A new taxonomy of fourth-party logistics: a lexicometric-based classification

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Abstract

Purpose – This paper aims to elaborate on current research on fourth party logistics "4PL" by offering a taxonomy that provides a deeper understanding of 4PL service offerings, thus drawing clear frontiers between existing 4PL business models.

Design/methodology/approach – The authors collected data using semi-structured interviews conducted with 60 logistics executives working in 44 "4PL" providers located in France. Using automatic analysis of textual data, the authors combined spatial visualisation, clustering analysis and hierarchical descending classification to generate the taxonomy.

Findings – Two key dimensions emerged, allowing the authors to clearly identify and distinguish four 4PL business models: the level of reliance on interpersonal relationships and the level of involvement in 4PL service offering. As a result, 4PL providers fall under one of the following business models in the taxonomy: (1) The Metronome, (2) The Architect, (3) The Nostalgic and (4) The Minimalist.

Research limitations/implications – The study focuses on investigating 4PL providers located in France; thus, future studies should explore the classification of 4PL business models across different cultural contexts and social structures.

Practical implications – The findings offer valuable managerial insights for logistics executives and clients of 4PL to better orient their needs, the negotiations and the contracting process with 4PLs.

Originality/value – Using a Lexicometric analysis, the authors develop taxonomy of 4PL service providers based on empirical evidence from logistics executives; the work addresses the existing confusion regarding the conceptualisation of 4PL firms with other types of logistical providers and the role of in/formal interpersonal relationships in the logistical intermediation.

Keywords Fourth-party logistics providers, Taxonomy, Interpersonal relationships, Inductive reasoning, Automatic analysis of textual data

Paper type Research paper

Introduction

The complexity of today's supply chains (SC), combined with demand variability (Mehmann and Teuteberg, 2016a) and the global health crisis, require that logistics service providers (LSPs) improve their resiliency, competitiveness and innovativeness, thereby increasing the

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perceived importance of the role played by fourth-party logistics (4PL) (Pavlić Skender *et al.*, 2017; Saikouk *et al.*, 2021). Introduced by Andersen Consulting (Now Accenture Consulting) in 1996 as a trademark, 4PL has been defined by Bade and Mueller (1999) as "*an integrator that assembles its own resources, capabilities, technology and other service providers to design and manage complex supply chains*" (p. 78). Although this definition underscores the role of 4PL in managing SCs, it does not precisely define the range of ***4PL Service Offerings (SOs) – "what it does".*** This blurs the frontiers between what a ***4PL business model (BM) – "what it is***" – should offer in terms of service and what does not fall within its area of expertise. In practice, several service providers identify as 4PL, although they do not possess the required competencies in steering, coordinating or designing SCs. For instance, a traditional 3PL such as DHL or Geodis identify themselves as providers of 4PL service offerings. In contrast, Logika or 4P Central Station (4PLCS) identify as a 4PL even though they focus on offering SC management consulting. These divergences in terms of 4PL BMs exacerbate the confusion regarding the SOs of 4PL and whether there are only one or many types of 4PL providers.

A review of the literature on 4PL since the seminal definition of Accenture (Bade and Muelleur) from 1999, considered by several researchers as fundamental (Mukhopadhyay and Setaputra, 2006; Saglietto, 2013; Gruchmann *et al.*, 2020; Win, 2008), sheds light on the existence of a mismatch between current 4PL practices and their depiction in the definition of Accenture or the extant of literature. Although, scholarly work seeking to capture 4PL practices has been evolving, the changes in the 4PL are occurring at higher rate leaving a gap between academic conceptualisation and practical reality. Several cases of organisations lend support for the argument of mismatch between academic research and 4PL practices in the sector. Indeed, the market is constantly evolving and companies such as "Prism" a 4PL subsidiary of "Bolloré Transport & Logistics", the company "Linkepilot" a new 4PL activity of the "Log'S Group", or, Groupages Express de Franche-Comté (GEFCO)'s 4PL subsidiary called "Supply Chain Optimization", all of them engage in new forms of 4PL-type service offerings accompanied with a quasi-exclusive positioning on transport, consulting, customs clearance, etc. Considering the change in the landscape of the 4PL industry, we would be facing various companies in the industry which identify themselves as 4PLs, are not aligned with the 4PL service offerings as defined in several studies (Krakovics *et al.*, 2008; Razzaque and Sheng, 1998; Huang *et al.*, 2015).

The existing mismatch between what a 4PL should be and what it does in practice spawned various taxonomies and typologies, adding to the ambiguity of a coherent 4PL BM. Moreover, reliance on extant definitions of 4PL that mainly use 3PL business model frameworks further blurs the frontiers between these two LSPs. Indeed, the current taxonomies on 4PL are based on similar structures, resources and levels of outsourcing, which corresponds to those commonly used to classify the different LSPs (Selviaridis and Spring, 2007). The discrepancy between the 4PL concept and current business practices is unmistakably evident when LSP cases such as DHL, Geodis and GEFCO are considered. These LSPs are still undergoing a series of reconfigurations and permanent restructuring to offer classic 3PL and 4PL services within the same business unit (Saikouk *et al.*, 2021).

Using a qualitative methodology, we mobilise a lexicometric analysis of textual corpus to elaborate existing theory. To develop our taxonomy, we opted for an automatic analysis of textual data (AATD), which constitutes a suitable approach on account of its value in retrieving lexical divergences and convergences without *a priori* codification of data, resulting in classifications, categorisations and clusters that facilitate interpretative practices and the construction of abstract models. By conducting an exploratory analysis followed by a targeted analysis of more than 1050 pages of transcribed interviews that were collected from experts working strictly in companies identifying as 4PLs, we inductively develop a taxonomy of 4PL BMs. The application of two complementary methods, namely, Gephi and

Sphinx that facilitates the combination of spatial visualisation and lexicographic processing. The goal of this dual procedure, i.e. combining a semantic analysis with a clustering algorithm (Bastian *et al.*, 2009), is to analyse the conceptual architecture of a text with a semantic visualisation. These two processes constitute the essential milestones for the construction of themes, classes and, consequently, the taxonomy we seek to develop. Using an objective qualitative analysis technique without *a priori* codification of data, our analysis of the data will enhance the reliability of the interpretation, thus reducing the distortion in the interpretation of data.

Taxonomies play an instrumental role in SC research inasmuch as they enable us to develop a classification system that enhances our understanding by categorising SC phenomena into mutually exclusive and exhaustive sets through certain discrete decision rules (Doty and Glick, 1994). In fact, taxonomies help adjust conceptual development based on complex empirical realities and lead to coherent concepts (Rich, 1992). Therefore, we explore the current 4PL BM using an inductive approach to uncover the dimensions along which 4PL SOs varies in practice. Based on empirically derived dimensions, we will generate a taxonomy of 4PL BMs that reflects the current state of 4PL SOs and help eliminate the ambiguity regarding the concept of 4PL. Further, developing a taxonomy specific to 4PL services will allow us to shed light on the recent developments experienced by SC actors since its initial definition.

To this end, we first review the literature on 4PL and then we present the research methodology by introducing the exploratory analysis with Gephi and the targeted analysis with Sphinx. We then discuss the results and the newly developed taxonomy. Finally, we present the managerial and theoretical implications of our research.

Literature review

Fourth party logistics

4PL SOs is a strategic approach (Win, 2008) that has contributed to accelerating the transition from simple to complex value-added logistics systems. 4PL represents a process structured around integration and intermediation and focuses on the efficient and neutral coordination of SCs (Mukhopadhyay and Setaputra, 2006; Hingley *et al.*, 2011).

The literature on 4PLs focuses on their role in the integration of logistics processes and the facilitation of collaboration through effective information sharing between SC members (Bumstead and Cannons, 2002). Present in various sectors, 4PLs use their expertise and skills in process reengineering (Hingley *et al.*, 2011) to reduce costs and to implement a flexible and resilient SC model (Vivaldini *et al.*, 2008). 4PLs aggregate the demands for logistical services of multiple actors to achieve economies of scale. These extensive SC solutions allow for optimal resource allocation, SC optimisation (Huang *et al.*, 2015) and the reduction of costs owing to the associated sequence of 3PL-type activities (Jensen and Hertz, 2016). As a result, this essential asset-less logistics provider fosters synergies among a myriad of 3PLs according to their core competencies and the appropriate technical infrastructure (Mehmann and Teuteberg, 2016a). Therefore, a 4PL service offers structural and relational reconfigurations of 3PLs, enabling the creation of knowledge-based capability that offsets the lack of physical assets.

