Exploratory and Empirical Analysis of E-Marketplaces for Truck Transportation Services Procurement

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ABSTRACT

In the late 1990s, early 2000s, academic literature considered electronic marketplaces as a game changer in truck transportation services procurement. Early enthusiasm was followed by skepticism regarding e-marketplaces' usefulness and the popularity of e-marketplaces appeared to wane both in industry and in academic literature. However, recent sources argue that almost half of the freight currently transported by truck in the USA is subject to transactions conducted in e-marketplaces. This dissertation intends to fill a gap in the academic literature by showing that truck transportation e-marketplaces necessitate renewed dedicated research efforts, by exploring the strategies implemented by e-marketplaces in this specific industry and by linking these strategies to marketplaces' performance. First, transportation and non-transportation e-marketplaces are compared in chapter 2 with regard to their usage of mechanisms designed to generate trust among users. Results show that truck transportation e-marketplaces use these trust mechanisms differently than non-transportation e-marketplaces, which supports a call for research on e-marketplaces in the specific context of truck transportation services procurement. In chapter 3, a database inventorying the usage of 141 features by 208 e-marketplaces is then created to initiate the empirical exploration of these specific e-marketplaces. Thanks to that database, a new typology (a way of classifying objects based on several simultaneous classification criteria) is developed in chapter 4 that identifies three main truck transportation e-marketplace strategies (two with sub-divided into two sub-strategies). The typology provides a state of industry and puts in perspective the specificity of truck transportation e-marketplaces with regard to their structure along 11 dimensions known to the general e-marketplace literature. Finally, the link between e-marketplace strategies and performance is investigated in chapter 5. Performance is measured with three traffic metrics: number of unique visitors per day, number of page views per day, and website ranking. Results show that third-party-owned e-marketplaces that provide auction mechanisms with a fairly high level of user decision and transaction support are more successful than other e-marketplaces. This dissertation provides a picture of existing e-marketplaces for the procurement of truck transportation services, challenges components of existing theories and provides ground for further research.

DEDICATION

This dissertation is dedicated to my wife, Dr. Olga Bruyaka. You are the one great researcher that showed me what academia is and gave me the desire to join. Your tenacity, passion for research and high standards is the example I followed at all moments. Your love and unconditional support was key to this dissertation's accomplishment. Most of all, thank you for giving me the quintessential reason for all of it – our two superb boys, Archibald and Anatole.

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CHAPTER 1

Introduction to truck transportation, its procurement via e-marketplaces and dissertation plan

Truck transportation is a primary function of logistics, moving loads of products from one location to another as needed throughout a supply chain (Chopra and Meindl 2007, Sanders 2012). Legally and operationally, transportation also includes all services related to the movement of the products "including arranging for, receipt, delivery, elevation, transfer in transit, refrigeration, [*etc.*]" (49 U.S.C. §13102). Truck transportation is the most prominent mode of transportation in the U.S.A. The American Trucking Associations (ATA) reported that in 2015 trucks carried 9.96 billion tons of freight or 68.8% of the freight tonnage in the U.S., and trucking claimed 80.3% of the total revenue of all domestic transportation modes with $700.4 billion (http://www.trucking.org/article.aspx?uid=d62a253d-b830-4fa3-b069-f7f8ff5d40df). According to the 2013 Council of Supply Chain Management Professional's annual logistics report, truck transportation in the USA constitutes close to 50% of total logistics expenses and transportation costs have been reported to constitute up to two thirds of logistics budgets for Small and Medium-sized Enterprises (SMEs) (Martins *et al.* 2010).

In a supply chain, the transportation function acts as a link between the shippers (*i.e.,* the organization sending the goods) and their customers. The transportation service provided must meet the requirements imposed on both ends of the link and adapt to the type of products being carried, the legislation tied to those products, the distance to be covered, and the real estate constraints for loading and unloading. Carriers (*i.e.,* those providing the transportation services) buy specific equipment and hire drivers to match requirements. By doing so, the carriers add their own constraints to the problem – truck maintenance, geographical area served, time availability, and transportation legislation. Because of the combination of constraints, finding an efficient match between the offer and the demand of transportation is not trivial.

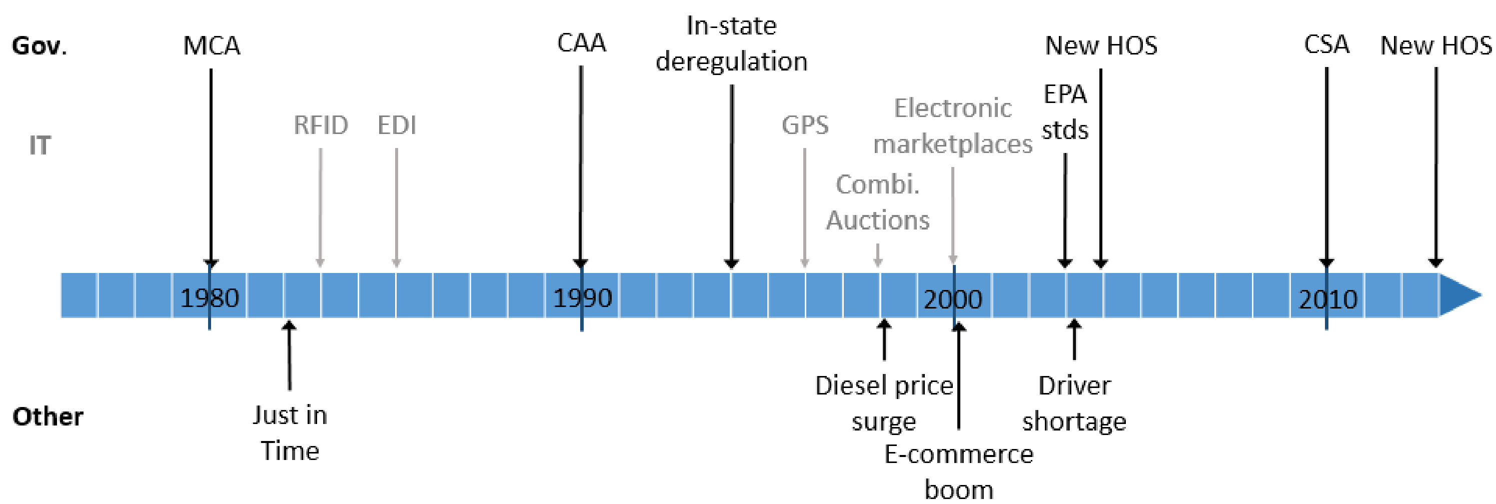
In the U.S. trucking industry, the most popular way to solve this matching problem has been private carriage. Private carriage is the result of a shipper creating a private carrier that would only carry the goods of the parent shipper. The advantage of private carriage resides in the certitude that the equipment matches the need and is available when needed at a known cost. Its disadvantage resides mainly in a potentially high operating cost since the carrier only works for the parent shipper and may be idle when the shipper's demand for transportation is low.

Independent carriers work for several shippers, thus potentially mitigating the risk of idle time that exists with private carriage. The relationship between shippers and independent carriers can be complementary in terms of the meeting of transportation needs and the reduction of idleness. These independent carriers are called for-hire carriers since they offer transportation capacity to any shipper who wants to hire them. However, working for several shippers re-introduces the diversity of requirements issue. To simplify the matching process, the carriers' market has been fragmented in segments along several dimensions. Load size is one of the major dimensions. If the load of products to be shipped fills a whole truck, it is termed a truckload (TL). Otherwise, it is called a less-than-truckload (LTL), unless the load is only made of a few parcels (generally about 150 pounds), in which case it is considered as small parcel or package delivery (http://www.irs.gov/Businesses/Trucking-Industry-Overview---Complete-Version, Agarwal *et al.* 2009, Chopra and Meindl 2007, Hill 2012, Shapiro 2001, Wisner *et al.* 2012). Another dimension is the distance to be covered. Some carriers offer to transport goods over long distances whereas some focus on local deliveries. Long distance delivery is often TL and short distance is often LTL or small package delivery. Carriers can also specialize based on the products to be carried. Finally, time is a *de facto* segmentation dimension. Since the matching task is arduous, carriers and shippers may create anticipated matches based on forecasted demand. These matches often give lieu to long-term contracts. For-hire carriers benefiting from those contracts are often referred to as "contract carriers". Demand that has not been matched based on forecasts but requires a match once the live requirements are known generally necessitates the use of often called "common carriers" who offer their services on a spot basis. The main advantage for a shipper to proceed with for-hire carriers rather than with a private carrier, is to reduce cost by transforming a structural cost into a variable cost that can shrink with the activity level. Advanced matching, based on long-term forecasts, can create economies of scope and scale that reduce costs and thus can be beneficial to both shippers and carriers. The main disadvantage of outsourcing is the loss of control over operations which results in a higher risk in quality loss, especially if the transportation function is a core competency of the shipper. Further, common (*i.e.,* non-contracted) carriage adds vulnerability to cost being dependent on the market prices.

Despite this segmentation of the market, it remains difficult to match demand and offer in such a way that no equipment is left idle. The task is actually so complex that intermediaries exist to handle it professionally. Those intermediaries are called brokers and freight forwarders. Both offer to find carriers to move the shippers' freight with the difference being that the freight forwarders temporarily take possession of the freight and the corresponding liability (http://www.irs.gov/Businesses/Trucking-Industry-Overview---Complete-Version, Boyle 2000).

Besides the shippers, the carriers and the intermediaries, another set of players impacts the transportation industry at a structural level. Chopra and Meindl (2007) identified the policy makers (*i.e.,* the state and federal agencies) and the infrastructures owners (*i.e.,* road, truck stops owners, *etc.*). Information technology providers can be added to that list. Since 1980, a series of changes in the truck transportation industry have occurred, due mainly to the policy makers and IT providers responding to shifting technological and economic landscapes. These changes have had a great impact on how truck transportation is procured (Sheffi 1990). The following timeline (Figure 1) shows the sequence and abundance of changes that occurred in a relatively short time frame.

Figure 1: Timeline of changes that impacted the transportation industry



Legend:

Gov.: Government

MCA: Motor Carrier Act

CAA: Clean Air Act

EPA stds: Environmental Protection Agency standards

HOS: Hours Of Services

CSA: Compliance Safety and Accountability

RFID: Radio Frequency IDentification

EDI: Electronic Data Interchange

GPS: Global Positioning System

Combi. Auctions: Combinatorial Auctions

Before the 1980s, shippers preferred private fleets to outsourcing mainly to avoid complying with the for-hire regulations (Hirsch and Macpherson 1997) and typically maintained arm's length relationships with professional carriers when they did outsource (Andersson and Norrman 2002). After the market was deregulated in 1980, the number of for-hire carriers increased greatly (McMullen 2005) being multiplied by 68 since then (http://www.trucking.org/article.aspx?uid=d62a253d-b830-4fa3-b069-f7f8ff5d40df), prices went down (Bardi and Tracey 1991), emphasis was put on customized services offered at a price that could differ from the "standard" tariffs in use before deregulation (Bienstock 1994, Farris and Pohlen 2008, McGinnis 1990, Nandiraju and Regan 2003, Sink and Langley 1997, Weart 2007, Wisner *et al.* 2012), the JIT concept became popular among shippers and carriers (Andersson and Norrman 2002, Crum and Allen 1990, Jones *et al.* 1997, Larson and Gammelgaard 2001, Lee *et al.* 1997, Razzaque and Sheng 1998), and EDI improved communication between partner companies (Crainic *et al.* 2009, Crum *et al.* 1996, 1998, Harrington 2003, Larson and Gammelgaard 2001). All of these changes contributed to a decline in the use of private carriers whereas for-hire carriers thrived (Boyer 1987). Notably, in an industry known for its low investment in IT (Economics and Statistics Administration Office of Policy Development 1996, p.16), the ability of some for-hire carriers to offer advanced services (Andersson and Norrman 2002) with state-of-the-art technologies (Razzaque and Sheng 1998, Sauvage 2003) was compelling to shippers. Furthermore, the adoption of environmental and safety laws (e.g., CAA, EPA standards, CSA and HOS, please see Figure 1) reinforced the idea that expert partners are needed to fulfill increasingly complex transportation requirements (Andersson and Norrman 2002, Harrington 1996b, Weart 2007). Outsourcing became the preferred procurement practice (Razzaque and Sheng 1998). Shippers preferred long-term advanced partnerships with few carriers over long-term arm's length relationships (Bienstock 1994, Figliozzi 2004, Larson and Gammelgaard 2001) and private carriers (Crum and Allen 1997). An advanced partnership is defined as a cooperative relationship based on trust between a shipper and a multi-function for-hire carrier who share information and are aligned to perform extended customized services planned in advance in a mutually beneficial manner (Bolumole 2001, Gardner *et al.* 1994, Larson and Gammelgaard 2001, Li and Lin 2006, Razzaque and Sheng 1998, Rossiter Hofer 2007).

Since few advanced partners can provide all services, a new type of player appeared in the industry – Third Party Logistics providers or 3PL. In the literature, 3PL has been defined as "a relationship between a shipper and a third party which, compared with basic services, has more customized offerings, encompasses a broader number of service functions and is characterized by a longer-term, more mutually beneficial relationship" (Murphy and Poist 1998, p. 26). With regard to transportation, the service functions include working as a carrier and a broker/forwarder. A 3PL's value added to the shipper resides in the shipper getting rid of the liabilities associated with a private carrier while maintaining a high level of service to the customer (in terms of quality and cost). Since a 3PL generally has authority to be a broker/forwarder, whether the 3PL owns the assets (*i.e.,* trucks) or not is of little concern to the shipper. Hence the appearance of non-asset-based 3PLs, which are logistics providers that focus on people and systems as their major assets (Sheffi 1990) and do not invest in warehouses or trucks but subcontract that part of the business to asset-based providers (Murphy and Poist 1998, Song and Regan 2001).

The proliferation of intermediaries was, however, threatened by the appearance of new Internet-based technology. Starting in the mid-1990s with NTE (National Transportation Exchange) and DAT (Dial-A-Truck) (Nandiraju and Regan 2003), online transportation marketplaces (henceforth referred to as e-marketplaces or EMs) appeared and provided readily available and relatively cheap ways to apply existing mechanisms (e.g., auction) aimed at matching the demand of buyers with the offers of transportation services from sellers (Goldsby and Eckert 2003, Nandiraju and Regan 2003). Transportation EMs take a wide variety of names in the literature: online freight marketplaces, virtual marketplaces, electronic Internet marketplaces, electronic transportation marketplaces, spot markets, and electronic freight marketplaces just to name a few (Crainic *et al.* 2009, Goldsby and Eckert 2003, Lancioni *et al.* 2003, Nandiraju and Regan 2003, Song and Regan 2001). The tools offered online for the truck transportation procurement are very diverse. Following Nandiraju and Regan (2003) and Boyle (2000), 4 models of EMs can be identified based on the "method of trading or price discovery" (Boyle 2000, p. 21): the catalog model, the post and search model, the auction model, and the exchange model. In the ***catalog model***, a shipper gets to pick a carrier among a list of carriers who have provided the EM with their prices in advance. Iship, smartship and freightquote are examples of such EMs. The ***post and search model*** is the most common among EMs. It transferred the traditional load-board model online. Shippers post their loads and carriers post their idle equipment. When one party is interested in the other party's offer, one-on-one negotiations start. Generally negotiations are conducted offline. This model includes DAT Load Boards, The Internet Truckstop and getloaded.com. In ***auction models***, one party (most often the shipper in truck transportation) posts its requirements and several players of the other party (most often the carriers) place bids. In a reverse auction, the shipper posts loads and carriers offer their services. This market mechanism should drive the prices down as carriers compete for the loads. Uship.com and anyvan.com are examples of such EMs. Finally, an ***exchange model*** works as a many-to-many mechanism. Shippers post their loads and reservation prices, carriers post their availabilities and bids, and the market mechanism both finds matches and determines the prices dynamically as the players update their information in real time. True exchanges seem to be rare. Some versions of it are offered by Carrier Point and Manhattan Associates. As the EM industry matured, several providers began to offer ***mixed models***. For example, auction models can work as quasi catalog models by offering a "buy-it-now" or "book-it-now" option. Both uship and anyvan offer this option. Also, 123loadboard and Sylectus can work either as load-boards or auctions.

EMs were expected to replace intermediaries (*i.e.,* brokers, forwarders and maybe the 3PLs) but they have not for reasons that are still being explored (Koch and Schultze 2011). In the early 2000s, the most popular type of transportation EM was the auction model (Elmaghraby 2007, Goldsby and Eckert 2003, Nandiraju and Regan 2003). Auction EMs' primary use was to fulfill urgent transportation requirements at a lower price by forcing carriers to compete against each other (Nandiraju and Regan 2003). The initial popularity of these EMs faded quickly (Goldsby and Eckert 2003, Lancioni *et al.* 2003, Song and Regan 2001, Alt and Klein 1998, Elmaghraby 2007, Nandiraju and Regan 2003, Purchasing 2001). This wane in popularity is often attributed to the viewpoint that transportation is a complex service and not a commodity purchased solely based on price (Dupin and Saccomano 2003, Elmaghraby 2007, Goldsby and Eckert 2003, Nandiraju and Regan 2003, Song and Regan 2001). In addition, any party could participate in early EMs without any type of vetting process. Thus, EMs suffered from a lack of credibility (Lucking Reiley 1999). Undesirable behaviors, such as shippers posting fake loads to gain information and carriers taking jobs that they did not fulfill, were harder to control in the early days of EMs. Since EMs often belong to third parties not involved in the actual movement of freight, it was difficult to ensure that deals contracted through the EM would end in successful completion (Nandiraju and Regan 2003). Therefore, players that were already reluctant to share critical information online (Boyle 2000, Lin *et al.* 2006) turned away from EMs.

However, the 2008 financial crisis shrunk the American economy, thereby reducing the volumes to be carried by its trucking industry. As a consequence, loyalty to primary carriers was shaken when some shippers used online market technologies to drive prices down (Sparkman 2009, http://meltontruck.com/library/Press/2012/4-26-2012ShippersConditions&SpotMarketImpact.pdf; State of Logistics Report, 2008). This decrease in prices eroded profits to such an extent that many carriers, even large ones, went bankrupt (Moore *et al.* 2010, Williams *et al.* 2013). This forced changes in the practices of shippers, carriers and intermediaries regarding short-term procurement.

Traditionally, companies used short-term procurement when faced with unexpected needs (Russell and Taylor 2015). Many uncertainties (e.g., under-forecasted demand, road traffic or waiting times) disrupt long-term plans, forcing the shipper to improvise at the last minute (Nandiraju and Regan 2003). It has been suggested that when demand is highly uncertain, it is advisable to go on the spot market (Stojanovic *et al.* 2011). Moreover, short-term practices can be used to address the needs for basic services when decision criteria are clear (Andersson and Norrman 2002). That helps eliminate some of the complexities of long-term procurement (Andersson and Norrman 2002, Bask 2001). Based on the above considerations 3PL reduced their fleet sizes. Large carriers expanded their brokerage divisions to both make sure they can sell available space in their own trucks and be able to contract with shippers without having to invest in more trucks (e.g., JB Hunt) (Song and Regan 2003). Non-asset-based intermediaries gained in popularity (Cassidy 2011) and are expected to use EMs extensively (Armstrong & Associates, Inc., http://www.3plogistics.com/3PLmarket.htm; Murphy and Poist 1998, Song and Regan 2001). Several recent studies and surveys from the industry seem to confirm the regain in activity of EMs for short-term procurement. Whereas Caplice (2007) estimated that, in the TL segment, 5 to 10 % of the transportation needs are procured on the spot market, the actual number seems to be much higher in recent articles. In a recent study of the dry van TL segment (*i.e.,* trucks hauling 26- to 53-feet-long trailers that are not refrigerated), Kim (2013) shows that only 64% of a shipper's load are assigned via a long-term procurement practice. The remaining loads plus 20% of the loads rejected by the carriers after the attempted assignment are assigned through short-term practices. Overall, almost 50% of the TL dry van segment could be using short-term procurement practices. These numbers are close to what is disclosed by Transcore – the provider of DAT load boards and a respected authority in the truck transportation industry. Transcore carriers' survey (2011b) notes an upward trend among for-hire carriers in the use of the spot market to find loads. In this report, Transcore surveyed 20,000 carriers and found that on average carriers find 42% of their freight on the spot market (including load-boards). Similarly, intermediaries seem to indeed use EMs substantially. Transcore's broker benchmark survey (2011a) shows that 54% of brokers use commercial online spot market tools, in addition to their internal resources to find carriers. Therefore, EMs seem to currently impact a substantial share of the transportation procurement industry and to date few works have empirically studied transportation EMs. Consequently, this dissertation proposes to further identify the keys to the performance of transportation EMs.

Given the important role of trust in the EM literature (Gefen *et al.* 2003, Pavlou 2002), chapter 2 identifies differences in the approach of transportation EMs to trust issues compared to EMs from other industries. Academic research can benefit from this study as it is one of the first to empirically analyze the differences between transportation EMs and EMs from other industries. For practitioners, it provides an overview of the state of the transportation industry EMs with regard to trust building features, which can raise awareness of critical factors in the design of future transportation EMs. To conduct this empirical analysis, the concept of trust is first defined and based on Zucker's work (1986), trust production modes and the corresponding literature are reviewed. Second, the instrument developed by Son *et al.* (2006) is explained and its adequacy for comparing transportation EMs to other EMs is demonstrated. Third, differences between the transportation industry and other industries are identified by the exploration of multiple written sources (*i.e.,* academic literature, trucking forums, "terms and conditions" of transportation EMs, blogs and magazines) and hypotheses are developed. Fourth, the methodology to empirically compare transportation EMs to non-transportation EMs is explained. Finally, the results are presented and discussed.

