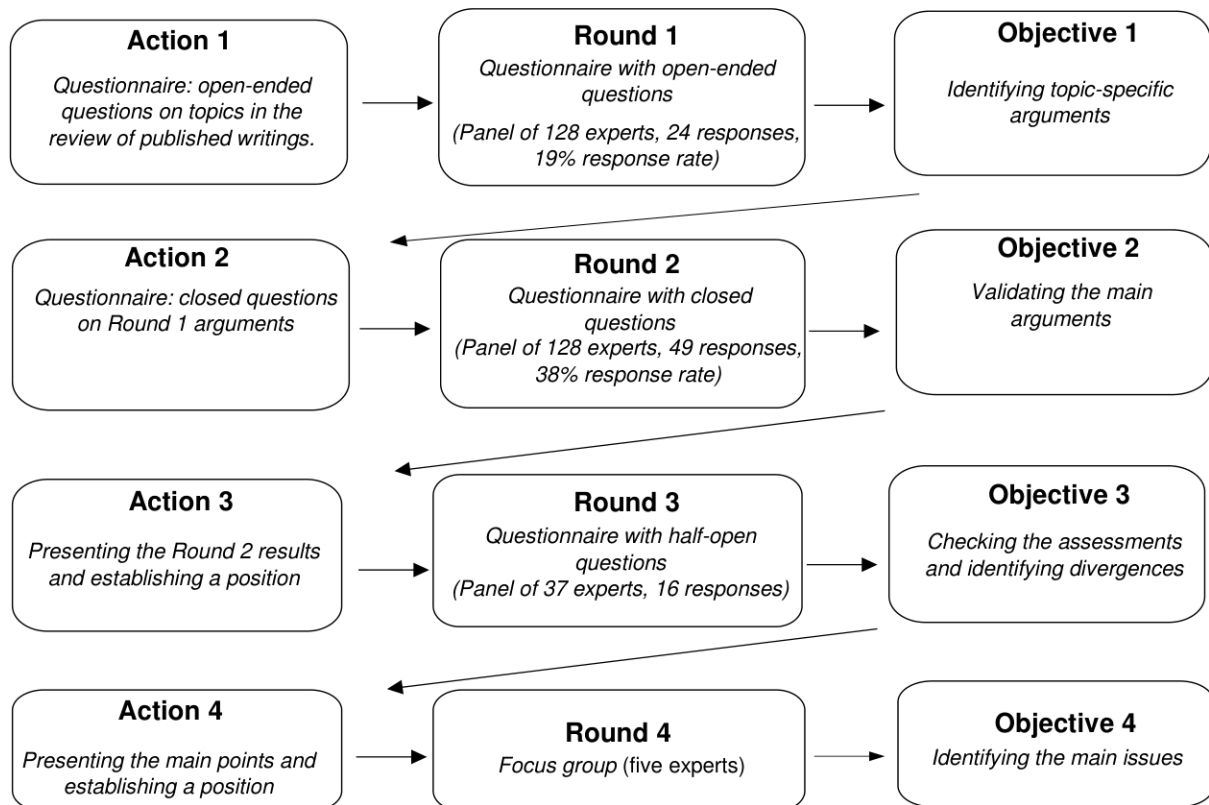


Figure 1. Chart summarising the forecasting method used.

The first round, a qualitative enquiry, is the longest. With this initial phase, a panorama of arguments required for drawing up a closed-question questionnaire<sup>2</sup> (Round 2) can be pieced together. This is

<sup>1</sup> 241 articles and reports from professional journals and publications by official bodies, appearing between 2015 and 2017, and 103 articles from academic papers, published between 2012 and 2017, were brought together, with research time having been considered longer than the monitoring of professional journals. The key words used were as follows: (logist\* OR supply chain\*) AND (futur\* OR à venir OR demain OR 4.0 OR innov\*), with their English-language equivalents for searches in professional journals.

<sup>2</sup> The questionnaire of closed questions is based on Round 1. It is made up of three blocks: the importance of tools (Block 1) and procedures (Block 2) in tomorrow's logistics, and a measure of agreement with a series of statements

followed by the sharing of feedback, a phase in which the respondents can confirm or revise their assessments, especially in the event of divergence of opinion among the respondents (Round 3). The main issues can then be identified, particularly if they bring about polarity in regard to which the experts will establish a position (Round 4).

### **Results and Discussions**

Following Phase 1, an analysis of the questionnaires, retranscribed in NVivo 11 (24 open-question questionnaires received from 17 practitioner-experts and seven researcher-experts) was used to identify a list of arguments, transformed into subject matters in a closed-question questionnaire for Round 2 of the forecasting method. This was distributed to the 128 members on the panel, with 49 responses received, and was followed by feedback shared to let the respondents revise, if need be, their assessments (16 responses received) in light of the group's median. Some divergences stood out. These were the subject of discussions in a focus group in Round 4, which brought together four experts (two researchers and two practitioners) in order to explore the points that brought about polarity over the two previous rounds. An overview of the entire procedure is displayed in the table below. This table identifies a number of issues relating to tomorrow's L/SCM from a perspective of three paradoxes, which can each be divided into two poles, of which the level of significance depends on the situation observed in each criterion in these paradoxes.