Classification of fourth-party logistics in the literature

Typologies concern interconnected sets of ideal types that are conceptually derived without specifying decision rules; thus, they generate multiple individual types, each of which embodies a particular combination of organisational attributes that influence important outcomes (Doty and Glick, 1994). Contrary to typologies, taxonomy involves a classification

system that applies a set of criteria to categorise a phenomenon into mutually exclusive and exhaustive groups (Doty and Glick, 1994). In our study, we orient our interest towards an inductively generated taxonomy of 4PL service offerings. Derived from empirical studies, taxonomies allow us to identify patterns of similarity (Everitt and Dunn, 1991). They are, thus, representations of classes according to measures of similarity and observable variables in the industry (Bailey, 1994).

4PL BMs transcend the frontiers of operational services to offer consulting solutions as well as an SC optimisation model design (Razzaque and Sheng, 1998). However, the lack of consensus regarding the definition of what constitutes 4PL SO contributes to the proliferation of business models identifying themselves as 4PL. As a result, it is challenging to select the right SO that meets global supply chain requirements.

Using a qualitative approach, Hingley *et al.* (2011) presented a classification of 4PL based on dimensions related to the complexity and the intensity of collaboration between LSPs and grocery retailers in the United Kingdom (UK). These dimensions are common to both 3PL and 4PL, which prevents the emergence of a specific 4PL classification, thus, accentuating the existing overlap between these two models. Using a design science research methodology, Soinio *et al.* (2012) proposed a classification of LSPs based on a dyadic perspective to investigate their potential to offer value-added logistics services. This study offers a classification of LSPs along the dimensions of asset ownership (asset-based or asset-less) and the nature of the proposed service (transaction-based or relationship-based). However, it does not allow for a classification that strictly incorporates 4PLs, but rather extends to 3PL service offerings as well. Based on secondary data emanating from the French reference system of logistics activities nomenclature d'activité française and LSPs websites, Saglietto (2013) offered a classification of 4PLs into four groups of services: (1) design and engineering of large projects, (2) simulation of logistics solutions, (3) subsidiaries of logistics groups and (4) "pure players" that have consulting competencies and expertise. The classification suggested is mainly based on *a priori* existing criteria rather than features emerging from the empirical practices of 4PLs. Moreover, the identified groups present a description of their relative SOs, whilst the role played by the criteria in managing the operations is overlooked. In their work on 4PLs, Schramm *et al.* (2019) studied the impact of digitalisation of SCs and Information Technologies (IT) capabilities as a differentiating factor amongst 4PLs. They offered five different categories of 4PL providers, namely large logistics groups, pure 4PL players, niche logistics providers, consulting firms and technology providers. The authors offer a typology of 4PL without using a set of distinct dimensions along which 4PL BM are categorised.

Research gaps

This literature review highlights the existing gap between the conceptualisation of 4PL services and their actual practices. The literature agrees that 4PL is an essential asset-less logistics provider that performs a principally a design role with limited involvement in the operational side. However, in practice, certain 4PLs service offerings do extend to the operational side by proposing warehousing, transport activities, whilst for other providers offerings focuses on consulting or overall Supply Chain Management (SCM). Nowadays, we will encounter 3PLs that provide 4PL services, IT service companies and consulting firms that identify as 4PL, or a company that identify as a 4PL but concentrates all its expertise on one service offering (transport, design, etc). Indeed, the perpetual alteration and transformation of 4PL services, the difficulty of accurately identifying current 4PL practices and the confusion/overlap between 3PL and 4PL terminologies have led to a proliferation of classification systems. Furthermore, 4PL classifications have seldom considered the study of disparity in the level of involvement of the 4PL service offerings. In practice, various firms label themselves as 4PL even though they offer services that

overlap with those of 3PL providers. We believe that his confusion is due to a lack of clarity in the existing 4PL classifications that were incorrectly based on 3PL models (Soinio *et al.*, 2012).

The review of the extant literature on 4PL has suggested classification schemes, taxonomies and typologies. Nonetheless, certain classifications do not depict taxonomy as defined by Doty and Glick (1994), considering the absence of mutually exclusive categorisations along with a clear set of decision criteria. The lack of uniformity in the criteria for classifying LSPs is amplified by confusion between typologies and taxonomies that characterise some scientific contributions (Saglietto, 2013). To address these research gaps, we aim to propose an answer to the following research questions:

RQ1. What are the appropriate dimensions to identify distinct and mutually exclusive 4PL business models?

RQ2. To what extent do the identified 4PL business models vary along these dimensions?

Answering RQ1 will allow us to identify the dimensions relevant for classifying distinct and mutually exclusive 4PL BMs, thus clarifying the frontiers between 3PL and 4PL. Using an inductive approach, the uncovered dimensions will emerge from current business practices and will, thereby, close the gap between theory and practice. Furthermore, answering RQ2 will reflect the current practices of 4PL providers by clarifying how these actors differ along the classification dimensions, even though they self-identify as a 4PL. Indeed, the identification of relevant dimensions will be instrumental in understanding how each distinct 4PL BM aligns with the global SC requirements of clients.

Methodology

We adopted an inductive qualitative research methodology (Fabbe-Costes *et al.*, 2020; Nevries and Wallenburg, 2021) to develop taxonomy of 4PL SO rooted in current business practices. Qualitative refers to a research approach that investigates the meaning and interpretation of concepts in a particular context of inquiry (Denzin and Lincoln, 2011). A qualitative approach is instrumental in helping researchers attain a granular understanding of socially embedded behaviour as it allows for the meanings and voices of interviewees to be expressed. This research study explores the dimensions that differentiate between various 4PL SOs. Hence, we aim to refine the existing theory of 4PL by conducting an in-depth analysis of the dimensions that will facilitate the classification of 4PLs, thus bridging the gap between current practices and conceptualisations. These dimensions are not *a priori* identified; rather, they will be informed and shaped through the narratives of the interviewees. By collecting data grounded in the actual experiences of executives working in 4PL, new insights will emerge regarding the dimensions along which 4PL SO vary. Therefore, a qualitative approach is appropriate for answering our research questions, as it will enable us to uncover deeply anchored insights through the contextual analysis of data (Harrison, 2013).

Sample and data collection

To answer our research questions, we used semi-structured interviews to collect data. The informants were selected through a theoretical sampling strategy that, contrary to random sampling that contributes to empirical generalisability to a population, is more adequate for inductive reasoning (Eisenhardt *et al.*, 2016). In theoretical sampling, cases are selected based on their ability to generate insights, extend relationships among constructs or develop an in-depth understanding of processes (Eisenhardt and Graebner, 2007). Considering our research questions that seek to address the classification dimensions of 4PL, we selected mainly logistics executives working exclusively in 4PLs as those who are best positioned to inform

our inquiry. We then used the snowball technique by asking each informant for his or her recommendations about others who are well-positioned to discuss 4PL. We began our data collection by interviewing logistics executives (e.g. Vice President (VP) of Logistics, Director of Logistics, etc.) and Chief Operating Officers (CEOs) of large 4PL service companies. These executives have unique access to knowledge of their company's structures, strategies, norms, values and actions and, thus, possess valuable and important insights into the organisation and the 4PL industry. Moreover, they are in a position to recommend further informants at various levels both within and outside the company.

Data collection

Semi-structured interviews were used to collect data with logistics executives. To ensure consistency of our data collection protocol, the lead author conducted all the interviews. The choice of semi-structured interviews is explained by the complexity of the phenomenon we are studying, which requires the identification of structures and types of classification dimensions. During data collection, we asked all informants to discuss the issues raised as the representative voice of the collective (i.e. as the voice of the 4PL they are working with). Indeed, executives represent a dominant cognitive stream that orients the decision-making process, thus ensuring a certain level of coherence (Prahalad and Bettis, 1986). Each interview was preceded by a phone call to confirm the date, time and place of the interview. At the beginning of each interview, the interviewer explained the objective of the research and how the data was going to be used. To ensure the anonymity of the interviewees, each interview is identified through a code. The interview protocol included a fixed set of questions and a variable part made up of various questions based on the particular situation and the informant's attitude. In total, 60 interviews were conducted, each lasting 54 min on average. Each interview was first recorded using a Dictaphone and then entirely transcribed to ensure better exploitation of the data. At the end of the 60th interview, many redundancies in the interviewees' answers were identified, indicating theoretical saturation.

Analysis of research trustworthiness

To assess the trustworthiness of our qualitative research, we followed the example of Flint *et al.* (2002). We applied five criteria, namely, credibility, transferability, dependability, conformability and integrity, which assess the trustworthiness as originally suggested by Lincoln and Guba (1985). We decided to not include the rest of the criteria – fit, understanding, generality and control – as they are more suitable for a grounded theory approach (Flint *et al.*, 2002). Table 1 presents the criteria used to assess the trustworthiness of the study and findings.