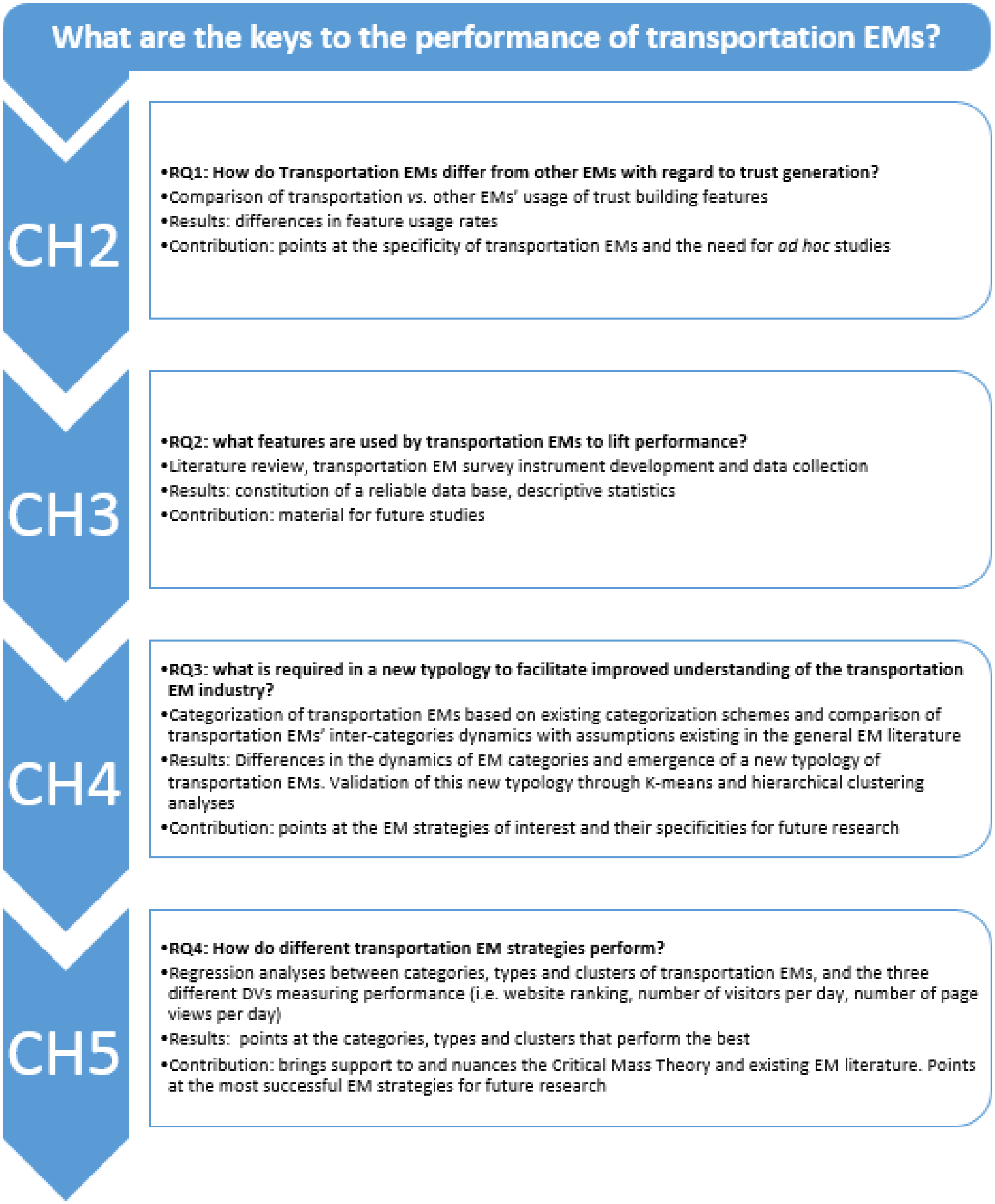
The identification of the differences in trust building features in chapter 2 provides the groundwork that is needed to answer the question *"what features are used by transportation EMs to lift performance?"* Chapter 3 answers this question. A database containing the usage records of 141 features by 208 transportation EMs is generated to serve the purpose of the following chapters. The canons of grounded theory approach are followed in order to create a transportation EM survey instrument. First, in an iterative process, a literature review is performed and a topic guide is elaborated to guide the exploration of transportation EMs features that can impact adoption, use or success. Five main topics have been identified: trust and uncertainty/risk, services offered, website quality, strategic factors and behavioral factors. The academic EM literature dealing with these topics is reviewed and all features that were identified as possibly impacting EM adoption, use or success are inventoried. Second, the data collection process is detailed. Third, the reliability of the data collected is tested to make sure that the database can be used for the subsequent chapters. Finally some descriptive statistics regarding the database are provided.

Chapter 4 focuses on the strategies implemented by transportation EMs and answers the following question: *"What is required in a new typology to facilitate improved understanding of the transportation EM industry?"* First, the literature on EM categorization schemes has been reviewed in order to identify all categorization schemes used in the general EM literature. A categorization scheme is a way to discriminate between EMs based on a specific chosen criterion (e.g., types of parties involved, number of participants, or fee structure). Categorization schemes can be useful for decision making in EM selection processes (Grieger 2003) and for theory building when the relationships between schemes are understood (Wang and Archer 2007). Therefore, hypotheses regarding inter-schemes associations are formulated based on the literature review. Then, based on the definition of categories within each categorization scheme, the features identified in chapter 3 are used to classify all EMs within the categorization schemes. After the coding reliability for adopted features is further verified, the methodology to test associations (a.k.a. tests of independence) between categorization schemes is demonstrated and implemented. A new typology is suggested based on all relationships revealed by the tests of independence between categories, and two clustering algorithms are run in order to validate and formulate a definitive version of the typology. The results are then presented and explained in terms of relationships between categories and the similarities and specificities of transportation EMs compared to the general EM literature.

Using the categorization schemes as well as the new typology and the clusters identified in chapter 4, chapter 5 answers the following question: *"how do different transportation EM strategies perform?"* After reviewing the literature on EM success, three metrics for success have been identified: website rank (alexa.com), number of unique visitors per day (hypestat.com), and number of page views per day (hypestat.com). The Critical Mass Theory (Markus 1987) is used to hypothesize the differences in performance between EM types and a set of three studies has been designed to test these hypotheses. The first study tests the effect of EM categories on performance. The second study tests the effect of types on performance and the hypotheses are tested. The results of study 1 help in explaining why some hypotheses are supported and some are not in study 2. Finally, study 3 analyzes the link between EM clusters and performance. This serves as a test of robustness for the findings of study 2 because clusters obtained through k-means and hierarchical algorithms were found to be tightly related to the types found through the analysis of dependences between EM categories.

Figure 2 summarizes the dissertation plan.

Figure 2: Dissertation plan



CHAPTER 2

Transportation *vs.* non-transportation EMs: the use of trust features

Abstract

Although some studies show the role of industry context in the survival and success of EMs, EMs for truck transportation services procurement have not been studied on their own. EMs dealing with different types of products and services all need to generate trust to attract participants but the way EMs do it might differ across industries. This chapter shows how truck transportation EMs differ from EMs in other industries with regard to trust generation. The concept of trust as well as trust production modes are defined. An instrument surveying usage proportions of features aimed at generating trust is identified and hypotheses are developed regarding expected differences in usage proportions between transportation and non-transportation EMs. The results supports 4 out of 8 hypotheses and show that transportation EMs use highly visible and actionable structural assurances (e.g., member screening) that are on EMs' "operational path" (where users have to click to conduct transactions) more frequently than non-transportation EMs but other assurances and reputation effects (e.g., disclosing team profile) less frequently.

2.1. Introduction

Internet marketplaces grew popular very rapidly at the end of the 20th century. Researchers that studied electronic marketplaces (EMs) quickly identified that the generation of trust between the different parties involved was of utmost importance (Ba and Pavlou 2002, Pavlou 2002). Frameworks developed to explain trust generation in traditional settings (e.g., Zucker 1986) were applied to EMs successfully (Gefen *et al.* 2003, Pavlou and Gefen 2004 and 2005) and allowed the development of knowledge about trust generation on EMs. In their paper, Son *et al.* (2006) survey 100 EMs to explore the usage made of 11 categories of trust building features (sub-divided into 29 features). This study described in what proportions trust features were used at the time and provided the research community with a survey instrument. However, the study by Son *et al.* (2006) considers EMs as a homogeneous population. Although researchers have shown that industry characteristics impact EM performance (Rosenzweig *et al.* 2011) and the concept of trust is known to be influenced by context (Kim and Ahn 2007), few attempts have been made at empirically studying trust generation in the specific environment of transportation EMs.

The primary goal of this dissertation is to identify the characteristics of transportation EMs that are key to performance. With this goal in mind, it is important to determine the differences in terms of trust generation mechanisms between transportation and non-transportation EMs. Transportation EMs have been developed for the needs and concerns of a specific industry. Although unique because of the industry structure and the sourcing processes used (Janssen and Verbraeck 2008), very few empirical studies have been conducted specifically on transportation EMs since the EM shake-out of the five first years of the 21st century. Therefore this dissertation chapter offers to answer the following research question:

RQ1: How do transportation EMs differ from other EMs with regards to trust generation?

In this chapter, the instrument from Son *et al.* (2006) is used to survey a sample of non-transportation EMs and a sample of transportation EMs. Once the data collected, descriptive statistics regarding the number of features and each feature's percentage of usage are provided. Based on that information, statistical tests are performed to identify statistically and substantially significant differences between the transportation industry and other industries.

The remainder of this chapter is organized as follows. First a theoretical background is unfolded to define trust, identify the actors impacted and the trust production modes conceptualized in the academic literature. Second, the survey instrument developed by Son *et al.* (2006) and adopted in this study is described and its usage justified. Third, hypotheses are developed to shed light on differences between transportation and non-transportation EMs that can be expected from the grey and academic literature. Fourth, the methodology for selecting and collecting data about the two different sample groups of EMs is explained. Finally, the results of the study are presented and discussed.

2.2. Theoretical background for studying trust measures

This section defines trust and describes the multiple trust belief concepts that will be used in the EM comparisons. The role of different actors in trust studies is explained and the mechanisms helping trust creation on EMs are exposed through the prism of Zucker's framework (Zucker 1986), which identifies the causes of trust, otherwise called trust production modes.

2.2.1. What is trust?

Son *et al.* (2006) point to the absence of a universal definition of trust. However, Gefen *et al.* (2003) listed the conceptualizations of trust found in the literature at the time and most of these conceptualizations are included in the definition of trust by Mayer *et al.* (1995, p.712): trust is "the willingness of a party (trustor) to be vulnerable to the actions of another party (trustee) based on the expectation that the other (trustee) will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party (trustee)." Son *et al.* (2006) also pointed at the frequent use of that definition and since then many authors have used this definition or a similar one (e.g., Alsaif and Ghoneim 2015, Carter and Kaufmann 2007, Kim and Ahn 2007.) The expectation that the trustee will perform a certain action rests on several belief concepts (Bhattacherjee 2002, McKnight and Chervany 2002). Kim and Ahn (2007) explain that most transaction-related literature focuses on benevolence and integrity as the two main trust grounding beliefs. "Benevolence is the extent to which a trustee is believed to want to do good to the trustor" (Mayer *et al.* 1995, p.718). The integrity belief relates to "the trustor's perception that the trustee adheres to a set of principles that the trustor finds acceptable" (Mayer *et al.* 1995, p.719). It is often interpreted as the perception of the honesty and willingness of the trustee to keep its promises (e.g., McKnight *et al.* 2002, Rai *et al.* 2009). The EM literature recognizes a third main dimension with subtle variations in the definition (please see McKnight *et al.* 2002 and Rai *et al.* 2009): competence (sometimes referred to as credibility). It is either viewed as the perceived expertise of the trustee in the domain under consideration (e.g., Rai *et al.* 2009) or the ability of the trustee to fulfill its promises (McKnight *et al.* 2002). The difference is subtle but as explained by Mayer *et al.* (1995), a trustee can be technically competent without being able to actually complete a task.

In spite of subtle differences, the EM literature is in relative agreement regarding the definition and the multiple belief concepts impacting trust. However, the study of trust remains disparate in the literature due to the fact that trust is a concept that requires context in order to be conceptualized/ understood (Kim and Ahn 2007, Verhagen *et al.* 2006).

2.2.2. Who are the actors in trust studies?

Hardin (1992) explains the usefulness of conceptualizing trust based on three determinants (1) the properties of the trustor, (2) the attributes of the trustee, and (3) the specific subject over which trust is conferred. A broad spectrum of configurations of these three determinants is found in the EM literature. The trustor can be the seller or the buyer (*i.e.,* respectively the carrier or the shipper/ broker). The trustee can also be the seller or the buyer or additionally can be the EM provider. Roles are determined based on who is in the focal position of any study. Carter *et al.* (2004) and Chua *et al.* (2007) show that within a context (e.g., reverse auction or forward auction), sellers, buyers and the EM provider all incur vulnerabilities specific to the context. It is then the angle adopted by the authors of a study that dictates who the trustor and the trustee are and what vulnerabilities are being considered. In addition, depending on the level of analysis of the study, the actors can be studied as individuals, companies or communities of individuals/ companies. It has been shown that generating trust at any level helps the adoption, use or success of an EM. In their multi-level analysis, Redondo *et al.* (2009) explain that inter-organizational trust helps the adoption of e-trading by companies and inter-personal trust helps the furthering of its use. In addition, there are transference mechanisms between levels, which means that fostering trust at one level can help building trust at another level. Pavlou and Gefen (2005) show that past experience with specific people affects the perception of the community of people (*i.e.,* sellers in that study). Table 1 gives an overview of who assumes which role in different EM studies.

Table 1: (Dis)Trustors and (Dis)trustees in the EM literature

(Dis)Trustor(s)	(Dis)Trustee(s)	References
Buyer	Seller	Ba and Pavlou 2002, Ou *et al.* 2014, Pavlou and Dimoka 2006
Buyer	Community of sellers	Carter and Kaufmann 2007, Pavlou 2002, Rai *et al.* 2009
Buyer	Community of sellers and the EM	Kim and Ahn 2007, Pavlou and Gefen 2004 and 2005, Verhagen *et al.* 2006
Buyer	EM which also is the seller (e-vendor)	Kim 2008, Pavlou *et al.* 2007, Qureshi *et al.* 2009, Zhang *et al*. 2011
Buyer	EM	Datta and Chatterjee 2008, Koch 2003, Yeh and Li 2014
Buyer and seller	EM	Charki and Josserand 2008
Buyer and seller	Buyer and seller	Wang and Chiang 2009
Seller	Buyer	Bellantuono *et al.* 2013, Carter and Stevens 2007, Jap 2003

As seen in Table 1, most studies adopt a perspective in which the buyer is the trustor and the seller or sellers are the trustees. This is because EMs such as E-bay or Amazon are the most studied in the literature. In these EMs, sellers post their offers (*i.e.,* they describe the product or service offered) and buyers bid and send their money in expectation of receiving the product offered. Buyers are thus the vulnerable party in this situation. By definition, it is the one that accepts vulnerability that is the trustor; on Amazon or E-bay, it is the buyer. In a procurement EM (e.g., reverse auction), buyers post their need (*i.e.,* describe the product or service needed) and sellers bid and are selected (they will provide the product or service afterwards in expectation of payment.) In this case, vulnerabilities are more distributed across participants. If uncertainty/ risk cannot be reduced, then trust is the mechanism that replaces the ability to control (Rousseau *et al.* 1998). That is why Nandiraju and Regan (2003) conclude that B2B EMs (specifically transportation EMs in their paper) need to generate trust between participants, increase their participation and create a critical mass for the EM to be successful. Consequently researchers have investigated approaches for increasing trust in buyers, sellers and EMs and those approaches are discussed in the next section.

2.2.3. How to generate trust?

The need for generating trust on EMs has long been recognized in the academic literature (e.g., Gefen *et al.* 2003, Pavlou 2002, Son *et al.* 2006). It is well accepted to borrow concepts and trust mechanisms applied to individuals and generalize them to the inter-organizational and impersonal environment of EMs (Pavlou 2002). Wang and Benbasat (2008) explain that online technologies display human-like characteristics, which is true for organizations and websites as well, and justifies that trust can arise between a person and an EM, a trading company or a community of people. Consequently, literature on trust in EMs where buyers and sellers were either companies or individuals was included in the literature review of this chapter.

The work of Zucker (1986) on modes of trust production serves as the primary basis for explaining the creation of trust between parties. Zucker (1986) distinguishes three modes of trust production:

- Characteristic-based: trust is generated through the fact that the trustor feels similar to the trustee because they both belong to a "common cultural system" (Chang *et al.* 2013, p.440).
- Institutional-based: trust is generated through societal structures and intermediary mechanisms. These structures and mechanisms generate a user belief in the security of the situation (Shapiro 1987), which means that "institutional trust provides favorable impersonal conditions conductive to transactional success" (Pavlou and Ratnasingam 2003, p. 203).

- Process-based: trust is generated thanks to prior experience with the process. This prior experience can be personal or communicated via reputation mechanisms.

Table 2 details the trust production modes applied in various empirical studies through the lens of Zucker's framework (1986). This table shows that although all trust production modes are studied in the empirical literature, characteristic-based trust is rarely observed whereas the two other modes are well studied. Son *et al.* (2006) explain that impersonal electronic transaction might not support characteristic-based trust creation. Characteristic-based trust is more likely to happen with inter-personal relationships, when people can share gender, age, ethnicity, *etc.* However, if it is postulated that organizations and technologies can display human-like characteristics, then all trust-production modes are indeed applicable to trust production in EMs.

Table 2: Zucker's trust production modes in the empirical literature

Trust production mode		References
Characteristics-based		Wang and Chiang 2009
Institutional-based		Datta and Chatterjee 2008, Fang et al. 2014, Gefen et al. 2003, Kim 2008, Kim and Ahn 2007, Kim and Benbasat 2006, Pavlou 2002, Pavlou and Gefen 2004, Pavlou and Gefen 2005, Son et al. 2006, Verhagen et al. 2006
Process-based	Reputation/ feedback	Ba and Pavlou 2002, Bolton et al. 2004, Charki and Josserand 2008, Kim and Ahn 2007, Pavlou 2002, Pavlou and Dimoka 2006, Pavlou and Gefen 2004, Pavlou and Gefen 2005, Qureshi et al. 2009, Son et al. 2006
	Past experience	Bolton et al. 2004 and 2008, Carter and Kaufmann 2007, Gefen et al. 2003, Hill et al. 2009, Kim and Ahn 2007, Ou et al. 2014, Pavlou and Dimoka 2006

It is interesting to observe that a trust production mode can work toward multiple types of trustees. Institution-based mechanisms have been demonstrated to impact trust in e-vendors, EMs, a single seller or a community of sellers (Table 3). Similarly, process-based mechanisms impact trust in EMs, a single seller, a community of sellers and/or a single buyer (Table 3).

Table 3: Trustees impacted by categories of trust production modes in empirical EM literature

Trust production mode	Trustee	References
Institution-based mechanisms positively impact trust in…	e-vendor	Gefen et al. 2003, Kim 2008, Kim and Benbasat 2006
	EM	Kim and Ahn 2007
	vendor/ seller	Fang et al. 2014
	community of sellers	Pavlou 2002, Pavlou and Gefen 2004 and 2005, Verhagen et al. 2006
Process-based mechanisms positively impact trust in…	EM	Charki and Josserand 2008, Kim and Ahn 2007
	vendor/ seller	Ba and Pavlou 2002, Bolton et al. 2004 and 2008, Fang et al. 2014, Ou et al. 2014, Pavlou and Dimoka 2006, Qureshi et al. 2009
	community of sellers	Carter and Kaufmann 2007, Pavlou 2002, Pavlou and Gefen 2004 and 2005
	buyer	Hill et al. 2009

Based on Zucker's (1986) trust production modes, Son *et al.* (2006) constructed an instrument to survey EMs' use of trust building features. This instrument offers opportunities for the comparison of EMs belonging to different industries.

2.3. An instrument to compare transportation EMs with non-transportation EMs

The instrument developed by Son *et al.* (2006) is adopted for comparing the usage proportion of trust-building features between transportation EMs and non-transportation EMs. Under the prisms of the trust concept and how to create trust on EMs, the survey instrument is described. In Appendix B, the features in blue with a number in parentheses show the coding guide corresponding to the instrument found in Son *et al.* (2006). The survey instrument is a check list encompassing these features and used to identify the features used by an EM. The instrument is limited to the two trust production modes that are the main focus of the academic literature: institutional-based and process-based modes. In addition, it limits the observation of institutional-based trust features to structural assurances. Structural assurances are features or “procedures [that] are in place to promote success” (McKnight *et al.* 2002, p.339) (e.g., professional associations’ certifications, guarantees, legal procedures).

Different works study trust creation by focusing on different trust creation modes and trust creation features because the target of trust is not the same and the context is specific (Table 3). Therefore, it is deemed important that the instrument adopted for this chapter covers several trust production modes and features that can target different actors of the EM environment through different beliefs. Depending on the industry an EM is in, it might be necessary to use some features more than the others. The instrument developed by Son *et al.* (2006) to survey B2B EMs as one population appears appropriate for comparing two sub-groups of that population. The trust building features in that instrument correspond to several trust production modes, and impact different trust belief concepts towards all kinds of participants (Table 4). Table 4 identifies the trust building features that can impact each belief concept and illustrates that an EM of a particular industry can shape the trust it creates by offering different features inventoried in the instrument developed by Son *et al.* (2006). Some trust features should impact participants (*i.e.,* trading partners) and some should impact trust in the EM. That way, it is expected that the instrument covers a broad enough spectrum of features to discover which features are more or less used by transportation EMs when compared with non-transportation EMs.

Table 4: Illustration of the beliefs that can be impacted by trust building features.

Trust production mode	Trust building features		Benevolence of...	Integrity of...	Competence of...
Institutional-based trust from structural assurances	Escrow Services		EM	Participants	
	Monitoring product/services	product appraisal by experts	EM		EM, sellers
		guarantees and warranties	EM, sellers	EM, sellers	
		product inspection by third party	EM		Sellers
		product reviews by third party	EM		Sellers
	Insurance		EM	EM	Participants
	Cooperative norms	Arbitration rules		EM, participants	
		Codes of conduct	EM	EM, participants	
		Expected transaction patterns		EM	
	Member screening		EM	EM	EM, participants
	Third party assurance seals			EM	EM
	Privacy policy			EM	
	EM affiliation with respected organizations			EM	
Process-based trust from reputation effects	Reputation systems	peer ratings	EM, participants	Participants	Participants
		EM evaluation of participants performance	EM		Participants
	Disclosing EM profile	Disclosing EM longevity			EM
		Disclosing management team profile			EM
		Disclosing EM size			EM
	Disclosing past performance	Testimonials from current participants			EM
		Advertising awards earned			EM
		Excerpts from news media outlets	EM	EM	EM
		Advertising well-known participants			EM, participants

Table adapted from table 1 in Son et al. (2006)

2.4. Hypotheses development, EMs and problems encountered in the transportation industry

Around the year 2000, electronic procurement boomed in all industries. The transportation industry was no exception and might even have gone beyond some other industries regarding specific form of e-procurement such as combinatorial auctions. These online auctions "enjoyed great success in the procurement of transportation services […] Their application has been limited to a handful of industry sectors, such as transportation." (Elmaghraby 2007, p.414). However, this enthusiasm for EMs (and auctions in particular) resulted in a backlash and terms such as auction and exchange can now carry a bad connotation in the transportation industry (Caplice 2007). As explained by Boyle (2000), transportation has benefited from operations research literature but trust was identified as a challenging issue. That same challenge remains in current EMs.

The instrument selected for this chapter and described in section 2.2 is used to survey two samples of distinct populations of EMs – transportation EMs on one side and non-transportation EMs on the other side. The instrument is a check list of features and is used to identify features used by each EM. The raw result of the survey is a percentage of usage per feature within each sample. Based on this result, statistical tests are conducted in order to ascertain if the differences observed in usage percentages are due to random variation or are statistically significant. Although the significance of the difference for each feature is tested, hypotheses, based on the literature, are also developed in this section to anticipate the differences of transportation EMs.