	<b>Pole A</b>	<b>Pole B</b>
<b>Paradox of human-machine COOPETITION</b>	<b><i>Pressured coopetition</i></b> Degree of crobotisation Degree of training Degree of specialisation of human/robot tasks Speed of innovation	<b><i>Balanced coopetition</i></b>
<b>Paradox of stakeholder GOVERNANCE</b>	<b><i>Brutal transformation without stakeholder involvement</i></b> Governmental vision Social vision* Chain vision Managers vision	<b><i>Light transformation with stakeholder involvement</i></b>
<b>Paradox of SYSTEMS in making operational logistics</b>	<b><i>Conventional method by Complexification of L/SCM incremental adaptation</i></b> Degree of strategisation (supplychainisation) Degree of personalisation (persondardisation) Degree of growth of performance criteria Degree of integration Degree of flexibility	

Table 1. Main issues in L/SCM from a perspective of paradoxes

The first paradox is a collaborative paradox concerning human-machine relations. The study highlights a form of coopetition (Bengtsson and Kock, 2000) between humans and machines in L/SCM. The verbatim responses that were analysed show that this paradox can be divided into several criteria: degree of crobotisation, which refers to the level of integration of robots and cobots in firms; degree of training, which refers to humans' capacity to work alongside machines (early adapters, acceptability, skills, etc.); degree of specialisation of tasks, which refers to the question of whether humans and cobots are performing similar or complementary tasks; and speed of innovation, which refers to firms' tendency to look for technological innovation. Based on these criteria, the level of conflict between

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on subjects identified following Round 1 (Block 3). Each block is made up of a range of subject matters on which the respondents give an opinion on a scale of 1 to 7.

humans and machines depends on whether this relationship focusses more on cooperation or competition. In the published writings, coopeitition refers to inter-personal or inter-organisational relations (Leroy and Yami, 2007), but human-machine coopeitition is not addressed. The study shows that human-machine coopeitition is an especially relevant topic as relationships with machines are set to develop in our era of digital technology. 'There will necessarily be both distrust in human-machine relations, or, rather, in humans' attitude to machines, and a need to work together, depending on a firm's corporate culture,' said one respondent. The following verbatim response illustrates the complementarity of human-machine relations, where cooperation is promoted: *'Humans will be more respected if they do more respectable work and if they cannot be replaced by robots: if their role can only be for them!'* Respondents were generally unanimous regarding the presence of humans and machines in tomorrow's L/SCM. Humans will always have a role to play. *'We've always tried to eliminate humans on the pretext that they're too expensive and prone to error and so forth, but it's a good job they're here to resolve problems daily, make decisions and be creative!'* One respondent said: 'In logistics, people have always been both a problem and a solution'. Are machines the subject of such speculations?

The second paradox concerns governance. Governance is set to develop in the coordination of firms in L/SCM as part of a desire to take into account all stakeholders concerned (Freeman and Reed, 1983) and will relate to the speed at which values in L/SCM are transformed. This paradox represents *in fine* the level of education of stakeholders in tomorrow's L/SCM. With many cooperating stakeholders, it is easier to apply L/SCM but relational issues are added to governance. Fewer, partitioned stakeholders make it easier for the workings of governance to run smoothly but make it more difficult for L/SCM to be integrated. The analysis shows that an increase in sources of governance creates ambiguity in the daily application of L/SCM: if everyone is managing it, who is at the helm? 'Everyone talks about ecosystems but we don't really know what it refers to. Yet we know it will be taken into consideration in the future,' said a respondent. In the respondents' view, the intensity of the paradox seems to go hand in hand with: the governmental vision in the organisation's environment; the social vision conveyed by customers, consumers and associations; the vision of the chain (ethics regarding suppliers, etc.); and the vision of the directors themselves, which is critical. One respondent said: *'The answer lies in directors' code of practice, not in customers' expectations. In my view, the director, or the governing body, is fully responsible for the limits a firm sets itself in meeting a customer's request.'* These issues are likely to form part of a behaviourist approach to tomorrow's L/SCM, which observes the behaviour of a group seeking consensus in addition to decisions made by senior management, allowing the entire ecosystem to operate through leeway enjoyed by different stakeholders other than managers (Cyert and March, 1963).