Data analysis methods

Textual Data Analysis. Automatic approaches: Textual data can be analysed using manual, semi-automatic or automatic tools that will applied to lexical structure of the text. As it is the case with any analysis tool, automatic analysis has its pros and cons. First, the use of AATD methods allows the researcher to guarantee a high level of objectivity by preventing any *a priori* assumptions to alter the results. This objectivity is rendered possible inasmuch as AATD functions without relying on an initial intervention of the researcher. Indeed, the description of the statistical and lexical properties of the corpus, which is controlled by the data visualisation and the continuous reading of textual data, contributes to an objective and critical presentation of the analysed material. The formal manipulation orchestrated by the software contributes largely to the production of an objective and explanatory knowledge of the studied phenomenon. Conversely, semi-automatic and manual software are partially

Criteria	Method of addressing in the study
Credibility: Extent to which results appear to be an acceptable representation of data	The researchers collected data over 11 months A group of four researchers and twelve professionals were consulted to inform the data collection process and interpretation of results at different stages of research A summary of the results was presented to the informants for feedback and interpretation Result: Feedback of participants was discussed with findings and used to enrich the model and the discussion of findings
Transferability: Extent to which results of a study will apply in different contexts	Use of theoretical sampling to collect data from various 4PL executives in different companies of various size Result: Derived concepts were considered applicable to various 4PL BMs and in various locations
Dependability: Extent to which results are unique to time and place, extent of consistency of the explanations	The interview questions were asked in a manner that allowed participants to discuss current situations and their relation to past experiences with 4PL Result: Findings reflect a consistent narrative of participants regardless of period (current or past)
Confirmability: Extent to which interpretation is the result of participants and the phenomenon as opposed to research bias	The findings and corpus of data were analysed by independent expert researchers in LSPs. The group of researchers and professionals were regularly consulted throughout the data collection and analysis Result: Interpretation of findings were expanded and refined
Integrity: The extent to which findings are the result of misinformation or evasions by participants	The interviews were conducted in a professional and nonthreatening nature Anonymity of the participants was ensured Result: There was no attempt by participants to avoid or evade discussing certain issues. Informants were open and keen on providing additional information to support the efforts of the research team

Table 1.
Trustworthiness of the study and findings

based on lexical structure, thus leaving the research free to specify the parameters of the text analysis and have control over the content of the thesaurus. AATD represent a suitable method for objectivising and elaborating the data to allow for theoretical advancement, without any pre-suppositions regarding the content of the analysed corpus.

To derive and generate our taxonomy of 4PL BMs, we applied AATD methods, which encompasses content and discourse analysis (see Figure 1). It refers to the process of extracting information from textual material through, selection, reduction, categorisation or classification (Krippendorff, 2004). Adopting this methodological approach without the application of statistical methods involving multivariate analysis poses certain challenges, particularly the volume of data, the sensitivity of the topic and the risk of interpretative inferences by the researcher. In order to remedy these constraints, we apply an AATD to our methodological approach. This technique substitutes for content analysis, considered subjective and relying on simpler keyword analysis which renders it insufficient (Bournois *et al.*, 2002). AATD applies multi-dimensional statistical analysis methods to categorise the content of corpus based on the nature of the association among words. Indeed, Automatic analysis of Textual Data (AADT) performs a pre-coding and an automatic structuring of the textual corpus, a lemmatization, a calculation of the statistical properties of the text, a lexicometric analysis and a grammatical categorisation into semantic networks.

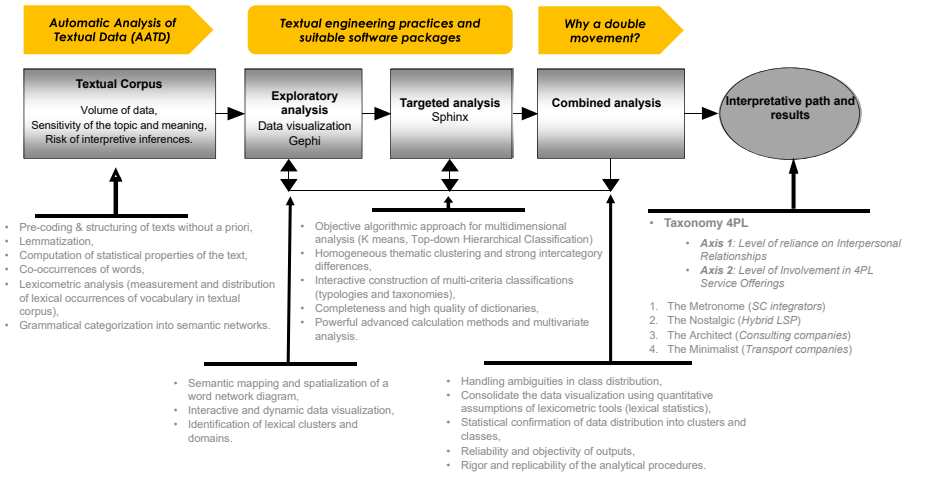

Figure 1.
Methodological design and results

How does AATD works. Technically, AATD analysis is based on data processing programs and a multi-dimensional descriptive analysis of the spectral type (*CFA* = correspondence factorial analysis, HAC = hierarchical ascending classification, etc.). These automatic programs provide visual representations of the lexical proximities of the various parts of the corpus based essentially on the most representative factors. The lexicometric results provided in the form of contrastive lists are thus reorganised, grouped into sets of grammatical categories, then into semantic networks, to be discussed finally on the enunciative and thematic levels. In this respect, the risks of misinterpretation are mitigated by the use of statistics (Basit, 2003). Interestingly, the AATD uses visualisation tools providing various classifications that facilitate the understanding and the interpretation of the corpus. Moreover, the advanced calculation methods, multivariate analysis and lexical analysis, ensures total homogeneity of the classes to the detriment of intercategory *differences* (Bolden and Moscarola, 2000).

Opportunities for AATD methods. The size of textual corpus is determinant in the choice of AATD, as it enables a rapid analysis of voluminous corpus from various sources, and combines automatic synthesis, content analysis, text mining and statistical analysis. The adoption of automatic tools circumvents the various iterations necessary to reach consensus among researchers on coding schemes and labels. Besides, the utilisation of AATD tools generates automatically replicable results without prior coding. The ability to provide replicable results (transferable analysis) through reproduced analytical procedures reinforces the validity of the rigour of data processing and analysis, thus, contributing to the enhancement of the scientific rigour of qualitative methodology.

Limitations of AATD methods. The improper use of AATD may threaten the validity of the results and implications derived from them. Solely relying on the technical dimension of research procedures (particularly computer-based) carries the risk of focussing attention on the instruments of research and their practical usefulness, rather than on its objectives and its ends (Jenny, 1997). The use of AATD does not take into account the meaning of the sentence, but analyzes the vocabulary used. Although computer-assisted analysis allows for perfect reliability, its validity depends largely on the researcher's knowledge of the corpus data (Pollach, 2010, p. 744). Using automatic analysis limits the researcher's intervention by proposing configurations and graphs that facilitate the editing of the taxonomy using the descending hierarchical classification (DHC) and K-means algorithms, which remains a result

subject to interpretation by the researchers and consolidated by proposals. No methodological device can free itself from an epistemological reflection and vigilance.

Furthermore, AATD methods, are of limited utility if applied to short texts (limited analysis of semantic networks), inasmuch as the repetitive effects are not large enough to lead to statistically significant results, thus, prompting a risk of misinterpretation of the textual data. The validity of the AATD approach thus relies on the completeness and quality of the dictionaries (Lewis and Maas, 2007). The corpus preparation operations (lemmatization) are likely to introduce misleading artefacts. Also, the highly automated nature of the processing (Krippendorff, 2004) may give the illusion of ease and objectivity. Indeed, the existence of a veritable risk of incorrect or misleading use of AATD must be emphasised, as it might hamper the construction of meaning if corpus is analysed without an objective recurring reading of the textual data. Finally, a background in quantitative analysis, with an understanding of correlations, chi-square tests or factor analysis is necessary to properly interpret the reports produced by AADT programs (Seale *et al.*, 2004).

Combination of AATD methods. After discussing the opportunities and possible limits that characterise AATD, we will explain the advantages derived from combining two methodological approaches (exploratory and targeted analysis) to conduct the AATD on our textual data. First, the joint utilisation of both approaches enables us to use different methods that enhances the depth of our study and improves the examination of our results (Bazeley, 2010). Applying different methods of analysis allow us to obtain multiple distinct but congruent facets of the studied object. In our manuscript we mobilised the Gephi and Sphinx software packages to read and analyse the same textual corpus. Using these two software enabled us to treat ambiguities in the distribution of thematic classes of words, and the partition of the text into homogenous units and groups.

Process of combination of AATD. In our study, we decided to leverage two methodological approaches, an exploratory analysis using Gephi, and a targeted analysis with Sphinx software tool. According to Onwuegbuzi and Teddlie (2003), representation and legitimisation lie at the heart of the need to combine methods of analysis. The adoption of these two methodological approaches is motivated by the willingness to enhance the rigour of our methods and the reliability of our results inasmuch as the joint application of the analysis to our textual corpus will offset the weakness of each approach.