The grey and academic literature were reviewed to identify problems that are specific to the transportation industry in the EM environment. Trucking forums, logistics magazines, logistics and supply chain annual reports, the "terms and conditions" webpages of four EMs with detailed "terms and conditions" (referatruck.com, DAT.com, freightquote.com, and anyvan.com), and academic literature were explored to identify the predominant concerns with transportation EMs. This allowed hypothesizing about differences to expect between transportation and other EMs.

One of the first issues found in transportation EM literature stems from the lack of participants' knowledge and understanding of the mechanics of EMs. Janssen and Verbraeck (2008) show that participants sometimes have trouble understanding the matching mechanism used by EMs, which can lead to distrust. This lack of understanding comes primarily from the difficulty of formulating bidding strategies and of understanding the outcome as the rules that determine the match can be complex and badly communicated (Janssen and Verbraeck 2008). As a consequence, it is recommended that the EM provide clear rules in order to avoid conflictual situations (Boyle 2000, Janssen and Verbraeck 2008). In the instrument adopted in this chapter, one feature relates to that concern: expected transaction patterns. It was coded as present in the EM when an EM provides users with an explanation of the transaction process and the rules that are adopted to make decisions (e.g., the winner determination rules in an auction). Since transportation EM literature seems particularly concerned about the clarity of rules, it can be assumed that "expected transaction patterns" will be more preponderant in transportation EMs than in other EMs. The following hypothesis is thus expressed regarding one of the expected differences between transportation and other EMs:

H1: Transportation EMs will display "expected transaction patterns" more often than other EMs

When EM behavior rules are set, another problem arises when participants adopt undesired behaviors. The problem of undesired behaviors is not restricted to transportation EMs as shown by Carter *et al.* (2004) and Chua *et al.* (2007), but the four webpages containing the "terms and conditions" of transportation EMs (please see referatruck.com, dat.com/load-board, freightquote.com, and anyvan.com) explored to support the formulation of hypotheses, unanimously condemn the use of one particular behavior: deceptive description of the objects of the transactions. Some webpages containing "terms and conditions" remain vague on the types of deception being used but indirectly acknowledge their existence:

> *"You understand that by using the Services, you may be exposed to Content that might be offensive, harmful, inaccurate or otherwise inappropriate, or in some cases, postings that have been mislabeled or are otherwise deceptive"* (https://www.referatruck.com/terms).

Other webpages, while encompassing a broad spectrum of cases also refer to specific cases:

> *"you agree that you shall not upload, post, […] any materials which […] constitute or contain false or misleading indications of origin, endorsement or statements of fact"*
> (http://www.dat.com/Company/Terms-and-Conditions.aspx)

Discussion forums also point at deceptive description of shipments (e.g., underestimated size of the shipment) in order to drive prices down or attract more offers (http://truckstopusa.com/showthread.php?29709-U-Ship&highlight=bidding). In Son *et al.* (2006), "code of conduct" is the feature coded if an EM tries to prevent those behaviors by recommending proper behaviors or practices. If transportation EMs substantially suffer from this undesired behavior, it can be expected that they will display codes of conducts more frequently than other EMs. Therefore, the following hypothesis is formulated:

H2: Transportation EMs will use codes of conducts more often than other EMs

Publishing a code of conduct pre-supposes that participants' behaviors can be shaped. It seems that in the transportation industry, relationships between shippers and carriers have long been adversarial and there is a profound fear of unreliable partners (Boyle 2000, Janssen and Verbraeck 2008). A way out of this issue is a screening process to restrict transportation EMs to reliable participants. All the terms and conditions explored for this dissertation chapter show that transportation EMs check for broker and carriers authority. Brokers and carriers are supposed to possess an authority number provided by governmental agencies and easily checked by EMs. As one user of the three predominant EMs put it in February 2012:

> *"First I do believe you have to have either motor carrier authority or a broker license to subscribe to one of the big 3 [EMs]. You will find there is a small vetting process that one has to overcome through time regardless of what kind of entity they are."*
>
> (http://www.thetruckersreport.com/truckingindustryforum/ask-an-owner-operator/170505-load-boards-101-a.html)

It can therefore be expected that "member screening" based on those government agencies' numbers is systematic in transportation EMs. However, these numbers are easy to get or to fake and comparing screening motor carrier authority or brokers' licenses might not be as rigorous as the screening process mentioned in the instrument borrowed from Son *et al.* (2006). Therefore, in order to keep the gist of Son *et al.* (2006) coding scheme, an additional feature was added to the coding instrument to determine if transportation EMs implement stricter vetting processes such as asking for recommendation letters (item 56b in Appendix B: coding guide). The literature does not support the idea that transportation EMs use heavier screening techniques but points at another technique: private EMs. In private EMs, few participants are invited, which reduces the threat of opportunistic and unreliable behaviors (Bellantuono *et al.* 2013, Figliozzi 2004, Nair 2005, Nandiraju and Regan 2003). As a consequence, an additional feature was added to the coding guide that checks for whether the EMs allow creating private events (feature 56f in the coding guide). Based on this information, the following hypotheses are formulated and will be tested:

H3a: Transportation EMs will "screen members" more often than other EMs

H3b: Transportation EMs will use "private EMs" more often than other EMs

Even though it is hypothesized that transportation EMs will display expected patterns, codes of conduct and screen members, it is believed that the memory of the first bad experiences with transportation EMs is often still vivid, driving the development of additional hypotheses. Most EMs do not have authority that would make participants legally bound to actually do what they promise online (Elmaghraby 2007, Nandiraju and Regan 2003). If the contracts are not fulfilled, Pavlou and Gefen (2005) have demonstrated it lowers the user's perceived effectiveness of the EM. Furthermore, bad experiences do not need to be experienced personally to impact users' perceptions. Charki and Josserand (2008) describe the impact of rumors attached to bad practices on the formation of distrust of procurement auctions. Conversely, positive experiences with an EM tend to create loyalty in the future (Yen and Lu 2008). Therefore the outcomes of positive past experiences with a specific EM need to be relayed to assure future participants that this EM generates positive outcomes for its participants. As presented in section 2.2.3. of this chapter, Zucker (1986) defines the process-based trust creation mode as the mode that creates trust through the recall of past experience, either through personal experience or through the experience of others. Three categories of features in the instrument from Son *et al.* (2006) are process-based trust creators: reputation systems, disclosing past performance, and disclosing EM profile. However, as suggested in Table 4 disclosing past performance and disclosing EM profile are the two process-based trust creators that create trust in the competence of the EM. Therefore, the following hypotheses are proposed:

H4a: Transportation EMs will disclose "past performance" more often than other EMs

H4b: Transportation EMs will disclose "EM profile" more often than other EMs

Payment issues were present in the transportation industry well before EMs were used (Boyle 2000) and the exploration of the four webpages containing the "terms and conditions" of transportation EMs shows that these issues remain important. A buyer can fail to pay the seller (*i.e.,* the carrier):

> *"Use this form to report a non-payment of freight bill"* (http://www.dat.com/Company/Terms-and-Conditions.aspx)

An invoice can require adjustment because the service differed from what was included in the quote:

> *"The Company reserves the right to amend or adjust the original quoted amount or re-invoice the Customer if the original quoted amount was based upon incorrect information received at the time of the original quote, if additional services by the carrier were required, or as otherwise necessary to perform the pickup, transportation and delivery functions therein"* (https://www.freightquote.com/terms.aspx)

In the EM literature, there is a well-known mechanism used to protect both buyers and sellers from issues regarding payment: escrow. Hu *et al.* (2004) explain that once a transaction is agreed upon, the buyer sends money to the escrow services provider who will only forward that money to the seller if the object of the transaction has been satisfactorily delivered. Pavlou and Gefen (2004 and 2005) have demonstrated the usefulness of EM escrow services with regard to trust building. That is why Son *et al.* 2006 included escrow services in the survey instrument. However, Boyle (2000) explains that financial intermediaries offering financial services other than escrow already had a preponderant role in the transportation industry. Consequently, "additional payment services" were included in the coding guide (feature 51b in Appendix B). Since the academic literature as well as the grey literature have not given any sign of escrow services being used in transportation, the following hypotheses are posited:

H5a: Transportation EMs will offer escrow services less frequently than other EMs

H5b: Transportation EMs will offer non-escrow payment facilitation mechanisms more often than other EMs

The adequacy of the instrument taken from Son *et al.* (2006) for the comparison of transportation EMs with other EMs and the differences to be expected have been demonstrated. In the next section, the methodology used for this dissertation chapter is exposed.

2.5. Methodology

The purpose of this chapter is to show differences in trust feature usage between transportation EMs and non-transportation EMs. This section therefore aims at establishing a methodology that provides percentages of use per feature within a sample of transportation EMs and a sample of non-transportation EMs. With these percentages of use, between-group comparisons have been performed for each feature in order to test for differences. The survey instrument and the features of interest have been identified in section 2.3 and a list of EMs containing transportation and non-transportation EMs has been established and surveyed using that instrument. Son *et al.* (2006) used a specific directory (emarketservices.com) in their study. In order for this study to be as close to the study by Son *et al.* (2006) as possible, it was decided to use the same directory. In this section, the validity of the directory is checked, then the methodology for constituting the sample is explained. Further, the coding methodology for the content analysis is explained. "Content analysis is a method of codifying the text (or content) of a piece of writing into various groups (or categories) depending on selected criteria" (Hackston and Milne 1996, referring to Weber 1988). The "piece of writing", more conventionally called recording unit (Tangpong 2011) is the EM itself. All 152 EMs have been surveyed using the instrument developed by Son *et al.* (2006). Based on the results of the content analysis, statistical tests have been performed to empirically determine the differences between transportation EMs and non-transportation EMs.

2.5.1. Relevance of the emarketservices.com directory:

In Son *et al.*'s paper, emarketservices.com directory boasted 24 industries and 323 EMs. Today, the same directory displays 40 industries and 819 EMs. These EMs are defined as follows (http://www.emarketservices.com/start/Knowledge/index.html?cl=ems):

- "it is open to several buyers and several sellers
- it is a trading platform, the e-market itself does not sell nor buy goods or services traded on the platform
- it has at least one trading function"

It is to be noted that the directory does not display all existing EMs but all those that use the services of emarketservices.com. Therefore, the representativeness of the directory could be questioned. In an attempt to control for the representativeness of the emarketservices.com directory, it was compared with the directory of business websites found at dmoz.org (http://www.dmoz.org/Business/). dmoz.org is also a non-profit organization but contrary to emarketservices.com, it relies on its members to identify and report websites. The dmoz.org business directory displays 27 industries and 161,078 websites. The difference in number of industries between the two directories mainly stems from emarketservices.com sub-dividing industries (e.g., agriculture and forestry are one in dmoz.org but two in emarketservices.com). Therefore, it was possible to bring both directories down to comparable 26 industries. Table 5 below shows the counts for each industry for both directories and the proportion that each industry occupies in each directory. Based on those proportions, a statistical test was completed to see if there was statistically significant differences between the proportions of different directories per industry.

Table 5: Distribution of EMs across 26 different industries in directories form (emarketservices.com and dmoz.org)

Industries from emarketservices.com	count	%	%	count	Industries from dmoz.org	z value
Defense	8	1%	1%	1683	Aerospace and Defense	0.053
Agriculture + Forestry	63	7%	4%	5960	Agriculture and Forestry	-0.986
arts & Entertainment + Advertising and media + Education and	56	6%	9%	14148	Arts and Entertainment	0.842
Automotive	17	2%	2%	2541	Automotive	-0.083
Biotechnology	12	1%	1%	1228	Biotechnology and	-0.165
Services + Excess inventory and Barter + Government and public sector	112	12%	9%	14531	Business Services	-1.017
Chemicals	28	3%	3%	4311	Chemicals	-0.113
Building and construction	42	5%	10%	15692	Construction and Maintenance	1.603
Retail & Consumer Goods + preowned and second-hand goods	71	8%	9%	14827	Consumer Goods and Services + retail trade	0.468
Electronics & Electrical products	44	5%	4%	7221	Electronic and Electrical	-0.093
Energy & Fuels	30	3%	2%	3569	Energy	-0.321
Environment	10	1%	1%	1490	Environment	-0.049
Finance & Insurance	20	2%	7%	10741	Financial Services	1.375
Food & Beverage	68	7%	3%	5342	Food and Related Products	-1.281
Healthcare and Pharmaceutical	31	3%	3%	4432	Healthcare	-0.190
Hospitality & Leisure	10	1%	1%	2160	Hospitality	0.077
Industrial Machinery & Equipment + Office equipment	60	7%	11%	17169	Industrial Goods and Services	1.294
IT Products & Services	42	5%	1%	834	Information And Technology	-1.253
Paper & Pulps + Plastics & Rubber	13	1%	1%	1699	Materials	-0.109
Metal & Mining	18	2%	0%	463	Mining and Drilling	-0.510
Printing	6	1%	3%	4257	Publishing and Printing	0.604
Real Estate	7	1%	1%	1578	Real Estate	0.066
Telecommunication & Bandwidth	11	1%	3%	4049	Telecommunications	0.401
Textiles & Leather	54	6%	9%	14236	Textiles and Nonwovens	0.925
Transportation + Aviation + Maritime+packaging	66	7%	4%	6787	Transportation and Logistics	-0.929
MRO	21	2%	0%	130	Wholesale Trade	-0.674
	920	TOTAL		161078		

The statistical test for the difference between two population proportions was performed following the recommendations of Ott and Longnecker (2010).

Let P1 and P2 be the proportions of EMs in one specific industry and N1 and N2 the number of EMs in that industry, respectively in emarketservices.com (1) and dmoz.org (2).

Ho: P1 – P2 = 0

Ha: P1 – P2 ≠ 0

Test statistic: $z = (P1 – P2)/\sqrt{(P1*(1-P1)/N1+P2*(1-P2)/N2)}$

On a two tailed test with 90% confidence interval, the absolute value of z must be greater than 1.645 to reject the null hypothesis.

Table 5 shows that none of the industries has a statistically significant difference in the proportion of the population from one directory to the other (*i.e.,* all z-values are below 1.645). Also, given the number of industries and the fact that no industry has an overwhelming influence on the population, the differences observed should have only a minor impact on the overall study of the population.

This fact leads to the decision to follow the emarketservices.com directory proportions for selecting a sample of EMs for this dissertation.

2.5.2. Sampling methodology for EM selection:

Sample size:

Son *et al.* (2006) randomly selected 100 EMs for their study. For this dissertation, since it is intended to compare the percentage of use of each trust feature between two different populations, two sub-samples are needed. One sample represents non-transportation EMs and one sample represents transportation EMs. The goal of the study is to compare the percentages of use for each trust measure/ feature between samples. To do so, the same test statistic used for comparing directories' proportions is re-employed.

$z = (P1 – P2)/\sqrt{(P1*(1-P1)/N1+P2*(1-P2)/N2)}$

Assuming that the same number of non-transportation EMs as of transportation EMs is surveyed (N). Then:

$z = (P1 – P2)/\sqrt{(P1*(1-P1) +P2*(1-P2))/N}$

Assuming that a minimum confidence interval of 90% is desired (*i.e.,* z must be greater than 1.645), then the following is needed:

$1.645<0.1/\sqrt{(P1*(1-P1) +P2*(1-P2))/N}$

It has been found that a sample size of 70 (N=70) for both populations enables the test statistics to be greater than 1.645 when the difference of proportions is greater than 10 to 14 points of percentage. In other words, with a sample size of 70, if 10% of non-transportation EMs use trust measure X whereas 20% of transportation EMs use it, the test statistics finds a significant difference between the two proportions with a confidence interval of 90%. It is the same if the proportions are 50% and 64%. This level of power seems reasonable. Also, a much greater and thus more difficult to implement sample size would be required to allow substantially increased statistical power. Therefore, in this dissertation, the targeted total sample size was 140 (70 EMs for each population – non-transportation *vs.* transportation). This number actually slightly varied and reached 152 (twice 76) as other sampling constraints were considered in the remainder of this section.

Sample selection:

a) Non transportation EMs sub-sample

Son *et al.* (2006) used random sampling for selecting 100 EMs out of the emarketservices.com directory. The purpose of comparing transportation EMs with other EMs is to determine whether the transportation industry uses the trust features in different proportions. It might well be that each industry has its own ways. Therefore, in order to take into account the influence of each industry in the non-transportation sub-sample studied in this dissertation, it was decided to use stratified random sampling. Stratified random sampling allows increasing the accuracy of the study based on *a priori* knowledge of an auxiliary variable to constitute strata (Ott and Longnecker 2010). In the present case, the EMs' distribution into industries observed on emarketservices.com served as the auxiliary variable, determining how many EMs were to be randomly picked per industry.

That scheme was however slightly modified to be as consistent as possible with Son *et al.*'s study (2006). It was decided to survey all EMs found in Son *et al.* (2006) that still exist. Thirty six EMs from Son *et al.*'s study still exist and are selected for the sample. Column 3 of Table 6 shows how many remaining EMs from the 2006 article can still be found per industry.

Column 6 of Table 6 shows how many EMs were needed from each industry in order to follow the observed distribution of EMs across industries. It can be observed that for some industries, the number of "still-existing" EMs exceeded the number of EMs needed for the sample (e.g., "automotive" contains two "still-existing" EMs and only one was needed for the sample). In these cases, since it is desired to stay as close as possible to the 2006 study (Son *et al.* 2006), it was decided to include all "still-existing" EMs in the sample, even if they were in excess of the quantity calculated. A sample of 76 EMs (*i.e.,* 78 – 2 transportation EMs that were included in the transportation sample) needed to be surveyed in order to abide by both constraints of a stratified sample, and a sample that includes Son *et al.*'s original EMs (Table 6). The cells in grey show if the number of EMs per industry came from the calculated distribution or from Son *et al.*'s previous sample.

Table 6: Number of EMs to be selected per industry for the non-transportation stratified sample

Industries	# EMs per industry now	# of EMs in Son et al. (2006)	still existing from 2006	% of whole (941)	calculated # for sample	Rounding	Modified final distribution
Advertising & Media	19	1	0	2%	1.4	1	**1**
Agriculture	42	5	1	4%	3.1	3	**3**
Arts & Entertainment	27	1	0	3%	2.0	2	**2**
Automotive	17	3	2	2%	1.3	1	**2**
Aviation	12	5	3	1%	0.9	1	**3**
Biotechnology	12			1%	0.9	1	**1**
Building & Construction	42	7	1	4%	3.1	3	**3**
Chemicals	28	6	2	3%	2.1	2	**2**
Defense	8	1	1	1%	0.6	1	**1**
Education & Training	10			1%	0.7	1	**1**
Electronics & Electrical products	44	10	3	5%	3.3	3	**3**
Energy & Fuels	30	7	2	3%	2.2	2	**2**
Environment	10	2	0	1%	0.7	1	**1**
Excess Inventory & Barter	6			1%	0.4	0	**0**
Finance & Insurance	20	11	4	2%	1.5	1	**4**
Food & Beverage	68	6	3	7%	5.1	5	**5**
Forestry & Wood	21	2	0	2%	1.6	2	**2**
Government and Public Sector	54			6%	4.0	4	**4**
Healthcare & Pharmaceutical	31	6	3	3%	2.3	2	**3**
Hospitality & Leisure	10	1	0	1%	0.7	1	**1**
Industrial Machinery &	55			6%	4.1	4	**4**
IT Products & Services	42	6	4	4%	3.1	3	**4**
Maritime products & Services	10	2	1	1%	0.7	1	**1**
Metal & Mining	18	2	1	2%	1.3	1	**1**
MRO	21			2%	1.6	2	**2**
Office Equipment	5			1%	0.4	0	**0**
Other Industries	11			1%	0.8	1	**1**
Packaging	11	1	0	1%	0.8	1	**1**
Paper & Pulp	6			1%	0.4	0	**0**
Plastics & rubber	7	3	1	1%	0.5	1	**1**
Pre-Owned/ Second-hand goods	31			3%	2.3	2	**2**
Printing	6			1%	0.4	0	**0**
Real Estate	7	3	2	1%	0.5	1	**2**
Retail & Consumer Goods	40			4%	3.0	3	**3**
Science & Engineering	10			1%	0.7	1	**1**
Services	52			6%	3.9	4	**4**
Telecommunication & Bandwidth	11	4	0	1%	0.8	1	**1**
Textiles & Leather	54	5	2	6%	4.0	4	**4**
Transportation & Logistics	33			4%	2.5	2	**2**
Total EMs	**941**	**100**	**36**	**100%**	**70**	**69**	**78**

Within each industry, the EMs were listed and a random number between 0 and 1 was generated and assigned to each EM. Per the distribution shown in the table above, for a list that should provide "n" EMs to the sample and contains "m" EMs from Son *et al.* (2006), the "n-m" EMs with the lowest random number values were included in the final sample with the "m" EMs from Son *et al.* (2006). For example, the "Building and construction" industry was supposed to provide 3 EMs to the final sample and 1 EM comes from Son *et al.* (2006). Thus 2 (3-1) EMs were randomly selected and the one from Son *et al.* (2006) completed the sub-sample. This process was applied to each industry (but transportation) and resulted in a final sample containing 77 EMs (the 76 desired plus one coded by mistake and kept).

b) Transportation sub-sample

The emarketservices.com directory contained 13 transportation EMs of interest to this dissertation. All of them were included in the transportation sub-sample and another 64 were integrated to match the non-transportation sub-sample's size. The database constituted in chapter 3 for the needs of chapters 4 and 5 was used to select an additional sample of transportation EMs.

The database constituted in chapter 3 encompasses all kinds of transportation EMs, including B2C EMs and one-to-many EMs (EMs owned by a company and oriented to fulfilling the needs of that company rather than serving the needs of the industry as a whole.) These EMs do not match the definition provided on emarketservices.com. As a consequence, it was decided to prevent them from potentially be selected. Out of the 208 EMs inventoried in the database of chapter 3, 106 are exclusively B2B, and have multiple buyers and sellers as per requested in the emarketservices.com definition. Since this list of 106 transportation EMs only includes EMs that correspond to the definition and are therefore similar to each other, it can serve as a base to provide an additional sample of 64 transportation EMs. With such a homogeneous list, random sampling is adapted (Ott and Longnecker 2010). Therefore, a random number ranging from 0 to 1 was generated for each row of the 106-EM list and the 64 lowest values (that are not part of the emarketservices.com directory) were selected to be part of the transportation sub-sample along with the 13 found in the emarketservices.com directory.