Lastly, and in relation to the previous paradox, complexification in L/SCM at different levels makes up the third paradox identified, which is systemic. Indeed, models oriented towards greater integration (of stakeholders, data, etc.), more performance indicators (increase in criteria), a vision of supply chains that is 'supplychainist' ('supplychainisation' being a degree of strategisation that potentially shifts logistics towards supply chain management) and personalised ('persondardisation' being a method whereby specific logistics is plugged into standardised logistics), as well as the desired degree of flexibility between lean management and agility, make up the criteria related to this paradox. Yet this complexification should differ according to context, shifting trends in one way or another. Regarding the modularity of specific and comprehensive logistics chains, respondents said: 'There'll be several levels of logistics: one rooted locally, up to the last kilometre, and specialised; and one plugged into international trends', and 'international standards and norms will apply to a national scale like a best practice. *There's the case of GS1, which has slightly different beginnings, but it will be like GS1 on a much larger scale, with standardised, exemplary norms.*' The debate on supplychainisation did not reach a conclusion, while the respondents were also hesitant to confuse logistics and supply chain management in a form of Larson's re-labelling (2007). The complexification of L/SCM will be more or less radical. For some, 'it is often complementary rather than a full shift in model. *Take RFID for example: this solution was supposed to revolutionise logistics 15 years ago, but today it still hasn't done so.* In terms of lean management, logistics remains a 'muda' (uselessness) in the deep sense, even if we add a form of service', while another respondent said, 'we will adapt ... and change in accordance with systemic changes, which will break from the models we've known'. This systemic vision is a continuation

of the writings of Wren (1967), Lemoigne (1977) and Lobre-Lebraty (2015). As part of L/SCM, the issue of complexification in making L/SCM operational reflects a deeper interconnection of interfaces in play, requiring subsystems that are autonomous yet interdependent to cooperate to reach common objectives. Lastly, through the paradoxes (Lewis, 2000), several theoretical approaches can mix in tomorrow's L/SCM, from the cooperative vision in strategic management to a systemic vision of L/SCM, which reveals interfaces to manage, and a behaviourist approach to governance.

## **Conclusion**

The research offers a forecasting study on how digital innovations affect issues in logistics and supply chain management. It uses an original methodology combining the Delphi method and the strengths of the Prodin method and underlines three 'paradoxes' to take into consideration in understanding tomorrow's L/SCM in light of theoretical issues: the paradox of human-machine cooperation in a collaborative vision of strategic management; the paradox of stakeholder governance in a more behaviourist approach to collective conduct; and a systemic paradox that highlights the complexification of making L/SCM operational. These are the directions that future research could follow regarding the role played by digital technology in L/SCM. In terms of management, the research carried out identifies the nodal points that are likely to cause divides in L/SCM in our digital era. By understanding these divides, stakeholders can be placed in one dynamic or another in L/SCM and, in this way, it can be easier to find solutions to any difficulties encountered.

Nevertheless, the research has limits. First, although the preliminary review of published writings identifying nine main topics to explore sought to include the concerns of practitioners according to professional journals, it led to less importance being accorded to current theoretical issues in L/SCM. Moreover, the list of experts, who were chosen carefully, remains relatively restrictive and cannot guarantee complete independence of expert knowledge on such a specialist topic. Four experts took part in the focus group, which would have benefited from support from a complementary focus group. Lastly, although the rate of feedback is interesting, each round inexorably loses a certain number of respondents, who, despite being interested in the approach, are more inclined to support research by taking part in questionnaires with closed questions rather than questionnaires with open-ended questions, notably due to their limited availability. To minimise risk, the researcher carrying out a forecasting study should use a low number of repetitions and preferably closed-question questionnaires from Round 2. In the case of focus groups, the starting panel should be as large as possible, and the presence of a nucleus of respondents for the focus group should be ensured from the outset. As part of this, exchange platforms offer the advantage of giving respondents anonymity and prevents them from having to take trips that are expensive or impractical.

Currently, the main themes of the research agenda have been put forward, putting research in the shadow of the paradoxes to manage. There are many perspectives and a non-exhaustive list of them could not be drawn up. As regards paradoxes, are we heading towards more paradoxes to manage as the environment becomes more oriented towards digital technology? Or towards a refocus on certain criteria associated with these paradoxes? Furthermore, while cooperation was studied from an inter-personal and inter-organisational point of view, how can human-machine cooperation be categorised given the different nature of the aspects concerned? Should not certain approaches to strategic management be adjusted to this version of cooperation? Or do we find the same features of conventional research in cooperation? To what extent can theoretical approaches in IT systems provide food for thought on an interdisciplinary approach? Regarding the governmental paradox, what are the visions that will prevail in governmental choices, according to the contexts of each system? Depending on the country, a sector's culture and so forth, a certain form of governance could be considered more appropriate to oversee tomorrow's L/SCM. Concerning the systemic paradox, it would be interesting to study the conditions required for producing poles (supplychainisation, persondardisation, etc.). Lastly, if digital technology in tomorrow's L/SCM means a shift towards reflections on interface management, what would be the most relevant interfaces to use in each form of paradox identified? Likewise, it would be interesting to make each criterion associated with the three paradoxes operational in order to

determine the conditions leading to one pole or another in the paradox, as well as the interest of remaining in a pole or seeking to reach another one according to the system's conditions.

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