Contrary to an exploratory approach which may appear blind or tentative in nature, the targeted analysis using a series of implemented computational procedures offers us the ability to conduct an objective confrontation with the text in its entirety. The exploratory approach to analyse the corpus using Gephi software facilitates the comprehension of the corpus which is improved by the visualisation of the data. Gephi's spatial visualisation helps the researcher find and elaborate seamlessly a matching of thematic cluster. After the identification of lexical domains throughout the first exploratory step, we will leverage the targeted analysis to define the scope and the orientations of the textual corpus. To enrich our lexical analysis, we complemented our study by a targeted semantic analysis using the software Sphinx which supports a more focused analysis generating the four clusters of our taxonomy.

Exploratory analysis with Gephi. Gephi is an exploration platform that allows interactive data visualisation for the analysis of all types of complex networks and systems (Bastian *et al.*, 2009). It automatically forms clusters, i.e. hierarchised groups of concepts, which helps in studying the articulation and structure of ideas in the interviewees' thoughts according to the spatialisation of forms (words). Thanks to the spatialisation algorithm, Gephi detects and visually identifies reasoning that facilitates the reading and understanding of participants' postures. Using Gephi software, we were able to map the main themes identified in the textual data to determine those that were most predominant based on their statistical weight and centrality in the speech. The spatialisation of co-occurrences using Gephi is based on

"ForceAtlas2" type of algorithm, allowing attraction and repulsion between cluster nodes (Jacomy *et al.*, 2011). This leads to better visualisation of the weight of each word in the structure. To facilitate the reading of the resulting graph, two other algorithms of "delayering" and "label adjustment" were applied to the spatialisation while preserving the "ForceAtlas2" analysis.

The data was processed using several algorithms, including ForceAtlas2, for complementarity analysis, *Modularity class* to identify relationships between nodes and highlight communities and *Eigenvector centrality* to highlight the most important *nodes* in the network. Through a colour coding of the different modularity classes, the network mapping analysis reveals communities of relationships according to the links that words have with each other. The mapping presented in Figure 2 highlights four network communities. The four clearly visible poles structuring the data network are organisation, transport, integration and consulting.

Automatic analysis of textual data in Sphinx. AATD objectively identifies associations and frequencies of relationships between keywords. Through statistical processing, AATD highlights thematic configurations and contextual specificities. It finely categorises essential linguistic elements and extracts logical meanings as to common conversational patterns. Classification techniques and semantic analysis give textual data processing objectivity, validity and reliability (Goddard, 2011). Without *a priori* codification, current classification algorithms automatically analyse textual data and draw consistent interpretations (Reinert, 1983).

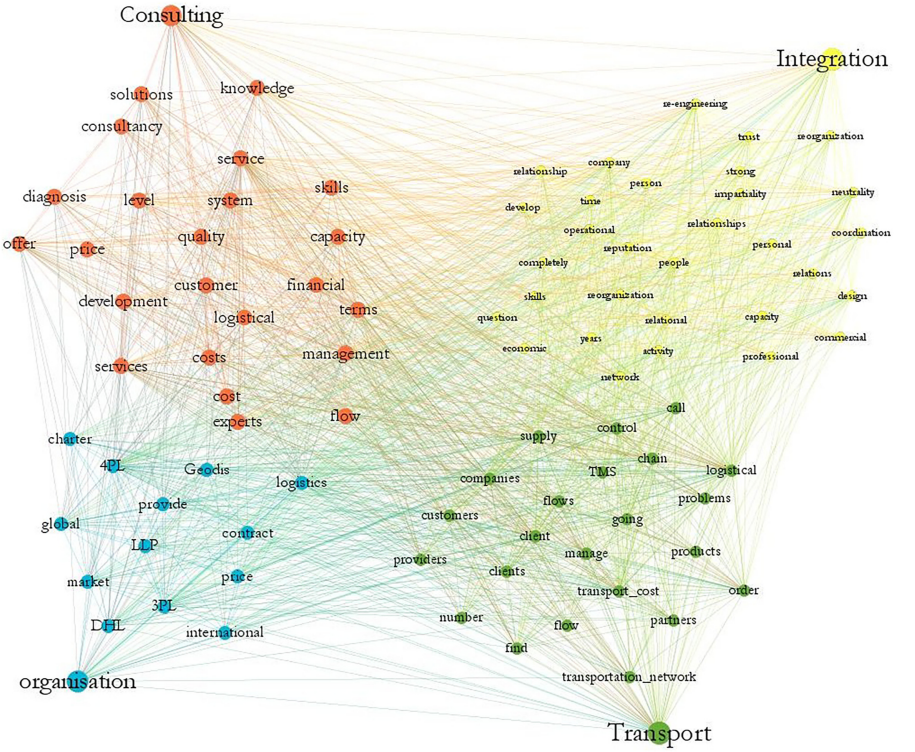

Figure 2.
Four clusters under Gephi

Sphinx iQ2 and DataViv version 4.22 have the capacity to generate taxonomies by combining classification analysis with clustering or factorial analysis. The power of these tools also resides in their capacity to analyse multivariate data, construct typologies and highlight systems of relations. As such, they appear to be the appropriate tools to adopt for the development of taxonomy. Through AATD, we were able to generate coherent and relatively homogeneous groupings of individuals having similar 4PL SOs. A first exploratory analysis with Gephi allows us to detect the major orientations in the data.

(1) In the "organisation" cluster, informants most frequently mention the words international, price, charter, Lead Logistics Provider, market, DHL and Geodis. DHL and Geodis are classic service providers that have integrated into their offer a business unit called 4PL dedicated to the management and design of innovative logistics schemes.

(2) The second cluster, "integration", refers simultaneously to integration mechanisms and the relational dimension through words such as reengineering, trust, reorganisation, neutrality, relational, person and design.

(3) The third cluster, "consulting", refers to companies that offer consulting and control tower services without engaging in the operations and management of logistics operators. In this group, the informants are interested in the terms solutions, knowledge, experts, diagnosis and consultancy, among others.

(4) The last cluster, "transport", expresses a vision of the informants around the 4PL type of service that is reduced to transportation activities. The informants put forward terms such as transportation network, transportation cost, software and flow.

In this first exploratory phase, Gephi allowed us to detect four clusters that express the interviewees' opinions about 4PL services. However, we consider that it is necessary to go deeper into the subject by means of Sphinx.

Targeted analysis under Sphinx. The two algorithms that enable targeted analysis under Sphinx are (1) descending hierarchical classification (DHC) and (2) K-means classification.

DHC: The DHC consists of an automatic process of deconstruction of the initial corpus and its reconstruction according to the repetition and succession of words, concepts and expressions. In Sphinx, this algorithm helps reach an objective partition of the verbal behaviour of interviewees, thus reflecting a specific representation of their activities. It enables the observation of inter-cluster variations and the identification of clusters of individuals by grouping similar observations. Schematically, it is expressed by the identification of the grouped forms and their degree of proximity and dependence on the clusters (Figure 3). The projection of descriptive variables onto the factorial axes illustrates major typologies of speech broken down into registers specific to each theme. DHC (Alceste procedure) consists of breaking down the speech into homogenous categories allowing us to uncover four registers (lexical profiles), which we refer to as business models, namely: (1) SC integrator "the Metronome" includes actors that focus mainly to giving the tempo to the coordination of SC activities, (2) consulting companies "The Architect" refers to actors focussing on the design of SC network and solutions, (3) transport companies "the Minimalist" they limit their 4PL SO to the international transportation coordination, and (4) hybrid LSP "The Nostalgic", are logistics providers who perform principally 3PL activities and offer 4PL SO under separate business units. In the remainder of this paper, we will use the labels: Architect, Minimalist, Nostalgic and Metronome.