2.5.3. Coding

In order for coding to be reliable, a rigorous content analysis process must be respected. As recommended by Krippendorff (2004), 2 coders were carefully selected. One is an experienced and well-published researcher who already had experience with content coding, the other is the author of the dissertation. Both coders already had experience with coding using Son *et al.*'s instrument because of a pilot study implemented with 32 EMs more than a year prior to this study. Despite this prior experience due to the pilot study, a training session was performed in order to make sure that coders agreed on the definitions of the instrument (Wang and Benbasat 2008). First, as applied by Pavlou and Dimoka (2006) the main author/ coder provided examples of content for each item of the instrument to the second coder. Second, 7 EMs, that do not belong to the final sample (Son *et al.* 2006) were coded independently and followed by a debriefing in order to agree on definitions (Wang and Benbasat 2008) and to solve cases of disagreement (Pavlou and Dimoka 2006).

After the practice session, following the example of Tangpong (2011), 25 EMs picked randomly within the pool of 152 EMs were coded independently by the two coders. To prevent any bias, the order of the 25 EMs were randomized and different for each coder (Pavlou and Dimoka 2006). Inter-coder reliability (ICR) was calculated using Scott's pi (Milne and Adler 1999). (Please see chapter 3 for a more detailed explanation of the reliability check). Using the scale suggested by Landis and Koch (1977) and used by Son *et al.* (2006), ICR was deemed satisfactory (*i.e.,* above 0.4) for all trust building features but three (please refer to the coding guide in Appendix B for the item number): feature 53 – Insurance (Scott pi = -0.02), feature 56a – Member screening (Scott pi = 0.39), and feature 57b – Participants' performance evaluation by the EM (Scott pi = -0.07). Table 7 shows all features' reliability. Following the procedure recommended by Neuendorf (2002), Son *et al.* (2006) and Wang and Benbasat (2008), the two coders analyzed the coding discrepancies for the features with unsatisfactory coding reliability. Regarding feature 53 – Insurance, the coders agreed on the definition but the appearance of that feature is so rare and dissimulated that it was difficult to record. It was decided that nothing could be done to fix that issue. This feature is thus dropped from the study. Feature 56a was barely under the reliability threshold and after discussion, it was determined that the secondary coder partially misunderstood the coding procedure for this feature. Therefore, the coder re-coded the subsample with the exact definition in mind and coding reliability reached the acceptable level of 0.61. Finally, feature 57b was deemed un-fixable and dropped from the study. In the coding instrument, feature 57b is supposed to record whether an EM measures the performance of its participants. The definition includes participants' exclusion procedures as a form of evaluation. Nevertheless, all exclusion procedures are not based on participants' behavior or performance on the EM. Some are only designed for default of payment situations, which was not considered as a performance evaluation. After surveying several EMs together, the coders concluded that additional coding was not going to fix the discrepancies. Thus, the feature was dropped.

Table 7: Inter-coder reliability (Scott's pi)

Feature	Number in Son et al. 2006	Number in Appendix B	Scott's pi
Escrow	1	50	0.46
Payment facilitation services	new	51b	0.51
Product appraisal by experts	2a	52a	0.65
Guarantees/ warranties	2b	52b	0.63
Product inspection	2c	52c	0.78
Product review by third or marketplace	2d	52d	0.42
Insurance	3	53	*-0.02*
Coop. norms NAF	4.1a	54a	N/A
Coop. norms AAA	4.1b	54b	0.65
Other coop. norm	new	54c	0.71
Codes of conduct	4.2a	54d	0.55
Transaction patterns	4.3a	54e	0.57
Member screening (includes carrier or broker #)	5a	56a	0.63
Member screening beyond professional #	new	56b	0.57
Private events capability	new	56f	0.43
Peer rating	6a	57a	0.70
EM evaluates performance	6b	57b	*-0.07*
Third-party assurance seal	7	58	0.60
BBB	7a	58a	1.00
CyberProcess	7b	58b	N/A
THAWTE	7c	58c	N/A
TRUSTe	7d	58d	1.00
UCCNET	7e	58e	N/A
Verisign	7f	58f	N/A
Privacy statement	8a	59	0.82
Disclosing longevity	9a	60	0.77
Team profile	10a	61	0.66
Disclosing marketplace size	11a	62	0.63
Partners	12a	63a	0.54
Member of an association	12b	63b	1.00
Testimonials	13a	64	0.61
Awards	14a	65	0.46
Media coverage of EM	15a	66	0.51
Advertised participants	16a	67	0.40

Since a satisfying ICR level was reached for all features remaining in the study, coding continued with a single coder for the rest of the sample. A similar methodology was used by Hackston and Milne (1996) who used a single coder after pre-testing their instruments and reaching a satisfactory level of ICR.

2.5.4. Statistical analysis: difference between two populations feature usage proportions

This section identifies and explains the statistical analyses that were performed to test the hypotheses drawn earlier and to observe if the proportions of use of the different features are different between non-transportation EMs and transportation EMs. Two statistical procedures were identified, one using the z-statistics from a normal distribution and one using Fisher's Exact Test. This section explains the generic procedures and provides one example to illustrate each procedure. The results of all tests are presented in section 2.6.

For each trust building feature, the data collected through coding is made of binary variables that show whether or not (1 or 0 respectively) each EM surveyed uses the feature. As a consequence, it is possible to count how many EMs display a particular feature out of the 77 EMs surveyed from each population (non-transportation *vs.* transportation). These counts divided by the sample sizes (N1 for the non-transportation sample and N2 for the transportation sample) yield binomial parameters that will be called feature usage proportions and labelled P1 for the non-transportation sample and P2 for the transportation sample. In this case, "hypothesis testing about the difference between two population proportions is based on the z statistics from a normal distribution" (Ott and Longnecker 2010, p. 509). Table 8 summarizes the hypothesis testing procedure.

Table 8: Statistical test for the difference between two populations

Ho:	1. $P1 - P2 \leq 0$	**Ha**:	1. $P1 - P2 > 0$
	2. $P1 - P2 \geq 0$		2. $P1 - P2 < 0$
	3. $P1 - P2 = 0$		3. $P1 - P2 \neq 0$
Test Statistics:	$z = (P1 - P2)/ \sqrt{(P1(1-P1)/N1 + P2(1-P2)/N2)}$		
Rejection Region:	1. $z > z_{\alpha}$		
	2. $z < z_{\alpha}$		
	3. $\lvert z \rvert > z_{\alpha/2}$		
Assumptions:	N1P1, N1(1-P1), N2P2, N2(1-P2) all at least 5		

Source: Ott and Longnecker (2010)

For example, regarding feature 51b (payment facilitation services), it is hypothesized (in H5b) that Transportation EMs provide facilitated payment services more frequently than non-transportation EMs. In other words the usage proportion within the transportation population should be greater than it is in the non-transportation population, which results in the following set of hypotheses:

Ho: $P1 - P2 \geq 0$ Ha: $P1 - P2 < 0$

In the non-transportation sample, 8 EMs use that feature out of 77 EMs. Thus P1 = 0.1039. 18 EMs out of 77 use it in the transportation sample, thus P2 = 0.2338. Consequently:

$z = (.1039 - .2338)/ \sqrt{(.1039(1-.1039)/77 + .2338(1-.2338)/77)} = -2.18$

z is less than zero, which means that Ho is rejected and Ha is supported. H5b is therefore supported. Transportation EMs use payment facilitation services more frequently than non-transportation EMs.

For the features that do not meet the assumptions shown in Table 8, the Fisher Exact Test needs to be used (Ott and Longnecker 2010). Seven features do not meet the assumptions for the normal approximation test (escrow, product inspection, product review, insurance, cooperation norms AAA, and the BBB and TRUSTe assurance seals). In Table 10, those are the features with less than 5 (but greater than 0) EMs counted in one of the “Use” columns. The following example illustrates how the Fisher Exact Test was performed. In the Fisher Exact Test, the hypotheses to be tested are Ho: P1 ≤ P2 *vs.* Ha: P1 > P2. For example, regarding the usage proportion of escrow services. Table 9 shows that N2P2 (the number of EMs using escrow services in the transportation EM industry) is less than 5. Thus the Fisher Exact Test needs to be used to compare proportions between non-transportation and transportation EMs. H5a states that the usage proportion of escrow services by non-transportation EMs is greater than it is by transportation EMs. So the set of hypotheses to be tested is Ho: P1 ≤ P2 *vs.* Ha: P1 > P2 (where P1 is the usage proportion in the non-transportation sample and P2 the usage proportion in the transportation sample).

Table 9: Counts of EMs using or not escrow services in both non-transportation and transportation EM samples

	Escrow		
	User	Non-user	Total
Non-transportation	7	70	77
Transportation	1	76	77
Total	8	146	154

In order to test these hypotheses, “the exact probability distribution for the cell counts in all 2x2 tables having the same row and column totals as the 2x2 table observed needs to be developed. [Then] the p-value of the test is the sum of these probabilities for outcomes at least as in support of the alternative hypothesis as the observed table” (Ott and Longnecker 2010, pp. 511-512). The p-value is calculated as follows:

$$\text{p-value} = P[x \geq k] = \sum_{j=k}^{\min(N1,m)} \frac{\binom{N1}{j}\binom{N2}{m-j}}{\binom{N}{m}}$$

where k in this case is the number of escrow users in the non-transportation group (7), m is the total number of escrow users (8), and N is the overall total (154).

If the p-value is greater than a pre-set alpha reflecting the level of confidence desired for the test (1-alpha), the test fails to reject the null hypothesis. On the contrary, if the p-value is less than alpha, then the null hypothesis is rejected and the alternative supported.

In the escrow services usage example shown in Table 9, the p-value is:

$$\text{p-value} = P[x \geq 7] = \sum_{j=7}^{8} \frac{\binom{77}{j}\binom{77}{8-j}}{\binom{154}{8}} = 0.0316$$

For this study, the desired level of confidence is 0.95. Thus alpha = 0.05. The p-value is less than alpha, therefore the null hypothesis is rejected and the alternative is supported. Factually, it means that there is statistical significance supporting the idea that non-transportation EMs use escrow services more frequently than transportation EMs do.

In this study, the calculations for the Exact Fisher Test have been performed with JMP Pro 11.

The examples above illustrate the use of one-tailed tests when it has been hypothesized that one proportion is supposed to be greater than the other. In the event that no difference in feature usage was hypothesized, two-tailed tests were conducted. Two-tailed tests are the standard way of looking for a relationship between two proportions when the direction of that relationship cannot be assumed (Ott and Longnecker 2010). For two-tailed tests, alpha was set at 0.1.

2.6. Results

This section presents the results of the statistical analyses completed in this chapter. Table 10 reports the results of all statistical tests. For each feature, Table 10 shows the counts of EMs using and not using the feature in both samples (non-transportation EMs and transportation EMs). To the right of these counts, the usage proportion (count of EMs using the feature divided by the sample size) is displayed for each sample. Next to these descriptive statistics, the z-score for the test using a normal approximation is recorded and the p-value corresponding to this z-score is shown for one-tailed and two-tailed tests. If the counts in each sample did not meet the assumptions of Table 8, the normal approximation test was not performed and no values are displayed. In that case, the Fisher Exact Test was performed and the p-values corresponding to that test are recorded in the last two columns of Table 10. Features with no variation observed during coding (e.g., 54a – Cooperation norms NAF), cannot be subject to statistical testing, this is why no values are recorded in any of the statistical test columns for those features.

Table 10: Statistical tests' results for the difference between the two populations' feature usage proportions

Trust building features			Non-trpt counts		Transportation counts		Usage proportions		Normal approximation test (assum. of Table 8 are met)			Fisher Exact Test (assum. of Table 8 not met)	
Feature categories	Appendix B #	Features' names	Use	No Use	Use	No Use	Non-trpt	Trpt	z score	one-tailed test p-value	two-tailed test p-value	one-tailed test p-value	two-tailed test p-value
Payment protection	50	Escrow	7	70	1	76	9%	1%				0.032	0.063
	51b	Payment facilitation	8	69	18	59	10%	23%	-2.184	0.015	0.029	0.026	0.051
Monitoring product/ services	52a	Product appraisal	10	67	19	58	13%	25%	-1.876	0.030	0.060	0.049	0.098
	52b	Guarantees/ warranties	8	69	5	72	10%	6%	0.872	0.192	0.384	0.564	0.282
	52c	Product inspection	3	74	0	77	4%	0%				0.123	0.245
	52d	Product review	4	73	27	50	5%	35%				0.000	0.000
	53	Insurance	0	77	3	74	0%	4%				0.123	0.245
Coop. Norms	54a	Coop. norms NAF	0	77	0	77	0%	0%					
	54b	Coop. norms AAA	2	75	2	75	3%	3%				0.690	1.000
	54c	Other Coop. norms	13	64	7	70	17%	9%	1.448	0.074	0.147	0.115	0.230
	54d	Codes of conduct	46	31	36	41	60%	47%	1.629	0.052	0.103	0.073	0.146
	54e	Transaction patterns	26	51	27	50	34%	35%	-0.170	0.421	0.841	0.500	1.000
Member screening	56a	Member screening	31	46	42	35	40%	55%	-1.794	0.036	0.073	0.053	0.106
	56b	Member screening ++	26	51	29	48	34%	38%	-0.505	0.309	0.617	0.368	0.737
	56f	Private events	8	69	26	51	10%	34%	-3.645	0.000	0.000	0.000	0.001
Reputation systems	57a	Peer rating	12	65	17	60	16%	22%	-1.034	0.159	0.317	0.205	0.410
	57b	EM evaluates perf	5	72	12	65	6%	16%	-1.819	0.034	0.069	0.061	0.121
Third party assurance seals	58	Assurance seal	10	67	11	66	13%	14%	-0.235	0.407	0.814	0.500	1.000
	58a	BBB	1	76	4	73	1%	5%				0.183	0.367
	58b	CyberProcess	0	77	0	77	0%	0%					
	58c	THAWTE	0	77	0	77	0%	0%					
	58d	TRUSTe	1	76	1	76	1%	1%				0.752	1.000
	58e	UCCNET	0	77	0	77	0%	0%					
	58f	Verisign	0	77	0	77	0%	0%					
	59	Privacy policy	63	14	47	30	82%	61%	2.933	0.002	0.003	0.004	0.007
Disclosing EM profile	60	Longevity	41	36	44	33	53%	57%	-0.486	0.309	0.617	0.373	0.746
	61	Team profile	25	52	15	62	32%	19%	1.858	0.031	0.063	0.049	0.098
	62	Marketplace size	51	26	38	39	66%	49%	2.153	0.016	0.032	0.025	0.050
Affiliation	63a	Partners	27	50	32	45	35%	42%	-0.831	0.203	0.407	0.254	0.508
	63b	Member of an assos.	7	70	17	60	9%	22%	-2.258	0.012	0.024	0.022	0.044
Disclosing past performance	64	Testimonials	23	54	27	50	30%	35%	-0.689	0.245	0.490	0.303	0.606
	65	Awards	8	69	13	64	10%	17%	-1.179	0.119	0.238	0.174	0.348
	66	Media coverage	16	61	20	57	21%	26%	-0.763	0.212	0.424	0.284	0.568
	67	Advertised participants	26	51	19	58	34%	25%	1.247	0.106	0.211	0.144	0.288

In Table 10, usage proportions highlighted and bolded indicate proportions that are statistically greater than their counter parts in the sample it is compared with (e.g., the non-transportation sample's usage proportion for feature 62 – Marketplace size, is highlighted and bolded because it is statistically higher than the proportion in the transportation sample). Dark yellow shading points at p-values under 0.05. Light yellow shading points at p-values under 0.1. The sample size for each sample was calculated to allow statistical analyses with a confidence level of 90% when two-tailed tests are performed (*i.e.,* when the direction of the relationships between the two populations' proportions are unknown). A higher confidence level could not be obtained because 140 EMs per sample would have been required and 140 EMs fitting the definition adopted in this study were not available in the transportation population. When the direction of the differences in proportions between populations can be assumed thanks to the literature review, an alpha of 0.05 was chosen as a threshold for statistical significance for one-tailed tests and thus the confidence level for the statistical analysis was boosted to 95%. It is to be noted that Table 10 displays the p-values for one-tailed tests in the direction suggested by the data (not the hypotheses). For example, H4b states that transportation EMs will disclose the EM profile (features 60, 61 and 62) more often than non-transportation EMs. The statistical test in that direction was not significant. However, the two-tailed test shows a significant difference in usage proportion. Thus it makes sense to try the relationship in the opposite direction and Table 10 shows that the one-tailed test in the opposite direction of the hypothesis is significant. In that case, it was considered that the statistical analysis brought support for the reverse relationship between the two populations' usage proportions. After reading the grey and academic literature, 8 features were identified that could presumably have different usage proportions between non-transportation and transportation EMs. These presumed differences thus gave lieu to 8 hypotheses. Five out of the 8 hypotheses testing procedures found statistically significant results. Four of them are in support of the hypotheses developed. One shows the opposite of what was hypothesized and three are rejected (Table 11).

Table 11: Results of the hypotheses testing

	Hypotheses	Test results
H1	*Transportation EMs will display "expected transaction patterns" more often than other EMs*	Not supported
H2	*Transportation EMs will use "codes of conducts" more often than other EMs*	Not supported
H3a	*Transportation EMs will "screen members" more often than other EMs*	Supported
H3b	*Transportation EMs will use "private EMs" more often than other EMs*	Supported
H4a	*Transportation EMs will disclose "past performance" more often than other EMs*	Not supported
H4b	*Transportation EMs will disclose "EM profile" more often than other EMs*	Reverse
H5a	*Transportation EMs will offer "escrow services" less frequently than other EMs*	Supported
H5b	*Transportation EMs will offer "non-escrow payment facilitation mechanisms" more often than other EMs*	Supported

Additionally, three other trust building features, that were not the subject of any hypothesis, are employed in different proportions by the two populations studied (Table 12).

Table 12: Additional differences in populations' usage proportions

	Non-hypothesized relationships found statistically significant
NH1	*Transportation EMs monitor product/services more often than non-transportation EMs thanks to service appraisal (52a) and review (52d)*
NH2	*Transportation EMs post privacy policies less frequently than non-transportation EMs*
NH3	*Transportation EMs are more frequently members of respected associations (63b) than non-transportation EMs*

Finally, it is to be noted that there is a significant difference between populations' proportions in term of participants' performance evaluation (feature 56b) (please see Table 10) but coding of this feature was found unreliable and thus results cannot be considered viable.

2.7. Discussion

In this section, the results of this chapter are discussed in order to answer the research question: *How do transportation EMs differ from other EMs with regards to trust generation?*

The survey instrument adopted in this chapter measures the usage proportions of trust building mechanisms that can be grouped under two of the trust production modes explained by Zucker (1986): institutional-based trust and process-based trust. For the first time, this instrument has been used to compare transportation EMs with non-transportation EMs. In this section, the analysis first reveals that transportation EMs favor actionable and highly visible institutional-based trust features more than non-transportation EMs. Features are considered highly visible in this section if they belong to the "operational path" of the EM (*i.e.,* these features appear on the pages where users have to go to use the EM.) Second, it shows that less visible (not on the "operational path"), more administrative and process-based trust features are either used no differently or even neglected. The implications of these findings are then discussed.

Institutional based trust from actionable and visible features/ structural assurances

Although features categorized as generating institutional-based trust are not all used more frequently by transportation EMs than by non-transportation EMs, all features that are used more frequently by transportation EMs belong to that category (please see Table 13).

Table 13: Summary of trust building mechanisms usage proportion differences between populations

Trust production mode	Transportation EMs use …	
Institutional-based trust from structural assurances	Payment protection	more frequently but differently (factoring and other mechanisms instead of escrow)
	Monitoring product/ services	more frequently (rate estimator tools for service appraisal and FMCSA safety scores and credit scores for service reviews)
	Insurance	no frequency difference
	Cooperative norms	no frequency difference
	Member screening	more frequently (capability to check for professional numbers such as MC or DOT numbers and more private events)
	Third party assurance seals	no frequency difference
	EM affiliations	more frequently (through association memberships)
	Privacy policy	less frequently
Process-based trust from reputation effects	Reputation systems	no frequency difference
	EM profile	less frequently
	Past performance	no frequency difference

Zucker (1986) explained that institutional-based trust can be generated by showing structures have been put it place that makes the trustee (the EM in this case) trustworthy. These structures or structural assurances help the trustee/ EM by emulating people's beliefs in the benevolence, integrity and/ or competence of the EM and its participants. These three beliefs are sources of trust and the results appear to show that structural assurances are especially used by transportation EMs to influence these beliefs, especially when these structural assurances are very actionable and/ or visible.

First, the literature review emphasized that EM participants are afraid of meeting unethical carriers and shippers. A highly visible and actionable way to generate trust upon entry to the EM, is to screen users or offer the possibility to screen users. Member screening is a structural assurance that influence the three trust-generating beliefs (please see Table 4). Users explained on forums that transportation EMs use Motor Carrier (MC) numbers or Department of Transportation (DOT) numbers to vet participants upon entrance. The results support that transportation EMs vet participants through member screening more frequently than non-transportation EMs (**Hypothesis**

5a). A statistically significant difference in usage proportions was found. Fifty five percent of transportation EMs screen members, whereas only 40% of the non-transportation EMs screen their members. However, MC numbers are easy to procure and new numbers with a clean history are easy to obtain. Also anecdotal evidence on truckers' forums show that a carrier can purchase an old number or legally possess several numbers and try to use them to their advantage when being screened (https://www.truckersforum.net/forum/threads/anyone-know-of-a-broker-and-or-carrier-mc-for-sale.85199/, http://www.thetruckersreport.com/truckingindustryforum/threads/how-can-a-company-have-2-usdot-numbers.129451/). That is why another feature was created in the instrument survey (feature 56b) to see if transportation EMs ask additional documentation beyond authority numbers. In that case, transportation EMs' screening proportions are not found to be different from non-transportation EMs'. Therefore, although more frequent, screening might not be any stronger in the transportation EM industry than in other industries.

To compensate for that potential weakness in an EM's screening process, another actionable way to screen users is to allow the organization of private events. Private events are places within the market place where only trusted or preferred participants are admitted (e.g., upon invitation auctions). Following the academic literature, it was hypothesized (H3b) that transportation EMs tend to privilege the organization of private events (Bellantuono *et al.* 2013, Figliozzi 2004, Nair 2005, Nandiraju and Regan 2003). Feature 56f was added to the survey to capture that aspect of EMs' offerings and the results indeed confirm **Hypothesis 3b** with a statistically significant difference of private events' usage proportions (34% for transportation EMs *vs.* 10% for non-transportation EMs). In addition, it is interesting to notice that nearly two thirds of the EMs offering the possibility of private events also screen their participants. Although private events can be motivated by many reasons (such as restricting competition in order to protect privileged relationships with historical partners), it is sometimes used as a complement to screening methods.