(1) *Business model 1: "The Metronome"*

In the *Metronome* BM, we find a strong presence of semantic categories around issues of interpersonal trust, the individual, persons and relations. The occurrences detailed in Figure 3

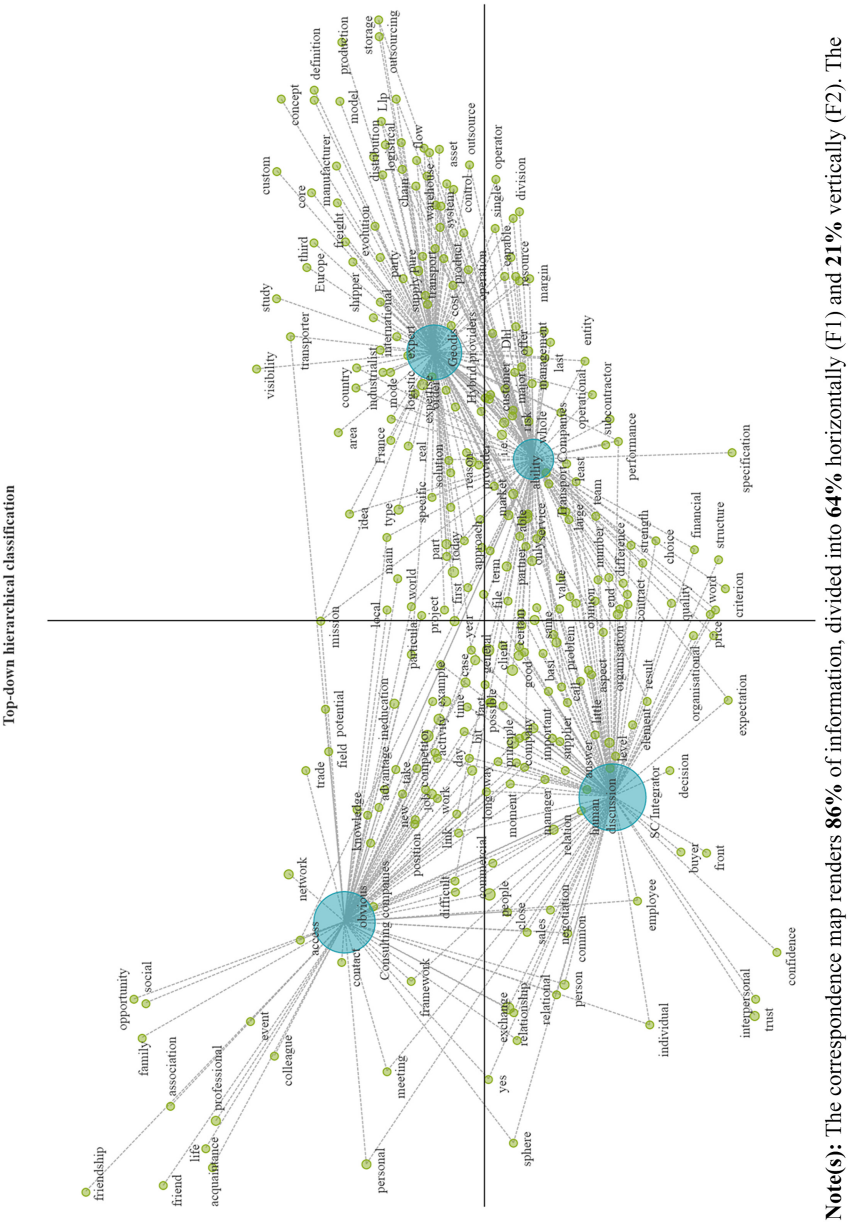

Figure 3.
Top-down hierarchical classification

indicate that the interviewees express, with a great lexical variety, their perceptions of interpersonal relations. In the same logic, the fundamental associations observed between the different concepts attest to the predominance of a strong reliance on an informal, interpersonal relational dimension, clearly transmitting the importance the informants attach to it. They consider that friendships interfere with business and that informal relationships developed within clubs and associations serve to consolidate business and increase the company's visibility.

(2) *Business model 2: "The Architect"*

The level of reliance on interpersonal relationships changes in the *Architect's* BM. The data analysis shows a prevalence of formal relations compared to the organisational and technical aspects of logistics services. The informants gave high importance to their clients and integrated a human dimension into the inter-firm exchanges. They insist on *acquaintance, professional, colleague, association, knowledge, mission, project and* competences in managing flows. This business model, which is mostly represented by "control towers", is clearly different from the business model above, as informants in consulting companies do not rely extensively on informal interpersonal relationships in managing or offering 4PL services.

(3) *Business model 3: "The Minimalist"*

In the *Minimalist* BM, the dominant themes revolve around *performance, transport, resource, margin, capacity, operator, solution and division*. These *asset-less* companies limit their focus on 4PL SO via a strong emphasis on the management of a global transport network and, thus, are better depicted as "International Transport Companies". The most important issues for the informants are the budgetary and tariff aspects in negotiations, formal administrative structures, charters and procedures for selecting transportation service providers. The extensive reliance on informal interpersonal relationships in these companies represents a strategic and operational dimension. These relationships not only allow the company to resolve daily operational situations but also to position itself in long-term strategic partnerships.

(4) *Business model 4: "The Nostalgic"*

The corpus of texts depicting the *Nostalgic* BM focus on *assets, distribution, freight, international, warehousing, production, outsourcing and manufacturing.* Their discourse is somewhat technical, highlighting the skills that a 4PL should possess, namely flow management, information flow management, business relations and IT solutions. They give primacy to contract-based transactions and purely formal relationships. Individuals who develop in this business model favour technical and factual presentations based on the specification of actions that refer primarily to the business world.

The K-means classification: We perform a K-means classification in Sphinx DataViv data analysis and visualisation web service. This classification of responses is done according to five themes used in the process of textual data collection during the interviews, namely: (1) Impact of interpersonal relationships "IPRs" (2) multilevel trust, (3) embeddedness, (4) coordination and (5) social capital. K-means is a partitioning method that increases the intergroup variance as much as possible while minimising the intragroup variance. The algorithm splits the data into n compact and clearly separated clusters according to certain criteria, starting by dividing observations into a predetermined number of clusters (four in this study) as suggested by the results of the hierarchical cluster analysis. Through a lexical and/or semantic AATD, keywords are first decomposed into n classes. This process is repeated until a stable structure is obtained. The data can be weighted, and the number of classes can be set by the user. The tool, thus, produces a typology that best discriminates

between resulting groups or classes. The algorithm also progressively reallocates the individuals to improve the homogeneity of the classes. Figure 4 shows the results of the K-means classification.

Taxonomy dimensions

Inspired by current practices of 4PLs and based on the data collected from our knowledgeable informants, the experts participating in the validation of the results of our study, conjugated to the professional expertise in the 4PL industry of part our authorship team, we derived two dimensions, namely (1) the level of involvement in the 4PL SO and (2) the level of involvement in interpersonal relationships dimension. We propose taxonomy based on these two differentiating and relevant elements in 4PL that emerged from the prevailing practices in the sector. More importantly, the choice of these dimensions does not overlap with 3PL dimensions and allow us to create mutually exclusive and exhaustive sets that reflect the complex empirical realities of 4PL and generate coherent concepts (Rich, 1992). Indeed, the dimension of level of involvement in interpersonal relationships is salient in the case of 4PL considering its asset-less nature (Saikouk *et al.*, 2021). To enhance the validity of our taxonomy, we ensured that results are continuously confronted with experimented professionals in the sector, during and after the process of collection and analysis of data.

Findings and discussion

Following the sequence of typological constructions above, the corpus of textual data highlights the level of reliance on interpersonal relationship dimension expressed by the informants involved in the decision-making process within 4PLs. The classification process allowed us to identify four *business models* that we named: *(1) The Metronome, (2) the Nostalgic, (3) the Architect and (4) the Minimalist.* To answer our research questions RQ1 and RQ2, we propose a taxonomy that positions the profiles of companies' 4PL SO in a two-axis

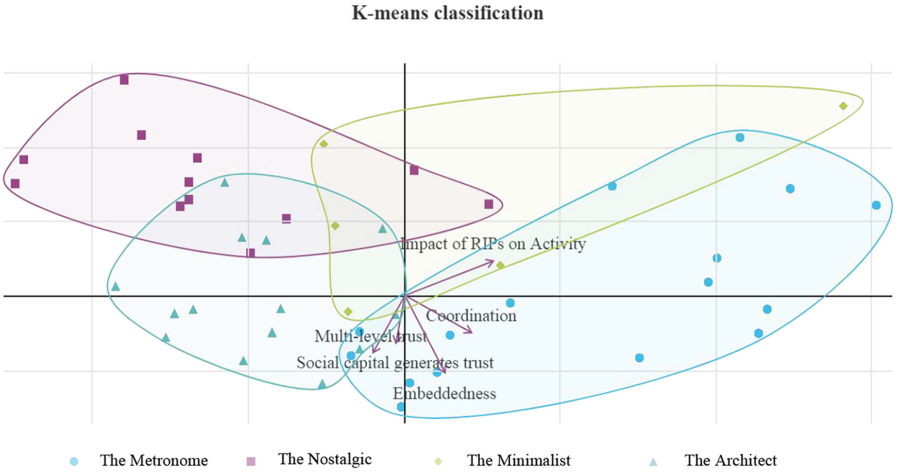

Figure 4.
K-means classification

Note(s): The classification groups individuals into homogeneous classes in terms of the variables considered. The calculation is initializedrandomly. The algorithm reassigns individuals to gradually improve class homogeneity

matrix of (1) the level of reliance on interpersonal relationships and (2) the level of involvement in the 4PL SO (Figure 5).