Second, whether it is in place of entry screening or as a complement to it, transportation EMs offer highly visible and actionable structural assurances that create the capability or at least the perceived capability to make the best decisions along the procurement process. Looking at Table 4, monitoring structures are able to enhance trustors' beliefs in the EM's and the sellers' competence (carriers' in the case of transportation EMs). To this regard, two trust building features are used more frequently by transportation EMs than non-transportation EMs: product/ service appraisal (52a) and product/ service review (52d). In terms of product appraisal, tools allowing the evaluation of product or service prices were considered as valid third party appraisal when surveying EMs. Knowing that, it was found that transportation EMs allow to appraise the price a lane is worth paying for 25% of the time whereas non-transportation EMs allow appraising the price of services and products only 13% of the time. This product/ service appraisal feature helps verify whether a seller's offer meets market prices. In addition to price, quality must also be considered. Product and service review fills that need. In the transportation industry, the Federal Motor Carrier Safety Administration (FMCSA) records safety scores (SAFER scores) for carriers. In addition, credit scores are obtainable through financial sources. Thus, it is easy to check the financial and safety reliability of carriers. This study shows there is a substantial and significant difference in usage proportions of product/ service review between transportation EMs and non-transportation EMs (35% *vs.* 5%). Thanks to these two features, transportation EMs' participants can have a higher level of trust in carriers. These features are undoubtedly actionable features and they are highly visible upon access to EMs because they generally are presented on screen as buttons or icons to click on next to an offer. Just like screening, they are part of what can be termed the "operational path" of EMs; they appear where users have to look when they are looking for trucks or loads.

Third, on top of offering structural assurances to generate a positive belief in the competence, benevolence and integrity of participants transportation, EMs attempt to generate trust by showing they belong to the transportation industry and by offering to anticipate one of the historical issues in this industry – payment (Boyle 2000). In this study, it was found that there was a significant difference between transportation and non-transportation EMs in terms of affiliation with respected organizations. Transportation EMs are more frequently members of associations than non-transportation EMs (22% *vs.* 9%). The principle behind this structural assurance is that the respectability of an organization can transfer to another (Kim 2008). The most common associations engaged by transportation EMs are the Transportation Intermediaries Association (TIA) and the Owner Operator Independent Drivers Association (OOIDA). Belonging to an association is sometimes conveyed only graphically and graphical seals have been shown to be very effective for trust generation purposes (Kim 2008). Thus, Figure 3 shows the seals used for the two most popular associations on transportation EMs.

Figure 3: seals corresponding to the most popular associations on transportation EMs

Following the logic that seals are highly visible and effective at generating trust, it can be argued that third party assurance seals should be more present on transportation EMs than on non-transportation EMs, but no significant difference in usage proportion was found. It is worth noticing that the instrument developed by Son *et al.* (2006) inventories seals that do not seem to be commonly used by contemporary EMs anymore. Only two out of the six seals inventoried are still in use. BBB and TRUSTe have been encountered (respectively 5 and 2 instances). The most frequently used seals are now Godaddy, BBB, Geotrust, COMODO, Norton, and Authorize.net. Almost all those seals are used by both transportation and non-transportation EMs. Authorize.net is an exception; it is used strictly by transportation EMs. Since those seals are graphical features, Figure 4 shows how they can appear on the EMs surveyed (some seals have several designs). It might be that these seals convey only a technical or business expertise that is not of enough interest in the transportation industry to justify using it more than in other industries. However, the fact that one of the seals is specific to the transportation industry may hint at a potential for this kind of seal if people in the transportation industry assimilate it as a component of the transportation industry.

Figure 4: Third party assurance seals found on EMs

Finally, EMs display a structural assurance that addresses a major carrier concern – ensuring payment for services performed (Boyle 2000). Financial services were used in the transportation industry to secure payment prior to the existence of EMS. Therefore, although escrow services are the recommended structural assurance for EMs (Hu *et al.* 2004), it was hypothesized that escrow services are less frequently used by transportation EMs (H5a) but other services for payment assurance are more frequently offered (H5b) (e.g., factoring). These hypotheses were supported. Only 1% of transportation EMs use escrow services whereas 9% use it in non-transportation industries but 23% of transportation EMs use other payment protection services (against 10% in other industries). Similarly to service appraisal and review features, the payment protection service is generally highly visible because loads that can be factored or participants that qualify for factoring are often visually tagged with an icon on the “operational path”.

Structural assurances lacking visibility and process-based trust from reputation features

Some of the hypotheses in this chapter are rejected because transportation EMs do not use some of the structural assurances that could have further enhanced institutional-based trust. None of the cooperation norms seem to be used in significantly different proportions in the two different samples and privacy policies are used less frequently by transportation EMs than by non-transportation EMs. The common point of these structural assurances is that they lack visibility as they require users to log on specific webpages out of the "operational path" ("terms and conditions", "privacy policies" or "how it works") and to read thoroughly the terms of the structural assurance.

Although EMs were criticized for not having the authority to solve conflicts in the past (Elmaghraby 2007), few of them now offer their help in the arbitration of disputes between users both in the transportation and in the non-transportation industries. EMs show high usage proportions for transaction patterns (approximately 35% of the time) in both samples (without significant difference, H1 is not supported). Codes of conduct are posted at even higher rates (47 to 60% of the time). Regarding codes of conduct, it would have taken a slightly larger sample to find a statistical difference between the two samples proportions in favor of non-transportation EMs (reverse of H2). The p-value for the one-tailed test of difference in proportions between the two samples on that matter (assuming that non-transportation EMs' proportion is greater) is 0.052, very close to the 0.05 threshold. Given that transportation EMs already screen participants, offer private events, are part of respected associations and offer payment assurances more frequently than non-transportation EMs, posting codes of conduct might be considered as unnecessary by a larger proportion of the transportation population.

The last structural assurance reported in this study is the most frequently used by both samples but significantly more by non-transportation EMs: privacy policies. Whereas no hypothesis was drawn with this regard, it could have been expected that transportation companies just like any company on an EM might want to protect their privacy or confidentiality of their data. Carriers and shippers just like participants in any other industry do not want to reveal to their competition the volume of their business or the location of their clients. With 61% of transportation EMs displaying a privacy policy, the feature is the most used by transportation EMs but is substantially and significantly lower than the 82% from non-transportation EMs. One potential reason explaining this lack of written privacy policies is that the transportation industry is very used to working without contracts for spot needs. The spot market, main target of online transportation EMs, is traditionally managed orally with operational documents (e.g., the Bill of Lading or BOL) working as legal documents because for-hire carriers found on the spot market are not legally bound to write any other type of contract (Boyer 1993). This habit of trusting the word of other parties might explain why privacy policies are not as universally spread in the transportation population as in the non-transportation one.

Likewise, none of the features generating process-based trust is used in larger proportions by transportation EMs. **Hypothesis 4a** states that transportation EMs would disclose past performance more frequently than non-transportation EMs, but it is not the case. EMs from both samples display a relatively similar usage proportion of past performance trust building features and the hypothesis is rejected. A difference in usage proportions is found in EM profile disclosure – team profile (feature 61) and EM size (feature 62). Nevertheless the relationship between proportions is reverse of what was hypothesized (H4b). Non-transportation EMs disclose a team profile 32% of the time and the EM size 62% of the time while transportation EMs do it respectively 19% and 49% of the time (which constitute a statistically significant difference). In all these cases, the lack of visibility might be to blame. The past performance as well as EM profile are generally displayed in specific webpages that do not belong to the "operational path" of EMs (*i.e.,* users need to purposefully look for that information to find it, it does not appear while using the EM to find loads or trucks.) Longevity, team profile, awards earned, media outlets and lists of participants are pieces of information that are generally found in pages called "history", "about us", *etc.* EM size and testimonials can be more visible (often on the front page if not in the aforementioned pages) but those pieces of information are often self-reported and cannot be verified. A lot of the testimonials are from anonymous sources (named by their first names) and can anyway be cherry-picked so as to convey the desired message.

The lack of a statistically significant difference in peer rating usage is surprising because peer rating systems are actionable and often highly visible thanks to star systems that are part of the "operational path". Thus, if transportation EMs indeed favor highly visible trust generating features, the usage of peer rating mechanisms should be greater with transportation EMs than with non-transportation EMs. It might be that, unlike structural assurances that create a feeling of safety, peer rating can be viewed as a threat to the reputation of some users. Anecdotal evidence shows that a substantial proportion of loads found on EMs might be "difficult" loads (http://www.thetruckersreport.com/truckingindustryforum/ask-an-owner-operator/170505-load-boards-101-a.html). Thus, it might be that EMs are reluctant to place emphasis on peer rating systems and expose their participants to live negative feedback.

Implications

The purpose of this study is to show that transportation EMs differ in many ways from non-transportation EMs in term of trust generation mechanisms. Ten features out of the 34 of the instrument adopted and refined for this study show statistically significant differences in usage proportions between the two samples. Transportation EMs appear to be using structural assurances more than non-transportation EMs when they are on the "operational path" of users – the places where users have to go if they want to trade loads and trucks, and are thus highly visible. Payment facilitation capabilities are often shown with icons appearing next to partners that can be the object of payment facilitation services. Similarly monitoring generally appears as scores next to the names of the partners. Membership in an association or certification by a trusted third-party is communicated through logos published at the bottom of webpages. These signals are somewhat easy to see and are tied to a third party giving their permission to publish them. On the contrary, cooperation norms or privacy policies are not on the "operational path". They are also not as easily understood and are provided by the EMs with no third party verification. These characteristics might be some of the deterrents that explain their lower usage level in an industry that is less oriented toward written legal forms for spot needs – the transportation industry. For future research, these findings are of interest because it means that transportation EMs focus on trust building mechanisms that are immediately perceivable by EM participants. Research on ways to generate trust swiftly exists (Guo *et al.* 2014, Ou *et al.* 2014) but it is still in its infancy. This chapter shows that more research on swift trust is necessary for better understanding trust generation in transportation EMs. Also it shows that transportation EMs provide a proper context to conduct such research.

There are limitations in this study. As explained earlier, for practical reasons, the sample size was fixed at 77 EMs per sample. This sample size allowed the determination of many differences in usage proportions between samples beyond statistical doubt. Nevertheless, in spite of a substantial difference in usage proportions (60% *vs.* 47%) the test for the use of codes of conduct was statistically insignificant. Although this study, is one of the first to compare the EM transportation industry against other industries thanks to a fairly large sample, studies with even larger samples would be beneficial to the field. Also, despite using coders that were well-trained through a thorough procedure and previous experiences, one feature (EM performance evaluation – 57b) was still too unreliable to be used in this study. The instrument likely needs refining on that specific point.

Additionally, it is believed that there are differences within the transportation industry that require further investigations. For example, some of the EMs surveyed in this study target small groups of users (by implementing tight screening, private events, or targeting sub-segments of the transportation market) whereas some try to reach a massive audience. Depending on such differences in the strategic orientation of transportation EMs, trust building mechanisms' use might differ. Also, the instrument adopted from Son *et al.* (2006) covers quite a broad spectrum of trust building mechanisms but fails to catch some such as characteristic-based mechanisms that help in generating trust through a feeling of similarity between the EM and the participants. Finally, trust is not the only concept that deserves attention in order to uncover what leads to transportation EMs' performance. Chapter 3 therefore expands the work of this dissertation by further exploring the content of transportation EMs exclusively.

CHAPTER 3

Literature review and constitution of a truck transportation e-marketplaces database

Abstract

Using an instrument designed for surveying EMs of any industry, chapter 2 shows that transportation EMs do not use trust building features similarly to non-transportation EMs. In chapter 3, a tool is created to survey the content of transportation EMs exclusively. This tool includes 5 categories of features found to relate to EM performance in the literature – trust/ uncertainty/ risk, services offered, website quality, strategic factors, and behavioral factors. Along with creating this 141-feature instrument, data for 208 transportation EMs is collected and checked for reliability. Descriptive statistics of the database are provided.

3.1. Introduction

In over 50 years of existence, EMs have significantly evolved. They went from EDI-based to Internet-based technology (Movahedi and Lavassani 2012). During that time, EMs experienced the same boom and bust cycle as other Internet businesses with tremendous growth in the early 2000's, curtailed by the dotcom crisis (Alt and Klein 2011, Movahedi and Lavassani 2012, Rossignoli and Ricciardi 2015), and followed by the normalization of the industry at a more restrained level (Murtaza *et al.* 2004, Nandiraju and Regan 2003). A similar pattern emerged in EM research.

Searches of ProQuest's ABI/Inform database produced only 35 articles related to EMs published in trade and scholarly journals in 1999, but over 1200 published in 2000 and over 900 in 2001. By 2002, just over 230 EM articles were published, and from 2006 to 2013 the number of articles had steadied at 80 to 100 articles per year. In this research, the literature review followed an iterative process. Based on the results of chapter 2, it can be said that transportation EMs do not use the same features as other EMs to create trust and build their success. A literature review was therefore initiated to answer the following question:

RQ2: What features are used by transportation EMs to lift performance?

The first section of this chapter shows that the literature points at a need for studying a large population of EMs and more specifically transportation EMs. Given the absence of an answer to the research question in the literature, in the second section of the chapter, the canons of the grounded theory approach (Corbin and Strauss 1990) developed and well accepted in social sciences, and successfully applied in IS (Gasson and Waters 2013, Mattarelli *et al.* 2013, Vaast and Walsham 2013) and in OM (Cui *et al.* 2012, Lockström *et al.* 2010, Nair *et al.* 2011, Rungtusanatham and Salvador 2008), were followed to create a data collection instrument to capture features of transportation EMs that could impact adoption, use or performance. It was chosen to follow the canons of grounded theory because they allow rigorous scientific qualitative analysis when existing theory is lacking (Gasson and Waters 2013) and the environment is changing (Corbin and Strauss 1990). Both of these conditions are met in the realm of transportation EMs. These canons are used to build a theory because they "are designed to develop a well integrated set of concepts that provide a thorough theoretical explanation of social phenomena under study." (Corbin and Strauss 1990, p.5). In this dissertation, the canons of grounded theory have been used not to build a theory but to support the creation of a data collection instrument that lists a set of features that could contribute to transportation EMs' adoption, use or success. This list can be used as a check list to survey transportation EMs to identify the factual content, in terms of features, present in each EM. Specifically, in this dissertation, the applicable canons provided the framework of the data collection instrument development. First, a topic guide was developed as suggested by Gasson and Waters (2013). The topic guide shown in Table 14 defines broad categories of features (*i.e.,* topics) that can lead to adoption, use or success of EMs. These topics helped in identifying features during EM exploration by supporting the understanding of broad concepts (canon 3 from Corbin and Strauss 1990) and also guided further literature review. Indeed, a list of features existing in the literature and related to each topic was gathered in a second step of the literature review. This list ensures that prior knowledge found in the literature is taken into account (Barratt *et al.* 2011, Gasson and Waters 2013) and that the appropriate level of focus was adopted during the exploration (Gasson and Waters 2013). Second, once those steps were completed, data collection started simultaneously with the construction of the data collection instrument (canon 1 from Corbin and Strauss 1990). As data was collected and the instrument was refined, a coding guide providing the list of features, their definition and coding guidelines, was developed (canon 8 from Corbin and Strauss 1990). This coding guide ensures reliability in coding along the process and reproducibility of the study by other researchers. Third, the reliability of the database was tested. Finally, some descriptive statistics regarding the database were gathered.

3.2. E-marketplaces literature

To begin the discussion of EM research, the following definition is adopted: "Electronic Marketplaces (EMs) are electronic platforms enabling [one or more] buyers and sellers to conduct business" (Gärtner *et al.* 2010, p.3157). This definition, with slight modifications shown between brackets, allows for any number of buyers and a number of conceivably different electronic mediums through which the marketplace can be accessed. Several authors have provided excellent reviews of the literature on EMs with a focus that differs by academic discipline. The literature review provided in this dissertation covers both IS and OM academic disciplines.

Standing *et al.* (2010) reviewed IS academic literature published between 1997 and 2008 and identified four EM topics that were discussed: market mechanisms in EM, system designs, adoption of EMs, and organizational issues associated with the use of EMs. Noted gaps in the literature were an understanding of the nature of EMs, as well as macro studies of the industry. Following the Standing *et al.* (2010) article, a number of IS articles have examined EMs at the strategic or business model level (Koch and Schultze 2011, O'Reilly and Finnegan 2010, Sankaranarayanan and Sundararajan 2010, Zhao *et al.* 2009). However, studies that examine the nature (*i.e.,* activities) of EMs based on a large population of EMs are still lacking.

In operations management (OM) and marketing journals, some of the literature, and notably more recent research, focuses on the internal mechanisms (e.g., auction design) of EMs (Ağralı *et al.* 2008, Bapna *et al.* 2010, Chandrashekar *et al.* 2007, Chen *et al.* 2009, Elmaghraby 2007, Elmaghraby *et al.* 2012, Özener *et al.* 2011, Rothkopf and Whinston 2007, Schoenherr and Mabert 2008, Yeniyurt *et al.* 2011). Other works study EM adoption and EM decline (Adomavicius *et al.* 2013, Alt and Klein 1998, Angeles and Nath 2007, Goldsby and Eckert 2003, Gudmundsson and Walczuck 1999) or the effect of EMs on the operation of supply chains (Angeles and Nath 2007, Balocco *et al.* 2010, Caplice 2007, Carter and Kaufmann 2007, Carter *et al.* 2004, Figliozzi *et al.* 2006, Garrido 2007, Gattiker *et al.* 2007, Hawkins *et al.* 2010, Jap 2003, Jap and Haruvy 2008, Johnson *et al.* 2007, Kwon *et al.* 2009b). Rosenzweig *et al.* (2011) use a very large sample of EMs to study survival chances across industries at a macro level. They find that industrial sector, ownership (*i.e.,* publicly traded or not), and functionality impact survival. Finally, several OM studies are specific to EMs in the transportation industry. Boyle (2000) and Alt and Klein (1998) use case studies to provide excellent insight into the failure rate of transportation EMs in the early days. Figliozi (2004), Figliozzi *et al.* (2006) and Garrido (2007) use simulation and computational experiments to study the effect of auctions in spot transportation procurement markets. Caplice (2007) and Caplice and Sheffi (2003) give a good overview of different types of EMs, transportation economics, and the difference between strategic and spot procurement. They also explain the Winner Determination Problem (WDP) used in combinatorial auctions in order to reduce transportation costs by assigning lanes or bundles of lanes to the best bids (Caplice 2007). Recent OM literature still works on optimization models. Chen *et al.* (2009) present a model that allow bidders (*i.e.,* carriers) to formulate an exponential number of bids exhaustively (Chen *et al.* 2009) whereas Ozener *et al.* 2011 show how carriers can reduce their cost through a model that allows them to exchange lanes.

The current literature provides partial knowledge of the transportation EM industry, revealing the need for additional data collection and research. Therefore, an instrument to collect information about the content EMs offer is needed to further the understanding of these marketplaces. The next sections describes how grounded theory approach was followed to build a data collection instrument and create a transportation EM database.

3.3. Grounding the data collection in the reality of transportation EMs

3.3.1. Topic guide and list of features from the literature

The use of EMs boomed with the advent of Electronic Data Interchange (EDI) (Alt and Klein 2011) and the Internet. However the dotcom bubble burst in 2001 and the 2008 financial crisis showed that some EMs can be short-lived. As a consequence, a substantial stream of academic literature looks into what leads EMs to be successful, adopted and used or on the contrary to be rejected and fail. Following the example of Son *et al.* (2006), the EM academic literature was reviewed to identify the important topics that can serve as guides for the codification of features leading to successes and failures of EMs. This procedure pertains to the third canon of the grounded theory approach: "Categories [of concepts/features] must be developed and related" (Corbin and Strauss 1990, p.7). This was done by finding topics discussed in the literature and considered as influencing the use adoption or success of EMs. Gasson and Waters (2013) as well as Barratt *et al.* (2011) explain that the development of a topic guide (or *a priori* categories of concepts) helps acknowledge the influence of previous research and define an appropriate level of focus at the start of the data collection. Pragmatically speaking, the topic guide (please see Table 14) is constituted by the definitions of research topics from the literature that will be used as prisms to study the adoption, use or success of EMs. Five main topics have been identified: trust and uncertainty and risk, services offered, website quality, strategic factors and behavioral factors. The topic guide with the definition of each topic is provided in Table 14. The literature supporting these definitions are provided in the paragraphs below.

Table 14: Topic guide

Topics	Explanations
Trust, uncertainty and risk	Using EMs makes all participants vulnerable to losing some control over the trading process. Uncertainty and risk are negatively associated with adoption, use or success. Features that reduce uncertainty and risk can positively impact these outcomes. In the absence of or in complement to uncertainty or risk reducing features, trust creating features can be employed that also impact adoption, use or success positively.
Services offered	The services offered by the EMs before, during and after the transportation of goods occurs. An increase in the richness of services offered is positively associated with adoption, use or success.
Website quality	The quality of an EM is often based largely on perception and is the result of an ensemble of complex features that are difficult to list. Nevertheless, quality can be ruined by discrete and relatively objective flaws. This topic thus encompasses quality flaws observed on EMs.
Strategic factors	The features that can be considered almost as constants that define the identity of EMs. Each strategic factor is supposed to have its own relationship with adoption, use or success.
Behavioral factors	This topic encompasses the features triggering participants' behaviors that are susceptible to impact adoption, use or success.

The topics shown in Table 14 overlap. Trust, for example, is a behavioral factor but its predominance in the EM literature and its complexity dictated creating a topic on its own. In order to acknowledge the influence of prior literature beyond the definition of topics, the features found within each topic were listed and used as a basis for initiating data collection and the development of the new instrument. Appendix A shows the list of features (second column) identified in the literature under the topic(s) it belongs to (first column). These features or their close equivalents in the transportation EM context, were integrated, contingent on their relevance, in the instrument as the data collection progressed. Appendix A also shows the final instrument features (last column) and associates them with their closest equivalent from the existing literature (second column). In the following paragraphs, each topic is further defined and its role in the adoption, use or success of EMs is explained or illustrated by examples.

Trust, uncertainty and risk. The definition of trust adopted in chapter 2 stems from Mayer *et al.* (1995, p.712): "the willingness of a party (trustor) to be vulnerable to the actions of another party (trustee) based on the expectation that the other (trustee) will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party (trustee)." The reason for the trustor's vulnerability resides in uncertainty or risk involved in relationships or transactions; without uncertainty or risk, there is no need for trust (Rousseau *et al.* 1998). The EM literature identifies three main sources of uncertainty/risk: the product (Dimoka and Pavlou 2008, Dimoka *et al.* 2012); the seller (Dimoka and Pavlou 2008, Dimoka *et al.* 2012) or the community of sellers (Pavlou and Gefen 2004, 2005); and the EM process and lack of transparency of that process (Datta and Chatterjee 2008, Hackney *et al.* 2007). The buyers could also be a source of uncertainty but most of the EM literature focuses on retail EMs and adopts the perspective of the buyers who only worry about the aforementioned sources of uncertainty. Since uncertainty and risk negatively impact the adoption (Son and Benbasat 2007), use (Pavlou 2002, Pavlou *et al.* 2007, Wu and Gaytan

2013) or success (Baker and Song 2007) of EMs, there is a need for uncertainty reducing features[1] (Datta and Chatterjee 2008). Mavlanova *et al.* (2012) is one of the most significant sources that identify EM features that can reduce uncertainty across purchasing phases (pre-purchase, during the purchase and after the purchase). Appendix A displays the exhaustive list of uncertainty/risk reducing features found in the EM literature. The first column of Appendix A shows what topic(s) the feature belongs to in the literature. The table is sorted based on those topics. The second column shows the specific features with their corresponding academic sources in the third column. The fourth column entitled "expected impact on" shows the dependent variables that the features (*i.e.,* the independent variables) are supposed to impact based on the academic sources. The last column indicates the name of the feature(s)/ variable(s) that was (were) collected if any, to constitute the transportation EM database.

If uncertainty/ risk cannot be reduced through features, then trust is the mechanism that replaces the ability to control (Rousseau *et al.* 1998). In chapter 2, the beliefs concepts of benevolence, integrity and competence that affect what a trustor thinks he or she can expect from the trustee have been explained. These beliefs concepts can be influenced and aroused through trust production modes. Chapter 2 exposes the most renowned framework for trust production modes (Zucker 1986) but does it partially as it is used to justify the instrument developed by Son *et al.* (2006). The results of the work in chapter 2 point at a need to include all possible modes of trust production in a specific-to-transportation-industry instrument. Consequently, further literature review has been conducted to include all trust features that could influence the performance of transportation EMs. Several works go beyond Zucker's (1986) framework to study trust creation.

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[1] The term feature is used as an umbrella term that covers tools, functionalities, designs and mechanisms of the EMs.

Wang and Benbasat (2008) encompass all trust creation modes by identifying six reasons for trust creation: dispositional, institutional, heuristic, calculative, interactive, and knowledge-based.

The *dispositional reason* is intrinsic to the trustor as some people are more prone to trust than others. Although this reason contributes to trust creation, especially at early stages of inter-personal interaction (Wang and Benbasat 2008), it can be evaluated only by surveying the trustor. It is difficult to include this type of trust creation in the exploration of EM content and the dispositional reason is therefore excluded from this dissertation.

The conceptualization of *institutional reasons* for trust stems from Zucker (1986) and is based on confidence in societal structures. In the absence of characteristic-based trust (discussed in chapter 2), institutional-based trust production is considered as the primary trust production mode (Pavlou 2002, Zucker 1986). Within the institutional-based mode, the most studied societal structures are structural assurances because they are frequently used and were proven effective (Gefen *et al.* 2003). As expressed by Gefen *et al.* (2003), structural assurances include impersonal safety nets under the form of policies that provide structured ways of either protecting participants or finding solutions if problems arise during transactions. The safety nets included in the list of features guiding the development of the survey instrument are member screening, insurance, guarantees, security or privacy policies, terms and conditions, cooperation norms, codes of conduct, "contact us" links, customer service links, and training structures. Structural assurances also include signals from reputable organizations. Signals included in Appendix A are certifications, affiliation with respected organizations, and third party seals. Son *et al.* (2006) and chapter 2 focus almost exclusively on structural assurances with exceptions for escrow services and monitoring of products, which are intermediary mechanisms, not structural assurances. Intermediary mechanisms are also institutional reasons to trust a person, company or an EM. As illustrated by the inclusion of escrow services and product monitoring in Son *et al.* (2006), intermediary mechanisms might contribute to trust production on EMs and are thus included in the work of chapter 3. The intermediary mechanisms included in the list of features guiding the development of the survey instrument are escrow services, payment facilitation services, product appraisal, product reviews, and product inspection. There is a third institutional-based trust production mode in Zucker (1986) – situational normality. This mode described in Zucker's framework by Gefen *et al.* (2003) is actually viewed as a heuristic reason for trust in the work of Wang and Benbasat (2008).

Heuristic reasons for trust generation relate to first impressions and a general feeling for the trustee (Wang and Benbasat 2008). Wang and Benbasat (2008) allude to the similarity with the notion of swift trust (Guo *et al.* 2014, Ou *et al.* 2014) and how trust can be generated swiftly through the look and feel of the EM. Wang and Benbasat (2008) mention the friendliness of an interface to illustrate this notion in an online environment. It shows how the notion of heuristic reason for trust ties closely to the notion of website quality that is included in this section and is therefore part of this chapter's work.

Calculative reasons for trust pertain to two types of calculations: (1) the estimation of the trustee's cost and/or gain from untrustworthy behavior, and (2) the trade-off evaluation on the trustor side between potential gains from a trusting behavior and risks incurred. A content analysis cannot help estimating the result of these calculations, however, it can uncover elements that weigh on one side or another of the balance. Wang and Benbasat (2008) mention how a website's bias in favor of one participant can influence the generation of trust. Therefore, features that could help a user estimate gains and risks from participating in an EM are included in this study.

Interactive reasons are partly included in chapter 2 and correspond to process-based trust production modes from Zucker's framework (1986). These modes include personal past experience the user had with the EM and experience gained through reputation mechanisms. However, Wang and Benbasat (2008) add the notion of control to that category. In their interaction with the EM, users want to reduce uncertainty by increasing their control over the process. This conceptualization of control as a way to increase trust through uncertainty reduction shows the intricacies of the concept of trust and uncertainty, which are already exposed earlier in this section.

Knowledge-based reasons are based on the information the trustor has on the trustee *per se*. Wang and Benbasat (2008) distinguish the information that constitutes interactive-based reasons or heuristics reasons from knowledge-based reasons by explaining that unlike interactive reasons, knowledge-based reasons can be gathered without interacting with the trustee and unlike heuristics reasons, they are only about the trustee *per se* and not about the trustee's environment. Basically, the information considered relates to the exact patterns of the EM organization and transaction processes, its existing customers, *etc.* Thus, as the transportation EMs were explored, identifying characteristics of EMs (e.g., who owns the EM, where it is based, transaction patterns, *etc.*) were integrated to the list of features guiding the instrument development (please see Appendix A) so that their potential impact on trust can be analyzed.

Another reason to integrate identifying characteristics to the list displayed in Appendix A is that trust can be conferred based on a feeling of similarity, or belongingness to the same group. While this type of trust creation mode is part of Zucker's model (1986), it does not appear clearly in the Wang and Benbasat (2008) 6-reason framework. However, the work of Wang and Chiang (2009) is one of a few studies that uses characteristic-based trust as they show that shared vision between parties can create inter-organizational trust. Therefore, features that could help in creating a feeling of similarity between participants were collected for the instrument build in this chapter (e.g., EM expertise in a particular domain of transportation.)

Table 15 shows the empirical studies that are not mentioned in chapter 2 but were used in the elaboration of the list of features shown in Appendix A, which grounded the exploration of transportation EMs.

Table 15: Additional trust production modes in empirical studies not mentioned in chapter 2

Trust production mode	References
Heuristic-based	Gefen et al. 2003, Guo et al. 2014, Ou et al. 2014, Yeh and Li 2014
Interactive-based	Kim 2008, Kim and Ahn 2007, Pavlou 2002, Qureshi et al. 2009, Ou et al. 2014

In addition to trust building or uncertainty reducing features, EMs cannot attract users without answering their requirements (Stockdale and Standing 2002). Consequently, an EM needs to offer services or features that allow participants to find and receive the final product/ service they want in the required conditions.

The services offered by EMs are the services surrounding the transportation of goods. Otim and Grover (2006) break the services offered into 3 categories: pre-purchase, transaction-related and post-purchase services. Those categories are similar to transaction phases described by other authors (e.g., Grieger 2003). Pre-purchase services support the search and evaluation of the final product/ service. Examples of pre-purchase services are search tools (e.g., directory of carriers and shippers) and the type of information provided (e.g., weather and road conditions information relating to the purchase of a load on a particular lane.) Grieger (2003) explains that all EMs offer some pre-purchase services. Some EMs are even limited to those services (e.g., load boards). Transaction related services start when the participants have found the product/service that is the subject of the transaction. Transaction related services pertain to the arrangements needed for the transaction to give lieu to a factual or implicit contract. Arrangements include delivery options, payment options, and/or negotiation (e.g., price determination.) Mechanisms employed for price determination and contract attribution (*i.e.,* sealed auction *vs.* open auction *vs. etc.*) are often considered as part of the services offered (O'Reilly and Finnegan 2010, Rosenzweig *et al.* 2011, Stockdale and Standing 2002) and would belong to the transaction-related services. Post-purchase services help monitor the fulfillment of the terms of the contract and as consequence help justifying whether the pre-purchase decisions were the appropriate (Otim and Grover 2006). Order tracking is one of such services. In addition, post-purchase services also include customer support or after-sales services that help fixing issues resulting from the transaction.

In the EM literature, it has been shown that offering these services directly impacts adoption because they add value to the EM process (Stockdale and Standing 2002). It has also been shown that offering services before, during and after the transaction increases the continued usage of an EM (Otim and Grover 2006).

Otim and Grover (2006) include website aesthetics in the pre-purchase services category. However, aesthetics also falls under the umbrella of website quality which occupies a substantial portion of the EM literature *vis-à-vis* adoption, use and success.

Website quality pertains to the way the content is offered and has been measured in many different ways in the EM literature illustrating the multi-dimensionality of the concept. Gregg and Walczak (2008) provide a good review of the literature and survey instruments that are used for measuring website quality. The dimensions that can be found in their article are (in alphabetical order): accuracy, appeal (emotional and visual), assurance, attractiveness, clarity/readability, completeness, data fit to task, data quality, ease of use, empathy, interactivity, layout/organization, navigability, playfulness, privacy, reliability, responsibility, responsivity, security, service quality, technical adequacy, trust, understandability and usability. Although that list of dimensions is already long and accounts for dimensions found in previous and subsequent articles, recent research has also pointed at the importance of visual support (e.g., videos) for product descriptions (Yeh and Li 2014), and the feeling of social presence on the EM (e.g., Ou *et al.* 2014).

These dimensions of quality have been shown to directly impact adoption (e.g., Adomavicius *et al.* 2013, Gerow *et al.* 2013, Turel *et al.* 2011), use and re-use (Otim and Grover 2006, Qureshi *et al.* 2009, Wang and Chiang 2009, Zhang *et al.* 2011), and success or satisfaction (Yeh and Li 2014, Yen and Lu 2008). They also impact adoption, use or success indirectly through topics presented earlier: trust (Kim and Ahn 2007, Ou *et al.* 2014, Yeh and Li 2014), and uncertainty (Pavlou *et al.* 2007).

In spite of prolific literature studying website quality, it is difficult to seize the notion of quality based on features of websites. Most of the literature cited measures quality by surveying users. However, based on the dimensions reviewed, features that were deemed as potentially relevant were included in this dissertation. For example, EMs featuring pictures to describe the loads to be carried or the trucks available were coded as such since Yeh and Li (2014) showed that visual support in the product description impacts satisfaction. Similarly, based on the idea that social presence is beneficial to perception of trust, the possibility to live-chat with people of the EM was taken into account.

Furthermore, some of the literature on website quality approaches quality under the perspective of the absence of mistakes (e.g., horrible colors and misspelling) (Everard and Galletta 2006, Kincl and Štrach 2012). This is a convenient perspective because EMs' quality could be measured through the coding of objective facts. Specific flawed features were therefore captured while coding the EMs: incompleteness (e.g., "coming soon" pages, dysfunctional links), poor visual appeal (e.g., irregular size of fonts), poor color (e.g., font and background colors are the same), bad organization (e.g., available but difficult to find content) and bad navigability (e.g., no link back to a previous page). All features related to quality are also included in Appendix A.

Website quality does not define the long-term orientation of the EM in its environment. That is done through higher level factors – strategic factors. These strategic factors have been shown to also impact adoption, use or success.

Strategic factors can be viewed as the DNA of EMs. Mintzberg defines strategy as "the set of consistent behaviors by which the organisation establishes for a time its place in its environment" (Mintzberg 1978, p.941). O'Reilly and Finnegan (O'Reilly and Finnegan 2010) call this set of features the strategic factors whereas Stockdale and Standing (2002) call them business drivers. In both O'Reilly and Finnegan (2010) and Stockdale and Standing (2002), the services offered (covered earlier) and the type of ownership (*i.e.,* independent, owned by one big player, or consortia-owned) are strategic factors. In the strategic factors category, O'Reilly and Finnegan (2010) also classify the revenue model and management characteristics, which are sometimes not seen as a strategic factors but still considered important in the success of EMs (Quaddus and Hofmeyer 2007, Stockdale and Standing 2002). EMs can also strategically decide if they want to attract many or few participants and critical mass is viewed as important in the success of EMs (Johnson 2013, Quaddus and Hofmeyer 2007, Stockdale and Standing 2002).

In the EM literature, whether they are named as such or not, the strategic factors are linked to the selection/ adoption of EMs (Koch 2003, Quaddus and Hofmeyer 2007, Stockdale and Standing 2002), use (Jap 2007), and thus the success (Amelinckx *et al.* 2008, Bellantuono *et al.* 2014, O'Reilly and Finnegan 2010) or failure (Rosenzweig *et al.* 2011) of EMs.

Finally, participants also have a role in the adoption, use or success of EMs through their behaviors. Therefore, the literature has been reviewed in order to identify behaviors that have an impact on EMs' adoption, use or success and to identify the features that could lead to changes in behaviors.

Behavioral factors encompass attitudes, beliefs, perceptions, expectations and actions of users as individuals that can impact adoption, use or success of EMs. Trust and risk belong to that category but are so predominant in the EM literature that they deserve to be mentioned apart. Other behavioral factors exist that are sometimes less studied because they apply to specific types of EMs. Auctions are the most studied type of EMs and behaviors such as addiction (Turel *et al.* 2011), enjoyment and habits (Turel and Serenko 2012), winning (Goes *et al.* 2010) or losing effects (Yeniyurt *et al.* 2011) have been associated to them. Also it is within the realm of auctions that bidding strategies (Bapna *et al.* 2003, Goes *et al.* 2012, Jap 2003, Jap and Haruvy 2008) and unethical behaviors (Carter 2000) that are tightly associated with mistrust and risk and the difficulty to maintain buyer-supplier relationships (Carter and Kaufmann 2007, Zhang *et al.* 2011) have been studied. Because these behaviors can help or prevent an EM from thriving, features tied to these behaviors appearances are of interest. An examples of features that can help relationship management or prevent the appearance of unethical behaviors is the possibility to restrict the access to the EM to few selected participants (*i.e.,* organizing private events) (Emiliani 2005) and feedback mechanisms (Carter *et al.* 2004).

Perceptions of behaviors can also come into play as different transaction mechanisms have been shown to create different levels of perceived opportunism (Carter and Stevens 2007) and authors have therefore recommended further studying features that reduce opportunism/ maverick buying (Angeles and Nath 2007) or the feeling of it (Carter and Stevens 2007). Providing documentation on how transactions should occur on the EM is an example of such features (Tangpong *et al.* 2010). Perception can be impacted by how well EMs are accepted by either the competition or important partners. This social pressure or influence has been shown to impact adoption and use (Gumussoy and Calisir 2009, Hawkins *et al.* 2010, Koch 2003, Son and Benbasat 2007).

As the identification of these topics and the features for all kinds of EMs was completed, the exploration of transportation EMs can be initiated. Transportation EMs were identified and explored with the guidance of the topic guide in order to verify/ discover what features were part of transportation EMs.

3.3.2. Data collection instrument and coding guide: Database constitution

The fourth canon of the grounded theory approach relates to sampling. "Sampling in grounded theory proceeds on theoretical grounds" (Corbin and Strauss 1990, p.8). In the case of this study, a general definition of EM found in the academic literature (please see section 3.2.) was adopted after comparison with less parsimonious definitions. Based on that definition, a broad spectrum of EMs had to be investigated. Therefore, in order to ensure diversity in the sample and reduce bias in the data, and following the example of Grieger (2003), the academic literature as well as the "grey" literature (practitioners journals and magazines, transportation forums, content found on the websites themselves, *etc.*) has been searched for lists of potential transportation EMs. Table 16 lists the links that were explored to constitute a list of transportation EMs to be investigated.

Table 16: Links to transportation EM listings used to constitute the list of EMs to investigate

http://www.dmoz.org/Business/Transportation_and_Logistics/Marketplaces/Auctions/
http://www.dmoz.org/Business/Transportation_and_Logistics/Marketplaces/Freight_Exchanges/Trucking/
http://www.dmoz.org/Business/Transportation_and_Logistics/Distribution_and_Logistics/
http://toploadboards.com/
http://www.truckinfo.net/trucking/load-boards-online.htm
http://driversalike.wordpress.com/2010/08/18/load-board-list/
http://www.cashwayfunding.com/2014/05/free-load-boards-100-top-free-sources-find-
http://www.thetruckersreport.com/load-boards/
http://www.emarketservices.com/start/eMarket-Directory/index.html#FromText
http://www.4roadservice.com/lma/directory/Truck_Transport/Freight_Matching_Services/Fr
http://www.accessgrp.com/postonce_forms/new%20revised_posting_list_9.htm

Eventually, a list of 352 potential transportation EMs was gathered. Out of this list, 208 were actually EMs of interest (59%). Out of the 144 that were rejected, 66 were logistics companies without an online marketplace (46%), 25 had a url that returned an error page and could not be identified through a Google search (17%), 22 were website names that were bought but not developed (15%), 13 were not for transportation services (9%), 7 were redundant (5%), and the rest were other cases that were not relevant to this dissertation (*i.e.,* in a foreign language, not offering any information about the content, or for maritime or air transportation only) (8%).

Keeping in mind the topic guide and the list of features found in the EM literature, an exploratory survey of the content of 30 EMs was conducted. According to the first canon of grounded theory, analysis begins as soon as data collection starts in order to guide the rest of the data collection (Corbin and Strauss 1990). As coding of the first sample proceeded, a coding guide was developed that is shown in Appendix B. The coding guide defines the features found on transportation EMs and where they are generally found within the website. These features either correspond straightforwardly to features of general EMs or are interpretation of features found in the literature review adapted to transportation EMs. According to the fifth canon of the grounded theory approach, “analysis makes use of constant comparisons” (Corbin and Strauss 1990, p.9). This means that features that were encountered on transportation EMs were inventoried and defined. Definitions were then refined as features were again encountered subsequently. Thus some features correspond to features found in the literature whereas others are re-interpreted to fit the transportation environment. Appendix A shows the correspondence between features found in the literature and features collected for this dissertation. Furthermore, following the same canon, additional features that appeared on the transportation EMs were collected if they were relevant (based on the topic guide) to the discovery and conceptualization of transportation EMs. These features are marked as “additional” in Appendix A. Glaser and Strauss (2009) posit that this is the grounded theory’s major source of effectiveness as it allows exploration and “grounds theory in reality” (Corbin and Strauss 1990, p.6). It is to be noted that according to the second canon of the grounded theory approach, “concepts are the basic units of analysis” (Corbin and Strauss 1990, p.7). In the instrument, this relates to the fact that different services offered by EMs sometimes represent the same kind of feature and were thus coded as being different occurrences of the same feature. For example, some EMs offer to track the geographical position of a truck through GPS technology whereas others use technologies based on cell phone networks. Both cases were considered as occurrences of the “tracking/ locator” feature. This iterative process for defining the features requires keeping close track of the definitions’ evolution while coding. As recommended by the eighth canon of grounded theory (Corbin and Strauss 1990), theoretical memos under the form of a coding guide were developed to ensure consistency, precision in the coding, and reproducibility by other researchers. This coding guide was constantly updated as coding progressed and definitions evolved. Notes were also taken on the instrument itself to help coding and tracking evolutions in definitions. Also, following the tenth canon of the grounded theory approach - “a grounded theorist need not work alone” (Corbin and Strauss 1990, p.11), - the coding guide and the data collection instrument was developed under the guidance of members of the dissertation committee. After the collection of data for the first 30 EMs, the features and the coding guide were presented to three expert researchers in the OM/OR field and members of the dissertation committee. Opening the elaboration of the new theory (or instrument in this case) to other researchers helps prevent bias and brings insight to the work in progress (Corbin and Strauss 1990). Several feature definitions were modified, deleted or added in response to the remarks of the experts, and the evolved instrument was again tested and validated before further coding proceeded. Once theoretical saturation was reached (Glaser and Strauss 2009), the guides and features were validated and exhaustive coding started. One hundred forty one features were collected along the five topics.

The coding/analysis procedure started on October 24, 2014 and ended on February 06, 2015. It took the coder between 20 to 50 minutes to code a single EM (one to 15 minutes for a reject). Qualitative and content analyses can be pursued with a single coder (Hackston and Milne 1996) if reliability of coding is demonstrated (please see section 3.3.3.) Discourse analysis using the whole EM as a unit of analysis rather than certain words or phrases is employed in this study and justified by the complexity of the content to code (Lacity and Janson 1994). Some of the content is made of text but a big part is also constituted of pictures and/or videos. For example, to understand the mechanisms used by the load boards, "How it works" sections are very useful but often made of pictures and schemas (e.g., http://www.expediteloads.com/how-it-works-tour) or videos (e.g., http://www.shiply.com/how-it-works.php). The example of Cargomatic.com illustrates very well why a coder needs to literally see the big picture when coding rather than just read the text. On its "carriers" webpage, the only text that mentions a smartphone says: "Don't have a smartphone? We'll help you get what you need" (https://www.cargomatic.com/carriers/). Thus, it may be understood that the company targets people without a smart phone. However, when the text is complemented by the picture shown in Figure 5, it is easier to understand that the company actually targets people with smart phones; its EM is adapted to smart phones but the company still does take care of those who do not have smart phones.

Figure 5: Example of picture + text source of information (cargomatic.com)

The use of transportation jargon adds to the coding complexity. Also, because EMs are hosted all around the world (36 EMs were not based in the USA), specificities in language are to be accounted for. Continental Europe commonly uses the word "Tautliner" for a "curtainsider". A dump truck can also be referred to as a "tipper". Beyond language, the text content sometimes needed interpretation. For example, many EM companies are spin-offs of family businesses. Thus "history" or "about us" sections often mention the foundation of (literally) parent companies rendering the coding of the foundation year of the company under investigation more delicate (e.g., Smartlines LLC, http://www.smartlinesllc.com). Finally, the coder sometimes has to use good judgement with respect to voluntarily omitted information. For instance, "subscription is free" often means that other fees apply (e.g., http://www.freightseek.com.au/register.php). In spite of its difficulty, coding was made possible because the coder worked in the transportation industry for 7 years, in France and the UK and studied it in the USA. The coder first experienced a freight transportation EM (Teleroute.fr) in 2005 and is now a member of 20 of them. The coder also participates in trucker forums, reads practitioners' magazines, *etc.* According to Weijo *et al.* (2014), belonging to the community under investigation favors in-depth analysis.