The Metronome

The "*Metronome*" describes the SC integrators that are the result of the complexity of SC (Bumstead and Cannons, 2002). They are often asset-less intermediaries who use 3PLs to create a tailored service offering for their clients. They are differentiated by the range of services they provide to their clients based on two dimensions: (1) *a high level of involvement in the 4PL SO* and a *high level of reliance on interpersonal relationships*.

The level of involvement in 4PL service offerings. Born out of the vacated space left by the 3PLs, the Metronome improves the visibility of and control over the entire SC network by moving from operational to more strategic relationships. Its specific role revolves around SC design and management, a high degree of integration, SC optimisation and neutrality. Here, neutrality implies impartiality and the absence of conflicts of interest regarding the choice of the actors who compose the logistics scheme built by the 4PL. The lack of independence becomes apparent once the 4PL operates at the strategic and operational levels of the SC, having access to sensitive information about 3PLs such as price scale, specifications and quality level. This often generates arbitration problems as well as non-standard and unethical choices.

The Metronome's portfolio of value-added services encompasses analytics, planning, monitoring and reporting activities. They design and implement complete logistics solutions (Bade and Mueller, 1999) and offer the most advanced digital solutions. The Metronome's competences in designing SCs are primarily based on its extensive network of partners. Its business model marks a transformation in the nature of the relationship between the 4PL and its clients, constituting a single interface between companies and various SC actors and service providers. Being an intermediary, it offers him distinctive advantages in terms of organisational and process innovation (Jia *et al.*, 2021) and the reconfiguration of logistics patterns.

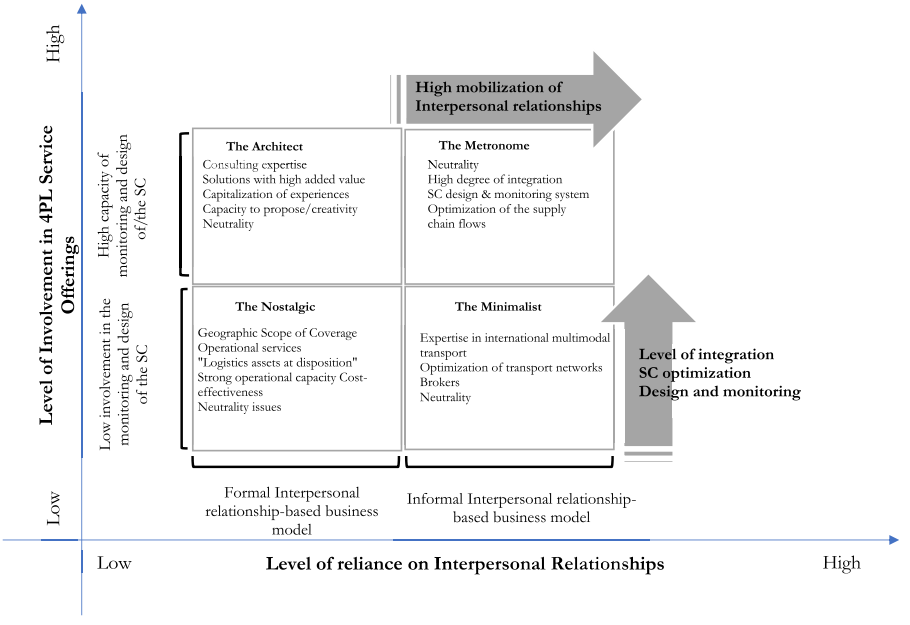

Figure 5.
New 4PL taxonomy

For considerations of credibility, efficiency and cost-effectiveness, clients find it extremely advantageous to involve a neutral player in SCs. As a mediator between several providers and clients, the Metronome enjoys great autonomy in the decision-making process. With an unbiased vision, Metronomes replace the numerous service providers and propose efficient logistic schemes (Persson and Virum, 2001). Being *asset-less*, this actor faces low pressure in terms of returns on assets (Mehmann and Teuteberg, 2016b) and is less vulnerable to suspicions of favouring its own resources (Win, 2008). However, the downside of this situation pertains to the heightened dependence and opportunism vis à vis traditional providers. Making an analogy with a music "maestro", Bitran *et al.* (2007) propose a neutral third party who acts impartially in integrating the supply chain by respecting an ethical charter.

The level of reliance on interpersonal relationships. Being *asset-less*, the Metronome is highly focused on mobilising relational competences with individuals involved in the business model by investing heavily in informal interpersonal relationships (professional and extraprofessional). These practices carry an important relational dimension, representing an opportunity for Metronomes to position themselves and anticipate clients' requests. As a result, this provider becomes more proactive in developing new SOs to better support the changing needs of its clients. It is through the bridge of informal interpersonal relationships that they often achieve a deeper understanding of the decision-making routines at the client's level, bypass the procedural obstacles and manage emergency situations.

The essential obligations and restrictive provisions characterising large groups and large companies are relinquished in a Metronome business model, replaced by an extraprofessional framework, including associations, clubs and forums. These drivers, which characterise small businesses, are instrumental in fostering a rich relationship portfolio and enabling them to become receptive to the importance of interpersonal connections. Moreover, the informal interpersonal relationships that develop in the extraprofessional framework are carriers of new information. Thus, in small entities, intimacy, knowledge and interpersonal skills facilitate access to decision-makers. They represent an impetus to business development and are highly effective in strategic alliances. These informal interpersonal relationships based on trust offer by far a greater opportunity for both parties to develop their business.

The Nostalgic

Considered the most prominent and perhaps most widespread business model, the Nostalgic is a service provider that decides to diversify its offer to meet complex international demand. These service providers offer both 3PL and 4PL services. This implies that, by extending their service portfolio with more complex activities, large 3PLs can also deliver 4PL services (Hingley *et al.*, 2011). This business model differs from other business models by the geographical scope of its services and the strong operational capacity owing to its physical assets.

The level of involvement in 4PL service offerings. Thanks to their global geographical reach, their extended services portfolio and the strength of their global logistics solutions, these large logistics groups dominate the current 4PL market. Nostalgic providers are considered an evolved version of the 3PL model (Win, 2008), offering a wide variety of standardised solutions. Thanks to their presence in several countries and continents, Nostalgic provides warehouse management, inventory planning, forecasting solutions, customs management, routing operations and logistics network optimisation.

Given the interweaving of 3PL and 4PL SOs and the presence of logistics assets, the Nostalgic distinguishes itself from other business models by its strong operational capacity. It has expertise in operational decision-making, operational coordination and operational flexibility. As such, Nostalgic providers can optimise transportation and warehousing planning, helping companies reduce ongoing logistics activities costs.

However, the issue of neutrality is often raised in this model, encouraging 4PL subsidiaries to be more independent from their 3PL entities. A conflict of interest may occur if this Nostalgic 4PL operates in the strategic and operational levels of SCs, thus jeopardising its neutrality principle. In such a configuration, the 4PL often has access to the 3PL's pricing grids, their specifications and their quality level, which generates problems of impartiality, arbitration and potentially unethical choices.

The level of reliance on interpersonal relationships. Managers who adhere to this model favour multi-criteria analysis such as the financial reliability of the company, costs, quality and the time required to establish business relationships. These same criteria are used in the selection of partner service providers in the proposition of a given logistics configuration. For Nostalgics, everything is regulated, controlled and structured to facilitate business growth at a rhythm and a pace that exceeds the relational contribution. This represents a positioning logic oriented towards involving strategic and confidential aspects.

The companies categorised under this taxon were found to be typically structured as a "profit centre" or "business unit" and managed by "activity specialists" or "business specialists". By combining this organisation under one structure, there is an overall consistency in the choice of partners. These large structures attach immense value to operational skills, contracting, purchasing and negotiating power. The complexity of the operating structure adopted by the Nostalgic business model indicates that informal interpersonal relationships are not central. In practice, we found that employees are instructed to sign a "confidentiality agreement" that indirectly prevents them from developing interpersonal relationships. Additionally, the various organisational layers between the 4PL and specialists act as "interface agents" that control access to the bargaining power, the purchasing power of the service, the experienced salespeople, etc. As a result, reliance on informal interpersonal relationships is perceived to be of little or no added value. In Nostalgic LSPs, processes are regulated, structured and controlled such that the business develops at a pace that transcends the contribution of inter-personal relationships. In practice, large groups tend to be organised into "business units" and "project teams" to facilitate the management of the complexity of 4PL SOs. The connections among the 4PL and the specialists are created purely on a business basis where the reputation of the company, the specialisation, cost structure and expertise are identified and utilised to make offers to clients. Depending on their role in the project teams, each individual strives to achieve the overall objectives of the project without relying on inter-personal relationships. Conventional and official communication mechanisms are sufficient in the inter-organisational relationship to function according to each partner's interest.