The coding guide was developed and the canons of the grounded theory were respected in order to ensure good reliability of the data collected. A reliable and tested instrument is enough for Milne and Adler to "negate the need for multiple coders" (Milne and Adler 1999, p.2). Also, Milne and Adler (1999) consider that a single coder is acceptable once the coder is well trained and his/her coding reliability has been ascertained. However, a statistical test was deemed necessary to verify coding reliability (Krippendorff 2012, Lacity and Janson 1994) and notably, the effect of fatigue on the coding reliability of the single coder.

3.3.3. Reliability check

Given the size of the database, a random sample consisting of 15% of the data base was reserved as a control. This sample was re-coded after the entire database was coded in order to verify coding reliability. This reevaluation process has notably been applied by Merono-Cerdan and Soto-Acosta (2007) in a website study similar to this dissertation. It is well accepted to test a random sample of the database and accept the work of a single coder if the sample passes the reliability test (Kaplan and Miller 1987, McLure Wasko and Faraj 2005). The test-retest procedure was performed with a substantial time lapse (one month) between coding sessions to validate coding results. This process is suggested by Milne and Adler (1999). All features/variables were tested as categorical variables (e.g., whether the information was provided or not, the feature was offered or not, and whether the variable fell within one category or the others when there are more than two categories). 37 EMs (18%) were re-coded between February 24, and March 3, 2015. The percentage of agreement (*i.e.,* number of mistakes divided by the number of variables coded) was 90.42%. Neuendorf (2002) explains that agreement above 90% is nearly always acceptable. Nevertheless, another measure is needed because agreement does not consider the effect of variables without variation. Although Cohen's kappa is often used for measuring inter-coder reliability (e.g., Son *et al.* 2006), it suffers from a statistical bias (Krippendorff 2004). Scott's pi is recommended as a conservative measure of inter-coder reliability (Krippendorff 2004) and has been used in previous research (e.g., Hackston and Milne 1996). Both Cohen's kappa and Scott's pi were calculated and Scott's pi indeed proves either equal to Cohen's kappa or lower. Scott's pi is calculated as follows:

Pi = (Po – Pe)/ (1 – Pe)

Where Po is the percentage of agreement between the two coding sessions, and Pe is the expected agreement based on chance (Scott 1955). Figure 6 shows an example of coding reliability calculation with a two-category variable (*i.e.,* "live loads" or "forecast loads") coded in the transportation EMs' database.

Figure 6: Example of calculation of Scott's pi for a two-category variable from the transportation EMs' database

Percentage of observed agreement (Po):

Number of observations (per coding session): 37 (74 all together)

Number of disagreements observed: 2

Po = (37 - 2)/ 37 = **0.946**

Percentage of expected agreement (Pe):

Categories	Test	Retest	Joint Proportion (JP)	JP squared
Live	34	32	(34 + 32)/ 74 = 0.892	0.795
Forecast	3	5	(3 + 5)/ 74 = 0.108	0.012
			Total or **Pe** =	**0.807**

Scott's Pi for this variable:

Pi = (0.946 - 0.807)/ (1 - 0.807) = **0.720**

Although standards for interpreting Cohen's kappa and Scott's pi can vary (Krippendorff 2012, Neuendorf 2002), Son *et al.* (2006) is taken as a template because of the granularity of the scale and the similarity between studies. Son *et al.* (2006) based their scale on Landis and Koch (1977) (please see Table 17), which is used in other studies (e.g., Merono-Cerdan and Soto-Acosta 2007). Landis and Koch (1977) suggested this scale in order for future studies to benefit from a benchmarking tool.

Table 17: Strength of agreement scale for Cohen's kappa and Scott's pi

Statistic	Landis and Koch (1977) interpretation	Son *et al.* (2006) interpretation
<0.00	Poor	Poor
0.00 – 0.20	Slight	
0.21 – 0.40	Fair	Fair
0.41 – 0.60	Moderate	Moderate
0.61 – 0.80	Substantial	Good
0.81 – 1.00	Almost Perfect	Excellent

In the example found in Figure 6, Scott's pi is 0.72. Thus, based on the scale displayed in Table 17, it can be interpreted that the agreement strength between the two coding sessions for the chosen variable is substantial/good.

Appendix C shows the results of the reliability test for all 141 variables collected for the database. All variables were tested as categorical variables even if they were not designed that way. For example variable 4 (*i.e.,* date the EM was launched) is a quasi-continuous variable. This specific variable was tested as whether the information was provided in each coding session or not. The exactitude of the date was not considered. Two reasons justified that procedure. First, discrepancy in the data was factually related to whether the data was found or not rather than whether it was differing in value. Second, in the context of this dissertation just like in similar studies (e.g., Merono-

Cerdan and Soto-Acosta 2007), the presence of the data matters, not its value. It is understood that for further studies, different tests would be required. Table 18 shows the distribution of the strength of agreement in codification (based on Scott's pi). One hundred eighteen variables have at least a moderate reliability that can be judged satisfying for research studies (Son *et al.* 2006). Other variables with a lower reliability should be eliminated because their low level of reliability shows that they are difficult to identify on EMs and therefore are unreliable predictors of users' behaviors. Therefore, variables with low reliability or no reliability score (because of a lack of variation) were dropped from the study.

Table 18: Reliability distribution of the EM database (Scott's pi)

Statistic	Interpretation	Count
Not computable (lack of variation)	N/A	6
0.00 – 0.20	Slight/Poor	6
0.21 – 0.40	Fair	11
0.41 – 0.60	Moderate	19
0.61 – 0.80	Substantial/Good	55
0.81 – 1.00	Almost Perfect/Excellent	44
TOTAL	N/A	141

3.4. Database's descriptive statistics

Table 19 shows the frequency of use for each feature surveyed in chapter 3. The table is sorted by feature number in order to ease references to the coding guide shown in Appendix B. In

Table 19, it can be seen that the frequencies of use range from slightly above 0% to 96%. It shows that the study encompasses features that are of general use as well as features that target very specific needs. Such diversity might help increase variation in the use of features as well as avoid bias due to the measure of either niche features or overly general ones. Figure 7 shows that 80% of the features have a frequency of use below 35%. This means that most features are used by a third or less of the EMs studied. These numbers differ from the study by Son *et al.* (2007), which had approximately 40% of its features with a frequency of use below 35%. This difference in numbers is due to the fact that an exploratory approach was adopted in this chapter. This approach aimed at capturing all specificities of the transportation EM industry. In that approach, the instrument in development was not restricted to trust features but encompassed the five topics found in the topic guide shown in Table 14.

Table 19: Features' use frequency

Feat. #	Name	count	% use	Feat. #	Name	count	% use
3	About Us	199	96%	45a	Operating documents/ paperwork tools	63	30%
4	EM Launch date	25	12%	45b	Posting documents capacity	35	17%
5	Company's foundation or incorporation date	117	57%	46	Tracking/ locator	42	20%
6	Publicly traded	17	8%	47	Status Updates	44	21%
7	Headquarters location	154	74%	48a	Automated confirmation of delivery	21	10%
8	Number of Employees	23	11%	48b	POD imaging	10	5%
9	Number of Countries Served	86	42%	49	Mobile app/ mobile compatible	40	19%
10	Registered Transporters	46	22%	50	Escrow	7	3%
11	Registered Shipping Customers/ brokers	18	9%	51a	Secure payment	48	23%
12	Number of users	25	12%	51b	Payment facilitation (quick pay or factoring)	63	30%
13a	Activity level	43	21%	51c	Payment speed (in days)	38	18%
14	Total Business Transactions	10	5%	52b	Product Warranties and Guarantees	11	5%
18a	Primary activity - EM/software	110	53%	52d	Product Rev. & Rating FMCSA and SAFER	21	10%
18b	Primary activity - transportation/carrier	30	14%	53	Insurance	10	5%
18c	Primary activity - broker	37	18%	54a	Coop. Norms - dispute resolution NAF	2	1%
18d	Primary activity - 3PL/consulting	28	14%	54b	Coop. Norms - dispute resolution AAA	2	1%
18e	Primary activity - logistics	15	7%	54c	Coop. Norms - dispute resolution	19	9%
18f	Primary activity - others	9	4%	54d	Codes of Conduct	61	29%
19	Possess own fleet?	48	23%	54e	Expected Transaction Patterns	55	27%
20	Accessed actual tool?	123	59%	55	Safe Shipping Guide/ help regarding fraud	4	2%
21aa	Fee - one-time	14	7%	56a	Member Screening (MC#, VAT#, etc.)	118	57%
21ab	Fee - periodic	57	28%	56b	Emphasis on screening	80	39%
21ac	Fee - transaction	14	7%	56c	Screening real?	108	52%
21ad	Fee - consumption	2	1%	56d	Technique for screening	111	54%
21ae	Fee - combination	3	1%	56f	Upon Invitation marketplace option	29	14%
21af	Fee - free	116	56%	57a	Reputation Systems - peer ratings	36	17%
23a	Mechanism - Catalog	7	3%	57b	Reputation Systems - evaluate performance	14	7%
23b	Mechanism - Post and Search	160	77%	58	Third-party Assurance Seals	26	13%
23c	Mechanism - Post only, no pricing, no nego	3	1%	59	Privacy Policy	95	46%
23d	Mechanism - Auction (open)	19	9%	60	Disclosing E-marketplace Longevity	50	24%
23e	Mechanism - RFQ (sealed bid auction)	36	17%	61	Disclosing Management Team Profile	47	23%
23f	Mechanism - Exchange	1	0%	62	Disclosing EM size	90	43%
24	Based on forecast demand?	27	13%	63a	Affiliation with Respected Org. - partnerships	47	23%
25	Loads ownership	81	39%	63b	Affiliation with Respected Org. - association	64	31%
26a	Population targeted - commercial shippers	170	82%	64	Testimonials from Current Participants	68	33%
26b	Pop. targeted - non-commercial shippers	21	10%	65	Displaying Awards Earned	30	14%
26c	Population targeted - carriers	185	89%	66	Excerpts from New Media Outlets	63	30%
26d	Population targeted - private carriers	8	4%	67	Disclosing Well-Known Participants	34	16%
26e	Population targeted - brokers	90	43%	68	Terms and Conditions	110	53%
26f	Population targeted - owner operators	70	34%	69	Culture statement/ vision/ mission	65	31%
27	Emphasis on direct shippers	8	4%	70	Emphasize neutrality	21	10%
28a	Entry logic - Shippers	59	29%	71a	Photo display of merchandise	9	4%
28b	Entry logic - Carriers	91	44%	71b	Photo display of users	9	4%
28c	Entry logic - Brokers	37	18%	72	Delivery date claim	7	3%
28d	Entry logic - load search	133	64%	73	Quality of merchandise claim	0	0%
28e	Entry logic - truck search	33	16%	74	Transportation additional specialized content	103	50%
28f	Entry logic - load post/ get quotes	53	26%	75aa	Interactivity - contact info - e-mail form	132	64%
28g	Entry logic - truck post	36	17%	75ab	Interactivity - contact info - e-mail address	100	48%
28h	Entry logic - Single Sign-up entry	87	42%	75ac	Interactivity - contact info of website - phone	170	82%
29	Service - Local	36	17%	75b	Interactivity - live chat with website people	21	10%
30	Service - Long-Distance	164	79%	75c	Interactivity - desktop sharing	4	2%
31	Service - General Freight	177	86%	76	Customer support	62	30%
32a	Service - Specialized (military or gov.)	2	1%	77	Search	61	29%
33	Service - Truckload	173	84%	78	Help	36	17%
34	Service - Less than Truckload/ partial	127	61%	79	FAQ	70	34%
35	Service - Small Package Delivery	29	14%	80	Videos/ screenshots	50	24%
36	Service - Courier	23	11%	81	Training/ webinars	16	8%
37	Weather and road conditions	16	8%	82	Incompleteness	43	21%
38a	Rate estimation	29	14%	83a	Poor style - visual appeal	19	9%
38b	Get a quote	57	28%	83b	Poor style - colors	3	1%
38c	Provide a quote	2	1%	84	Errors	16	8%
39	Instant/ automated matching	65	31%	85	Bad Layout/ organization	11	5%
40	Complementary load tools/ backhaul ...	19	9%	86	Bad navigation	46	22%
41	Interaction between carrier and shipper	163	79%	87	Commercial banners	40	19%
42	Mileage calculation	73	35%	88	Is there a Facebook page?	126	61%
43	Credit reports	29	14%	89	# likes	121	58%
44a	Planner/ fleet management	24	12%	90	Testimonials/ reviews	66	32%
44b	Routing	19	9%	91a	User rating	62	30%
44c	Analytics	36	17%	92	FB Description	123	59%
44d	Integration with TMSs	36	17%	93	Mission	45	22%
44e	Integration with other Transportation EMs	36	17%				

Figure 7: Number of features per frequency of use

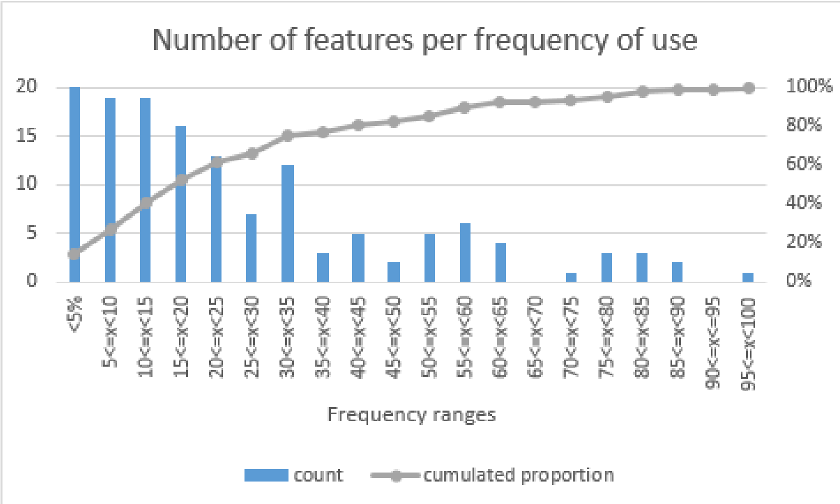
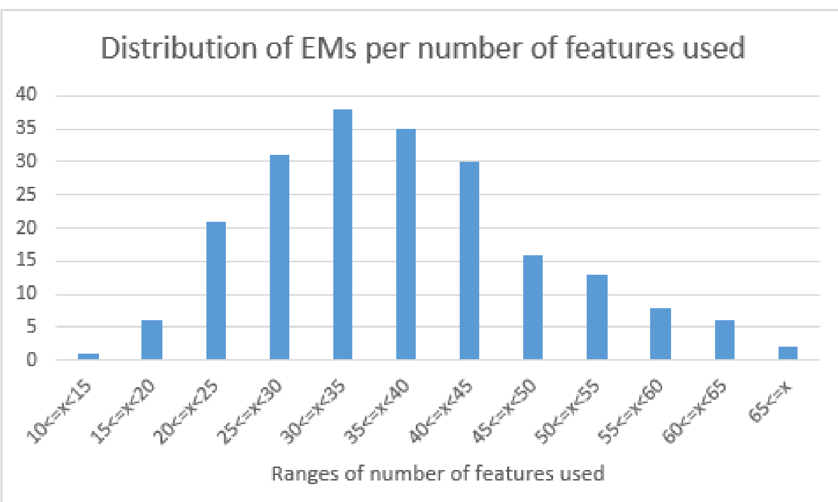


Figure 8 shows that most EMs use between 20 and 55 features and that the population of EMs is fairly normally distributed (although slightly skewed to the right) in terms of number of features used. Such a distribution means that the study of the database should not be biased by outliers or lack of variation.

Figure 8: Distribution of EMs per number of features used



CHAPTER 4

Empirical elaboration of a new typology for truck transportation e-marketplaces

Abstract

The content of 206 transportation EMs collected with the *ad hoc* instrument created in chapter 3 is used to formulate a new typology of EMs for truck transportation services procurement. The literature on EM categorization schemes has been reviewed to identify the perspectives academics have adopted to analyze all kinds of EMs. After the relationships between EM categories are hypothesized, 206 transportation EMs are categorized based on selected features and 55 independence tests are conducted between all categorization schemes. Tests results are first used to create a new typology. This typology is then confirmed via two clustering procedures. The specificity of transportation EMs are then discussed based on the new typology and the test results.

4.1. Introduction

The structure of the trucking industry impacts transportation procurement. Although there are big players in the industry, 97% of carriers have fewer than 20 trucks (ATA, 2011) and 90% have six trucks or fewer (ATA, 2011). Truck capacity is tight, with utilization approaching 97% in the U.S. market (CSCMP, 2013). A recent government report states that "effective innovation in information technology (IT) may be the most important tool for the private and public sectors to respond to capacity constraints and congestion" in freight transportation (SAIC 2009, p.1).

The fragmentation of the trucking industry, coupled with supply chain disruptions, lean production and unexpected demand for services, have created an environment for rapid on-demand procurement of transport services. Prior to the emergence of online transportation marketplaces, a shipper without its own private fleet or with short-term needs would contact a small group of known carriers and brokers to find transportation capacity. Since the appearance of NTE (National Transportation Exchange) and DAT (Dial-A-Truck), electronic marketplaces have taken an increasingly preponderant role in the matching of transportation capacity and transport offers. Transcore, owner of the leading truck freight transportation EM, estimates that 54% of brokers use commercial online market tools to find carriers (Transcore 2011a) and 42% of carriers find their freight through EMs (Transcore 2011b).

Despite these facts, limited literature is found regarding the specificities of EMs applied to truck transportation procurement. EMs in transportation have benefited from case studies and the anecdotal knowledge of academics, but not from empirical research based on a broad population of EMs (Movahedi and Lavassani 2012). Chapter 2 identified the limits of the only instrument found in the literature to survey EMs and the need for a specific transportation EM survey instrument. This specific instrument has been built in chapter 3 and data has been collected.

The result of the data collection is an exhaustive record of the actual features (characteristics, tools and options) found in transportation EMs. However, this record provides no insight on its own. One popular way to understand EMs has been to use categorization schemes (also called classification schemes) (Marradi 1990). A categorization scheme discriminates EMs based on one criterion (e.g., types of participants or number of participants) (Marradi 1990) and according to Webster and Watson (2002) constitutes the first step towards theory building. The following step towards theory building is to formulate a taxonomy of EMs in which relationships between categories of EMs are understood (Webster and Watson 2002). A taxonomy, like a typology, differs from a classification scheme because it uses several divisive criteria to obtain groups of objects (Marradi 1990). A typology differs from a taxonomy because the sequence in which the divisive criteria are applied for a typology does not matter (Marradi 1990). Typologies and taxonomies then provide a basis for frameworks and theories that respectively formulate propositions and laws explaining or predicting outcomes (e.g., adoption, use or success) (Webster and Watson 2002).Wang and Archer (2007) study relationships between EM categorization schemes in their work on B2B EMs, but their work does not aim at generating a typology because that requires being set it in a specific context (Wang and Archer 2007). Therefore, in the quest for the keys to performance of transportation EMs, chapter 4 will try to answer the following question:

RQ3: What is required in a new typology to facilitate improved understanding of the transportation EM industry?

First, to answer this question, the literature on EM categorization/classification has been reviewed. Eleven existing categorization schemes have been identified, defined, and the relationships between schemes that can be expected from the general EM literature have been hypothesized in order to focus this study on relationships that can help discover how transportation EMs differ from other EMs. Second, based on the actual features of EMs found in the database created in chapter 3, the transportation EMs have been classified within each of the 11 schemes found in the literature review. Each scheme contains between 2 and 8 categories. A re-coded database displaying the categories each transportation EM belongs to within each scheme, is therefore used for this chapter. Third, independence analyses between categorization schemes (*i.e.,* chi-square tests and likelihood ratio statistics) have been performed. A test of independence between two schemes allows to ascertain if one scheme has value for predicting the other scheme (Ott and Longnecker 2010). If it is the case, the two schemes are deemed dependent and relationships between the categories of the two schemes can be inferred. The results of these tests of independence allow the determination of whether the hypothesized relationships between schemes, and between schemes' categories, are supported (*i.e.,* schemes are found dependent and categories relationships display the hypothesized pattern). With transportation EM inter-schemes dynamics identified, the fourth step of this chapter is to derive and validate a typology based on these observations. Qualitative research provides good understanding of concepts and constructs permitting the investigation of a specific environment (Chua *et al.* 2007), which was done in chapter 3. Chapter 4 complements chapter 3's qualitative research thanks to the objectivity of evidence validation brought by empirical research (Gupta *et al.* 2006).

The primary contribution of this chapter is a new typology that allows scholars to better understand current strategies and business models employed by transportation EMs. This typology also sheds light on the specificity of EMs for truck transportation services procurement as it confirms, disconfirms and nuances existing understanding of dynamics between categorization schemes of EMs. Second, since this research relies on the exploration of actual tools and options of the IS (information system) artifacts (*i.e.,* e-marketplaces), the findings should help guide both EM design (Alt and Klein 2011) and selection (Haruvy and Katok 2013). Specifically, for transportation managers, understanding the mechanisms behind the EM offerings should help them better align transportation procurement with supply chain strategy (Sharifi *et al.* 2006).

This chapter shows that a large share of studied EM population is offered by carriers and brokers who try to attract sellers in order to ensure transportation capacity for business they overbooked. These marketplaces are often offered for free with a restricted spectrum of services. Conversely, other brokers and third-party providers offer sometimes more elaborate services, either in an environment open to unleashed competition or in a more protected environment. In both cases, it is notable that auction mechanisms that were once deemed unfit for transportation EMs are still being offered under specific conditions. Auctions are indeed either offered in a protected environment that vets its participants or in an unprotected environment with a series of more elaborate services to help manage uncertainty. A new typology is proposed that helps explain generic types of EMs that structure the EM population. The typology illuminates links between the 11 dimensions (*i.e.,* schemes) in this particular EM population and compare them with hypothesized links from traditional literature. This typology can serve as a basis for EM design and selection, and as a starting point for further research. Knowing the exact types of EMs offered in this industry, new studies can be embedded in EM contexts that are specific to this industry and have not been studied before.

The remainder of this chapter is organized as follows. First, the literature on EM categorization schemes is reviewed and hypotheses regarding inter-dependences between schemes are developed. Second, the methodology applied to the study is exposed. Third, a new typology is developed based on independence tests analysis and validated via clustering algorithms. Eventually, the new typology is used to highlight the specificity of transportation EMs.

4.2. Background literature on categorization schemes and hypotheses development

As EMs' form and use evolve, academicians try to understand the principles at the core of EMs. To that effect, many categorization schemes have been proposed (Grieger 2003, Movahedi and Lavassani 2012, Rossignoli and Ricciardi 2015, Sharifi *et al.* 2006, Wang and Archer 2007). Within a categorization scheme, the general EM population is sub-divided into groups based on one or more criteria. Each criterion makes sense within a theoretical frame. Since none of the works that developed or used categorization schemes specifically studied transportation EMs, it was decided to consider all the categorization schemes found in the EM literature in order to sort transportation EMs and compare the dynamics of categories applied to transportation EMS with what is known of EM categories in the general EM literature. Eleven categorization schemes have been identified in the EM literature that have been deemed relevant to transportation EMs. The discriminant criteria used to categorize EMs (and give their names to their respective schemes) are: ***(A) types of parties*** involved in the EMs; ***(B) bias*** *(four different types have been identified:* ***B1, 2, 3, and 4)*** in favor of one or the other party; ***(C) fee structure***; ***(D) market mechanisms*** used for matching demand and offer; ***(E) participants behavior*** towards the short or the long term; ***(F) the market's maker role*** as a consulting authority; ***(G1) the number of transaction phases*** accompanied by the EMs; and ***(G2) decision support*** options being offered or not.