The reliance on interpersonal relationships is not completely absent from the practices of nostalgic LSPs, but these are rather formal relationships that complement the business approach in the process of searching for potential clients and prospects in the early stage of starting an activity. Beyond this phase, the operating mode changes to allow for a more pragmatic logic; thus, the company's reputation and renown are necessary to be awarded a business deal. In short, the reliance on interpersonal relationships is contingent upon the size of the company in which the decision-maker operates. Hence, in large companies, the pragmatic approach to business dominates as it relies primarily on economic and contractual exchange.

The Architect

The Architect is known by several names, including logistics and SC consulting providers, consultancy companies, logistical consulting or SCM consultancy services. This business model aims to analyse the logistics processes and the different SC flows to rethink the SC configuration (Vivaldini *et al.*, 2008).

The level of involvement in 4PL service offerings. The Architect business model is oriented towards professional relations with a strong focus on 4PL type services. The Architect provides solutions that target processes optimisation, cost reduction and rationalisation, deep analysis and process redesign and organisational change. Their added value lies in redesigning the distribution network, the introduction of a novel process, SC reconfiguration analysis and innovative logistics concepts. In this business model, the consulting competence is a combination of expertise in design and reengineering of logistics processes and allocation of logistics resources (Stefansson, 2006; Saglietto, 2013). By conducting consulting work in various industries, the Architect engage in a knowledge capitalisation and renewed experiences approach. Their strength is supported by developing informational networks and accumulated professional knowledge. The Architect LSP provides intellectual services associated with analysis, planning and monitoring. This business model enhances the strategic consulting and IT capabilities of 4PL. This actor has become essential in modern SC, helping companies understand their logistics performances (reporting, dashboards, Key Performance Indicators (KPI)), assisting them in selecting adequate 3PLs, rethinking logistics practices and providing innovative solutions through industry benchmarks.

The level of reliance on interpersonal relationships. For the Architect business model, formal interpersonal relationships are considered an important resource in addition to other dimensions such as competence, business knowledge and expertise in the management and design of SCs. Through repeated missions, they develop formal networks of relationships built on trust and neutrality in the crafting of logistics solutions.

In this business model, companies are not organised into project teams, and the decision to purchase a service from a specialist does not require consensus within a decision committee. Subsequently, the reliance on formal interpersonal relationships is not precluded by the decision-makers or by the rules of conduct. In practice, the total decompartmentalisation and absence of administrative strata encourage the emergence of entanglements at all levels. This business model operating logic does not abide by the financial imperatives brought about by the evolution of industrial structures or the purchasing power that represents a veritable deterrent to relying on interpersonal relationships to create business deals.

The Minimalist

The Minimalist depicts an international transportation company's business model specialising in the design, management and optimisation of transportation activities by mobilising several LSPs and carriers. The main activity of this type of 4PL BM is transport management while taking into account social, ecological and economic constraints. The Minimalist business model can take the form of *freight forwarders* or *brokers* with expertise in international multi-modal transport and transport network optimisation.

The level of involvement in 4PL service offerings. The Minimalist orchestrates the logistics network (Mukhopadhyay and Setaputra, 2006) by taking full control of the manufacturer's operations, from daily transport needs to strategic planning activities such as relocation of warehouses or identification of road and sea transport routes. This is the case, for example, of the Metro Group, which uses the 4PL approach for managing the physical flows of its clients. In the United States, specifically in the chemical industry, this 4PL is contracted at a multi-actor level to plan transportation processes. Next to transportation planning, the Minimalist also offers a multitude of related services, including freight auditing and freight forwarding consolidation.

The solutions offered by the Minimalist are mainly focused on the optimisation of international transport networks (Schramm *et al.*, 2019). This business model specialises in coordinating outsourced transport flows, developing global transport networks and proposing integrated transport solutions. This primarily involves managing the transport

schedules of multiple 3PL providers (Huang *et al.*, 2015), steering transport schemes (Hingley *et al.*, 2011) and optimising transportation schedules (Li *et al.*, 2003). Its abilities also include the identification of the best transport alternatives and operating sites or delivery frequencies (Vivaldini *et al.*, 2008). This actor contributes to increasing the productivity of transports, enhancing performance transportation networks and reducing the number of trucks and greenhouse gas emissions.

The Minimalist business model evolves SCs into an efficient digital ecosystem with transparency of processes, taking care of customs formalities and realising economies of scale through freight consolidation. These companies ensure transportation visibility and create synergies through transportation networks and consolidating the purchase of international transport services.

The level of reliance on interpersonal relationships. The Minimalist business model relies on the informal relational dimension (contact networks, friendships and acquaintances) as it facilitates access to decision-makers, contributes to the development of the sales force and promotes negotiations. The relational dimension is a business driver and can be decisive in bringing companies together at the strategic level. Informal interpersonal relationships based on trust represent greater leeway for business development.

To support their business partners and maintain relationships, the Minimalist makes decisions in a manner that extends beyond the strictly economic and financial framework. Assisting and facilitating the operations of partners beyond their domestic markets and across different continents is extremely challenging without the mobilisation of informal interpersonal relationships. These relationships are instrumental to responding to and resolving emergency situations and they facilitate the exchange of skills and knowledge, thereby increasing the level of 4PL service offerings. To this end, Minimalists foster and nurture the capacity of individual decision-makers to mobilise various internal and external resources and to establish trustworthy relations with partners. This 4PL SO is frequently referred to as "Worldwide Transport Companies", wherein activities are based on relational entanglements between people, reciprocity in communications and a social space as a vector of shared organisational solutions. In other words, the network of contacts and the quality of relationships with various partners is an integral part of the capital of the provider, which creates a climate of trust that is conducive to the development of business deals. Establishing a network of informal interpersonal relationships with external partners is, therefore, a critical factor in ensuring the survival and progress of the company.

Advantages and disadvantages of each business model

The advantages and disadvantages of each business model, inherent to the proposed taxonomy, allow companies to orient their expectations according to the desired level of service. Considering different configurations and repositioning dynamics of the business models, Table 2 presents an update of the advantages and disadvantages of the 4PL service providers. This makes it easier for customers to make decisions based on the expertise and competence of the 4PLs. Considering the taxonomy we developed and the discussion above, we identify a range of advantages and disadvantages of each business model, presented in the table below.

Many clients turn to the Metronome as a neutral intermediary with a complete view of the SC. In this case, clients are looking for advanced supply chain solutions, information integration and continuous innovation as well as know-how in designing efficient SC networks. The Metronome works in project mode, guaranteeing personalised logistics solutions and an adaptation with the clients' different business sectors. However, despite the coordination capabilities, this business model has its drawbacks. The Metronome usually

	Benefits	Disadvantages
The Metronome	Complete vision, transversality Assembly skills, negotiation and purchasing power Logistical and relational intermediation Operation in project mode Neutrality relationship networks Advanced SC solutions Information integration and continuous innovation SC coordination Know-how to design efficient logistics networks Continuous innovation and improvement Adaptation with several sectors of activity of the customer Customised logistics solutions	Competition between 3PL & SC integrator Risk of cross dependency (4PL & customer) Irreversibility of the 4PL project in case of failure Being in a mono-client scheme Scope of service and cultural compatibility Lack of operational competence
The Nostalgic	Operational coordination and efficiency Possibility of substituting for a defaulting provider Assets allow operational flexibility Global presence and a multi-business aspect	Risk of clients losing bargaining power with providers Sensitivity of 3PL financial data Focus on operational activities Difficulty accepting 4PL as an actor Operating on strategic and operational SC levels (lack of neutrality) Competition with 3PL
The Architect	Neutrality Business process reengineering, SC knowledge, SC capitalisation analysis and innovative logistics concepts Streamline organisational structures improving SC financial performance Rethink logistics practices Ability to modularise and reconfigure Information networks	Lacks operational expertise in SC Client's perceived reluctance and risk Low demand for this type of service Very conceptual level of performance
The Minimalist	Neutrality Freight forwarding consolidation Proposing integrated and international transport solutions Optimisation of global transport networks Optimising capacity utilisation of empty and full trucks create synergies through transportation networks	Transport infrastructure's disparity among countries Relocation movements and bringing consumption areas closer to production areas Service limited to transportation

Table 2.
Benefits and disadvantages of 4PL Business Models

involves a single client scheme, which often implies cross dependencies (4PL and client). Entering a 4PL-client relationship is also risky because of (1) the enormous financial commitment from both parties and (2) the irreversibility of the 4PL-type project in the event of failure. Clients are sometimes reluctant to engage with a Metronome, advancing the lack of operational competencies of the LSP and the potential cultural incompatibility of the actors who could potentially take part in a proposed logistics organisation.

In practice, clients prefer the services of the Nostalgic, finding in this business model more operational coordination, efficiency skills and operational flexibility. This stems from the nature of the Nostalgic as provider who owns his proper assets offering the client better resilience in case of disruptions allowing him to easily recover from a failing 3PL. Also, he has a great ability to adapt to uncertain environments considering its global presence and various

expertise. Nevertheless, the Nostalgic provider presents risks suffers from the customers' perspective, namely the client's risk of losing the power to negotiate prices with service providers, or the sensitivity of the financial data of 3PLs. A Nostalgic that is part of a logistics organisation involving 3PLs has access to their price lists, which could represent an ethical problem/The Nostalgic could thus become a direct competitor to the 3PLs. This business model has usually a focus on operational activities and a difficulty in accepting 4PL as an actor operating on strategic and operation SC levels (lack of neutrality).

Other clients choose the Architect to ensure neutrality, improve SC financial performance and to have the ability to modularise and reconfigure informational networks. This business model is instrumental in enabling SC analysis, innovative logistics concepts development, rethinking logistics practices, reengineering business processes and capitalising SC knowledge. However, clients consider Architect as entities with a very conceptual level of service with very low operational expertise in SCs.

Finally, another set of clients is oriented towards the Minimalist, which is distinguished by neutrality, freight forwarding consolidation and optimisation of global transport networks. These business models create synergies through transportation networks, offer integrated and international transport solutions, and optimise capacity utilisation of trucks. Despite these advantages, the Minimalist is considered as a partner limited to transportation and confronted with several issues such as the disparity of transport infrastructure among countries. Another major risk facing the Minimalist as an international transport company is the movement of reshoring that reduces the opportunity of handling the transport of goods around the world. This movement of reshoring represents a risk as it might hinder the development of this mode of service.

Managerial and theoretical implication

The development of taxonomy of 4PL BMs has theoretical and managerial implications. First, we present the theoretical implications and then we suggest the managerial implications of this study.

Theoretical implications

Following an inductive approach, our study derives empirically rooted dimensions to suggest a taxonomy of 4PLs that bridges the gap between the conceptualisation of this LSP category and current business practices. The analysis of our textual enabled us to classify 4PL BM along two dimensions that emerged from data, namely, the level of involvement in 4PL SO and the level of reliance on interpersonal relationships. The classification of 4PL BM based on these dimensions allowed us to uncover clearly distinct 4PL taxa: the Metronome, the Minimalist, the Nostalgic and the Architect. By departing from previous taxonomies by focussing only on 4PL and excluding criteria relevant to 3PL, we contributed to 4PL literature by uncovering LSPs that differ in terms of resources and competences utilised to propose their 4PL SO. Derived from the narratives of participants working in organisation that identify as 4PL, we offer a taxonomy that is anchored in current practices and differentiates between 4PL BM that conflates with 3PL.

Previous works on 4PLs typologies and taxonomies overlooked the interpersonal relationships dimension as a classification criterion (Saglietto, 2013). Our taxonomic approach contributes to a better understanding of the reality of the 4PL SO by highlighting the role played by interpersonal relationships in offering 4PL SO. Based on empirical configurations, this taxonomic approach specific to 4PL practices constitutes a synthetic language used to express the dynamic and complex reality of the mutations of 4PL SO. It contributes to structuring, rethinking and making more intelligible the mutation of the 4PL

SO with the inclusion of the relational dimension. In line with the findings of Prajogo *et al.* (2021), we highlight the importance of the relational elements in generating positive outcomes from SC collaboration. Our findings add to the literature by differentiating between networks of interpersonal relationships and the utilisation of these networks in the coordination of SC activities. We demonstrate that the level of reliance on and nature of utilisation of social capital is contingent upon the 4PL BM and internal resources of the organisation. That said, our taxonomy leads to the identification of a consensus on the importance of the relational register in the four BMs. More importantly, our research findings explain how interpersonal relationships are extensively mobilised as resource by a 4PL, whether other types such as the Nostalgic for instance rely on this relational dimension to a limited extent. From the experience of participants, interpersonal relationships utilisation varies across 4PLs.

Finally, we do elaborate on the literature on 4PLs by enhancing our comprehension of how each business model differs. Through a comparison of the 4PL classification, we identify the benefits and disadvantages a client might face when choosing a particular type of 4PL. By identifying the characteristics that makes a particular suitable for certain situations and less advantageous in others, we increase the clarity of our taxonomy. Indeed, we demonstrate that 4PLs are not a one size fits all provider, thus, we bridge the gap between the conceptualisations and current practices of 4PLs.

Managerial implications

Our research findings can be used to make managerial recommendations to clients of 4PL services or to managers working for this category of LSP. We proposed new 4PL taxonomy anchored in current business practices that helps clarify the meaning of 4PL for actors in the logistics sector. By conducting a large study with the support of actors from within the 4PL sector, we derived four business models that better reflect the current practices and classifications of a 4PL. By analysing the data, we identified two key dimensions: the level of involvement in 4PL SO and the level of reliance on interpersonal relationships. The variation in 4PLs across these two dimensions will enable both clients and actors within the LSP industry to better differentiate between what are and what are not 4PLs. On the one hand, we offer practical insights for actors within the industry regarding situations in which a provider should mobilise inter-personal relationships and to what extent (developing business or managing operations). On the other hand, clients can use the taxonomy to identify the right 4PL to meet its business requirements. The findings are also of importance to policymakers inasmuch as they will better orient decision-making regarding investment in infrastructure, taxation and governance of the sector. Additionally, by differentiating between a high and low level of involvement in 4PL service offerings, we help disentangle the issues that have led to the persistent conflating of 3PL and 4PL actors. Using our taxa, 4PL actors can better tailor their services and strategies to serve targeted segments of clients more effectively.

Additionally, our analysis of interview data has enabled us to uncover a new category of 4PL that are only international transportation companies. Contrary to classic transportation companies, firms in this category of LSP do not limit their SOs to local transportation but rather extend their services to encompass multimodal transportation operations on a global scale on behalf of their clients. Furthermore, we develop an overview of the benefits and disadvantages of each 4PL business model. As a result, actors in the 4PL industry and their clients can use these practical recommendations considering their involvement in current business practices. Actors in the 4PL industry can apply these insights to better market and differentiate their service offerings by highlighting their benefits or by avoiding contracts that may be hampered by the weaknesses in their particular business model. At the same time, clients now have clear guidelines for choosing the 4PL type that best suits their business requirements.

Conclusion

In this paper, we applied an inductive approach to elaborate on existing theory combined with a set of objective qualitative analytical techniques (AATD) to generate empirically anchored dimensions of a taxonomy of 4PL BMs. Based on the analysis of the corpus of interviews, two dimensions emerged, enabling us to identify distinct and mutually exclusive 4PL BMs. Our taxonomy is instrumental to clarifying the complex reality of 4PL BMs and their shifting organisational configurations. Our empirical findings highlight the differences among these LSPs according to the level of involvement in the 4PL SO and the level of reliance on interpersonal relationships.

Induced from empirical reality and based on the application of qualitative analytical techniques our taxonomy further refines existing classifications. Indeed, it highlights the heterogeneity of LSPs that offer 4PL services with varying intensities. Built on the interdependencies between (1) the involvement in the 4PL services and (2) the investment in the relational sphere, our taxonomy makes it possible to describe the reality of complex and shifting organisational configurations of 4PLs. This classification system breaks down 4PL practices into four business models that we have called (1) The Metronome, (2) The Nostalgic, (3) The Architect and (4) The Minimalist. For the Metronome, social capital and social ties represent a lever enabling them to play the role of an intermediary. These players have a high involvement in the 4PL service and hold a neutral position in the supply chain. Paradoxically, the Nostalgic is structured differently. They believe that relationships are not a strategic dimension. With a low degree of integration, the Nostalgic perceives the 4PL service as logic of expansion and diversification. The Architect values the relational dimension as well as expertise in the design and reengineering of logistics processes. Their field of intervention in modelling and managing logistics chains is partial. They usually operate in project mode and do not have a strong focus on 4PL services. Finally, the Minimalist specialises in the design, management and optimisation of SC transport schemes by calling on several LSPs and carriers.

Although this research has produced important theoretical and managerial implications, it also suffers from a few limitations. First, our research is limited to 4PL practices in France. Future work should explore the taxonomy of 4PLs in other contexts, both in developed and emerging countries. In our study, we used reliance on interpersonal relationships as a key dimension. Future studies can integrate the dimensions we derived from data to further explore the possible change in taxonomies based on this work. Additionally, we focus primarily on the perspective of the 4PL as a provider but do not incorporate the vision of the clients into the proposed taxonomy. Future studies could include the perspective of clients to further enrich the taxonomy of 4PL service offerings. Finally, we did not explore the dynamics that can occur over time among the different 4PL business models. As a consequence, it would be valuable to explore those conditions under which a 4PL will change its business model to another.

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