When developing categorization schemes, researchers comment on the inter-dependences between categories and hypothesize how the categories impact each other. In this section, each categorization scheme from the general EM literature is defined, categories within each scheme are exposed and hypotheses regarding relationships between these existing categorization schemes are formulated based on the general EM literature.

(Scheme A) Types of parties: The categorization criterion is the participants in the EM. Businesses (B), individual consumers (C) or governments (G) can use EMs as suppliers or customers, creating nine different combinations of actors (B2B, B2C, B2G, *etc.*) (Coppel 2000). Regarding the EMs of interest in this study, the carrier is necessarily a business due to transportation regulations. The other party (the shipper), can be either another business, an individual or a government agency. Therefore only five out of Coppel's nine combinations (Coppel 2000) could occur in transportation EMs: B2G or G2B, B2C or C2B, and B2B.

(Scheme B) Bias: Bias defines the idea that an EM might serve one side of the trading parties better than the other. There are actually four schemes that represent bias because several approaches to bias have been employed in the EM literature. Consequently different criteria have been used in the literature to create categories of biased EMs. All criteria are considered in this study and the resulting schemes will be tested for inter-dependences. **(B1)** The **number of participants** on each side of the buyer-supplier relationship is a criterion defined by Wang and Archer (2007). Pavlou and El Sawy (2002) consider various cases of which the following are found in the database: one-to-many, many-to-few, many-to-many. A one-to-many EM is an EM with one buyer and many sellers, whereas many-to-few and many-to-many have many buyers and respectively few or many sellers. **(B2)** The **market orientation** criterion (sometimes called stakeholder focus or power asymmetry) defines the side of the market an EM is curtailed for. EMs are supposed to thrive when markets are fragmented (Wang and Archer 2007). Fragmentation increases administration costs, reduces visibility of the trading parties, *etc.* (Grieger 2003). That is why acting as aggregator and reaching some critical mass is often seen as essential to EM success (Grieger 2003, Wang and Archer 2007). Depending on what side of the market is being aggregated, the EM can better serve the interests of that side. Buyer-oriented EMs aggregate buyers and consequently defragment the demand side (*i.e.,* many buyers for one or more sellers) (Grieger 2003). Seller-oriented EMs aggregate sellers and thus defragment the supply side (*i.e.,* many suppliers for one or more buyers) (Grieger 2003). Neutral EMs are supposedly attractive to all by aggregating both sides (*i.e.,* many sellers and many buyers) (Grieger 2003, Kaplan and Sawhney 2000). Hence, the identified categories are seller-oriented, buyer-oriented or neutral. **(B3)** The **market ownership** criterion indicates whether the EM belongs to one of the trading parties, to a third party, or to a consortium (*Sharifi et al.* 2006). The categories are thus carrier-owned, shipper-owned, neutral-third-party-owned (*i.e.,* EM), interested-third-party-owned (*i.e.,* broker). No consortium was found in the database. **(B4)**

The **openness** criterion indicates whether the EM lets any qualified participant enter, or if it restricts entry to narrower circles of participants. An EM is deemed open (Grieger 2003) or public (Sharifi *et al.* 2006, Wang and Archer 2007) if there are no restrictions to entry, and private or closed when it does not welcome unleashed competition and constitutes a narrow circle of participants (registered members).

It is to be noted that the definitions of bias schemes overlap. A one-to-many structure often implies an EM owned by one of the parties and some authors equate it to being private/closed (Grieger 2003, Movahedi and Lavassani 2012, Sharifi et al. 2006, Wang and Archer 2007). Besides, EMs owned by neutral third parties are historically viewed as open to the public (Wang and Archer 2007) and of the many-to-many type (Grieger 2003, Movahedi and Lavassani 2012). Thus the following three hypotheses can be formulated:

H1a: Number of participants and ownership will be dependent

H1b: Number of participants and openness will be dependent

H1c: Ownership and openness will be dependent

Further, an EM owned by a trading party is often one-to-many and displays a certain market orientation (buyer- or seller-oriented), whereas an EM owned by a third party traditionally is more of the many-to-many type and more neutral to attract both buyers and sellers (Grieger 2003, Movahedi and Lavassani 2012). Grieger also explains that since ownership and market orientation are related and since ownership is assumed to be related to openness, openness should be related to market orientation (Grieger 2003). The following hypotheses are hence proposed:

H1d: Number of participants and market orientation will be dependent

H1e: Ownership and market orientation will be dependent

H1f: Openness and market orientation will be dependent

Grieger (2003) also explains that B2B market places prefer closed EMs more than B2C EMs do because they are more often aimed at hosting relationships between the owner and a few known partners. Thus, the following hypothesis:

H2: The types of parties and openness will be dependent.

(Scheme C) Fee structure: The type of fee charged to participants is the categorization criterion. Barratt and Rosdahl (2002) identify different sources of revenues for EMs: percentage of the amounts transacted, one-time subscription fee, or periodic membership fees. Others charge license fees (Segev *et al.* 1999, Wang and Archer 2007). Segev *et al.* (1999) also mention the combination of models with subscription fees plus additional charges for extra services. The exploratory part of this dissertation exposed in chapter 3 unveils other categories (e.g., free EM, consumption charges). In the end, the categories in this scheme are: one-time fee, periodic fee, per-transaction, consumption fee, combination of fees, and free. The number of categories might be reduced in the final version of the dissertation based on the research results. Wang and Archer (Wang and Archer 2007) suggest no link between the fee structure scheme and any of the other categorization schemes because they suppose that any EM can use any form of fee structure. However, free EMs shed a new light on the question. Carriers, brokers and shippers generate their revenues otherwise than with EMs and thus may not need to charge for using their EMs whereas for third-party-owned EMs, revenue from the EM is more likely to be part of the business model. As described by Lucking-Reiley, there should be a relationship between ownership and fee structure based on whether the EMs is merchant-owned or agent-owned (*i.e.,* neutral third party) (Lucking-Reiley 2000). In addition, if an EM is free, it must serve another purpose in line with the organization of the owner. That defines a hierarchical structure and implies a certain market orientation (Segev *et al.* 1999). Also, since a fee is a way to reduce access to an EM, the openness of

EMs should be impacted by the fee structure. Therefore, the following hypothesis is offered regarding fee structure:

H3: Fee structure and all bias schemes will be dependent.

(Scheme D) Market mechanism: the categorization criterion is the mechanism used to match offer and demand. Grieger (2003) and Rossignoli and Ricciardi (2015) divide the mechanisms into transactional *vs.* non transactional categories. The exploratory research pursued in chapter 3 only unveiled transactional EMs. Transactional EMs offer the following market mechanisms (Rossignoli and Ricciardi 2015, Wang and Archer 2007): (a) Aggregators/ ogs: the offer and demand are published and prices can be negotiated online or offline (post-and-search (Boyle 2000)), or prices can be posted (e-catalog (Boyle 2000)). (b) Online request for estimate or quotation: the prices or rates are not posted but requested by one or more participants and returned by a pool of carriers (not just the owner of the website). (c) Auction: each transaction requires a new auction in which price is determined through competitive bidding. (d) Exchange: borrowing to stock markets, the price is set by a real time bid-and-ask mechanism. Dans (2002) finds that B2B EMs use more sealed bid mechanisms and B2C EMs use more open mechanisms. Thus, the following hypothesis is proposed for our study:

H4: Market mechanism and types of parties will be dependent.

According to Mahadevan (2002), EMs that aim at liquidating the resources available (*i.e.,* auctions) are more associated with market relationships (*i.e.,* many-to-many EMs in this dissertation), whereas EMs aimed at aggregation (*i.e.*, e-catalogs) are more adapted to one-to-many EMs. Grieger (2003) nuances this view regarding e-catalogs by explaining that e-catalogs can be adequate when the market fragmentation is on both the buyers' and the sellers' sides, and a link still seems to exist between market mechanism and number of participants. The following hypothesis is then formulated:

H5a: Market mechanism and number of participants will be dependent

Wang and Archer (2007) also express a dependence between market mechanism and bias as they explain that exchanges and auctions are supposedly a predication of EMs owned by third parties. Hence, the following hypothesis:

H5b: Market mechanism and ownership will be dependent.

(Scheme E) Participant behavior: the categorization criterion is the time-frame in which the procurement of transportation occur - long-term (systematic) *vs.* short-term (spot) sourcing solutions. Supply chain paradigms suggest that systematic sourcing calls for contracts with few long-term qualified partners whereas spot sourcing is more adapted to repeated commodity purchases with many where no close relationships is necessary (Alt and Klein 2011, Grieger 2003, Kaplan and Sawhney 2000, Kwon *et al.* 2009a). Sharifi *et al.* (2006) also cautiously suggest that EMs owned by trading parties are supposed to be designed to build longer term relationships, whereas EMs belonging to third parties are more adapted to spot buying. Therefore, the following dependences are hypothesized:

H6a: Participant behavior and number of participants will be dependent.

H6b: Participant behavior and ownership will be dependent

Wang and Archer (2007) posit that e-catalogs are more adapted to long-term process management and post-and-search mechanisms are more useful for one-off relationships whereas Sharifi *et al.* (2006) assign all transactional mechanisms to the spot market. H7 is formulated according to Wang and Archer:

H7: Participant behavior and market mechanism will be dependent.

(Scheme F) Market maker's role: the categorization criterion is whether the EM acts as a consulting company - Sourcing service providers (SSP) *vs.* sourcing process outsourcers (SPO, sometimes referred to as "consulting" in this dissertation). Bartezzaghi and Ronchi (2005) explain that the market maker (*i.e.,* the EM company) can have two different roles *vis-à-vis* its users. SSP are EMs that offer e-sourcing tools and let the users handle their business on their own. SPO are entities that offer consulting on top of the tool provided by the EM. Of those two roles, SPO is more adapted to strategic and high budget procurement for critical products/services (Bartezzaghi and Ronchi 2005). Criticality is notably dictated by the complexity of the product and the concentration of the market because of collusion risks (Bartezzaghi and Ronchi 2005). In effect, one transporter can choose to create its own marketplace and attract many participants in order to make sure participants do not associate themselves to dictate their conditions. This concentration of the market is in this study assimilated to the one-to-many/few category of the "number of participants" scheme. It then seems to make sense to assume the following:

H8: Market maker's role and number of participants will be dependent.

H9: Market maker's role and participant behavior will be dependent.

(Scheme G1) Transaction phases: the categorization criterion is the type of transaction related actions that are accompanied by the EM. Alt and Klein (1998) identify three phases in transportation "exchanges" and Grieger (2003) adds one more. All EMs do not handle all the phases and therefore EMs can be classified upon what phases they support. The four phases are: (a) Information exchange; (b) negotiation; (c) settlement; (d) after sales. In the information exchange phase, buyers and sellers identify their needs and resources and potential partners. This phase ends with the submission of a transaction offer. In the negotiation phase, the terms of the transaction are being debated. This phase ends with a contract being sealed. In the settlement phase, the contract terms are being fulfilled. Finally, in the after sales, support is provided to cope with possible issues ulterior to the fulfillment phase and partners are being evaluated with regard to their performance. Since these categories are not exclusive of each other, for the purpose of this dissertation, the following exclusive categories were created: information only, information + settlement, information + after sales, information + settlement + after sales, negotiation only (assumed to include the information phase), negotiation + settlement, negotiation + after sales, and "all" if all phases are present.

(Scheme G2) Decision support: the categorization criterion is whether the EM provides decision support. All EMs include the information phase but there are several types of information. Rossignoli and Ricciardi (2015) explain that some EMs now provide information for decision support, which can help with different phases (e.g., the negotiation process) without these phases being formally included within the EM.

Schemes G1 and G2 are two distinct schemes. However, the general EM literature sometimes elaborates on concepts that are closely related to both. Barratt and Rosdahl (2002) mention customer service and value-adding services. Some of these services are settlement services (*i.e.*, settlement phase), and some are market information services (*i.e.,* decision support). Thus, when customer service or value-adding services are associated with certain categories of EMs, it is difficult to know if transaction phases or decision support is involved. Grieger (2003) specifically mentions transaction phases but employs a logic to associate it to other schemes that can apply to decision support as well. Therefore, it was deemed reasonable to assume that both schemes G1 and G2 would follow the same dynamics and the elaboration of hypotheses pertaining to both schemes have been merged. Grieger (2003) associates number of participants, openness and participant behavior to transaction phases. He explains that the number of transaction phases and their complexity parallels the development of long-term relationships within relatively closed EMs organized around "clubs" of participants. Barratt and Rosdahl (2002) rejoin Grieger's viewpoint by explaining that seller-centric EMs that defragment the demand (*i.e.*, buyer-oriented EMs) will tend to offer more customer service along the transaction process. In short, all bias perspectives seem to be associated with transaction phases and decision support. Thus, the following hypothesis is formulated:

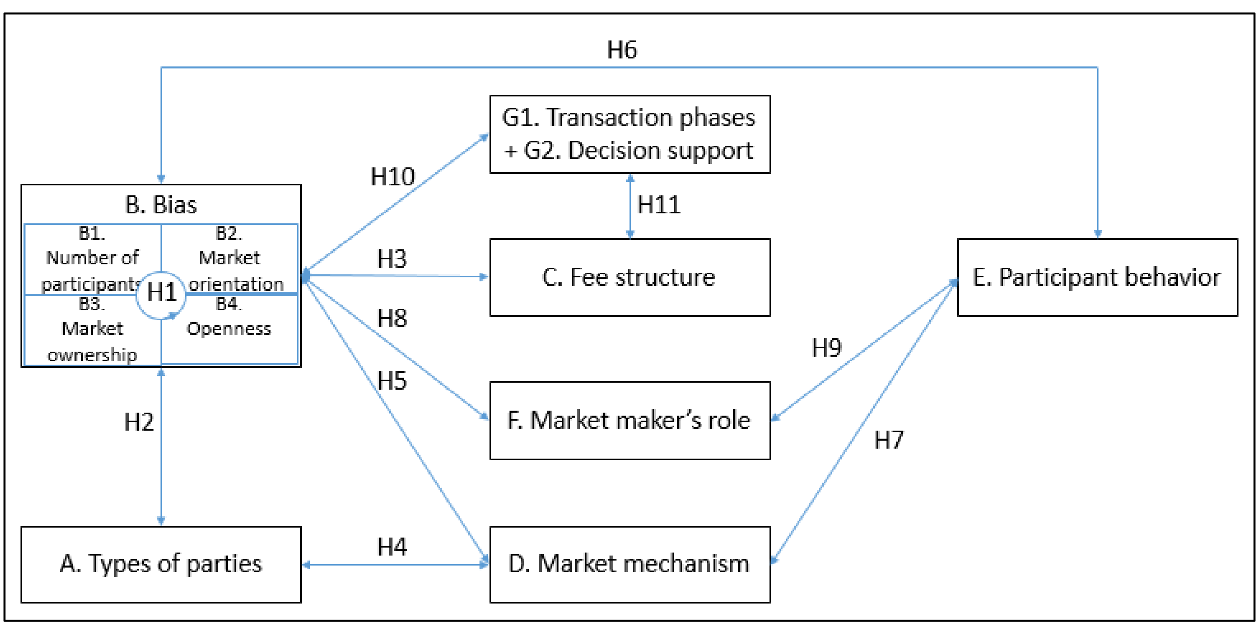
H10: Transaction phases/decision support and all bias schemes are dependent.

Finally, Barratt and Rosdahl (2002) implicitly posit that value-adding services require a fee, which links transaction phases and decision support to the fee scheme and justifies the following hypothesis:

H11: Transaction phases and decision support and fee structure will be dependent.

Figure 9 illustrates the categorization schemes retained for this study and the interrelationships hypothesized based on the EM literature.

Figure 9: Model of EM categorization schemes and their interdependences



4.3. Research design and methodology

4.3.1. Variables/ attribution to categories

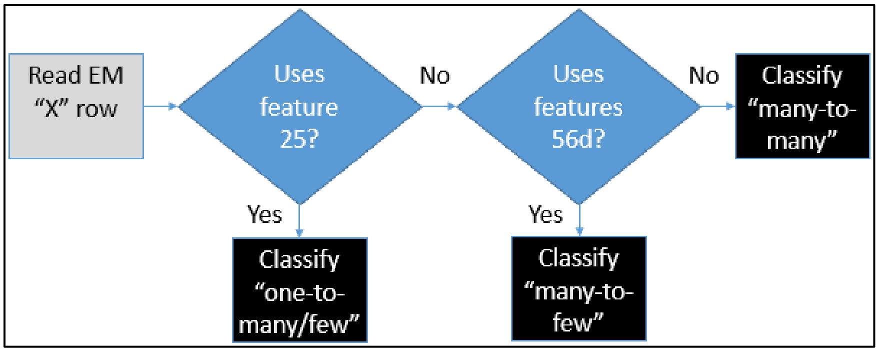
This section informs about the features of the database this study includes and how they are used to categorize EMs. The feature number (shown in parentheses) refers to the coding guide shown in Appendix B. Detailed illustrations are provided for schemes B1 and B2 that serve as examples throughout the methodology section. The paragraphs below describe each variable construction logic.

(A) Types of parties: By default EMs are assumed to be “B2B only” EMs. If an EM is coded as targeting “non-commercial shippers” (feature 26b), it is considered as being a “B2B and/or B2C” place. Originally, if the website offered to carry military equipment or provided governmental certifications to work with government agencies (information often found in feature 3 or 32), it was categorized as “B2B and/or B2G”. Because only four instances were categorized as B2G, it was decided to disregard this category and leave it as the default choice (B2B only).

Figure 10: How actual EM features are used to categorize EMs in the “number of participants” scheme (B1)

ORIGINAL DATABASE			RE-CODED DATABASE		
	Features impacting # of participants		Number of participants scheme		
Name	loads exclusively posted by website owner 25	Technique for screening 56d	One-to-many	Many-to-few	Many-to-many
ACME Truck Line	1	0	1	0	0
Addtran Logistics	1	1	1	0	0
Brothers Logistics	1	1	1	0	0
freightwatchers.net	0	1	0	1	0
Load surfer	0	1	0	1	0
Loadup and usacanadaloadup	0	1	0	1	0
123Loadboard	0	0	0	0	1
Freightwire	0	0	0	0	1
2 Buck Freight Company	0	0	0	0	1

Figure 11: Re-codification protocol for the "number of participants" scheme (B1)



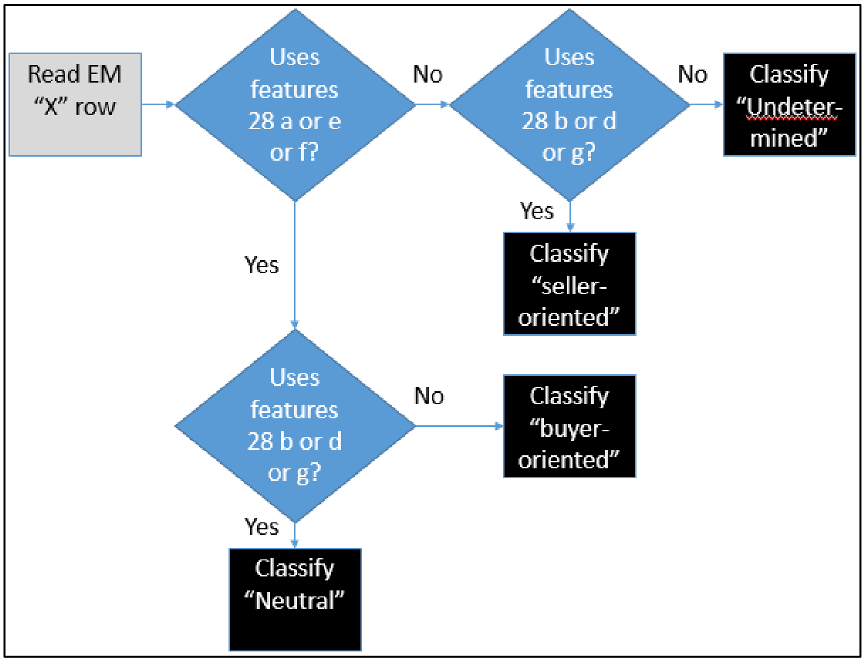
(Protocol format based on Rosenzweig et al. 2011)

(B1) Number of participants: Figure 10 and Figure 11 illustrate how the database created in chapter 3 is used to classify EMs in scheme B1. It shows that if the owner of the EM is the only one to post loads on the EM (feature 25), the EM is considered a "one-to-many/few" EM. EMs who are not "one-to-many/few" and use a small pool of carriers, or impose tight requirements for the selection of carriers (feature 56d) are considered as "many-to-few". Other EMs are coded as "many-to-many".

Figure 12: How actual EM features are used to categorize EMs in the "market orientation" scheme (B2)

ORIGINAL DATABASE							RE-CODED DATABASE		
	Shipper Entry logics			Carrier entry logics			Market orientation scheme		
Name	Shippers 28a	load post/ get quotes 28f	truck search 28e	Carriers 28b	load search 28d	truck post 28g	buyer oriented	seller oriented	neutral
123Loadboard	0	1	0	0	0	0	1	0	0
freightwatchers.net	0	1	0	0	0	0	1	0	0
Freightwire	0	1	0	0	0	0	1	0	0
ACME Truck Line	0	0	0	0	1	0	0	1	0
Addtran Logistics	0	0	0	0	1	0	0	1	0
Brothers Logistics	0	0	0	1	1	0	0	1	0
Hogan Logistics	0	0	0	0	1	1	0	1	0
Agfreight.com	1	0	0	1	0	0	0	0	1
Aljex	1	0	0	1	0	0	0	0	1
Anyvan	1	1	0	1	1	0	0	0	1

Figure 13: Re-codification protocol for the "market orientation" scheme (B2)



(B2) Market orientation:

Figure 12 and Figure 13 illustrate the features of the actual EMs that were used to classify EMs in the market orientation scheme. EMs are categorized as "buyer-oriented" if the entry logic to the EM focuses on "shipper log-in" (feature 28a) or "posting loads" (feature 28f) or "searching trucks" (feature 28e) (but not "carrier log-in" (feature 28b), not "posting trucks" (feature 28g), and not "searching loads" (feature 28d). It is considered as "seller-oriented" if the entry logic is "carrier log-in" (feature 28b)or "load search" (feature 28d) or "posting trucks" (feature 28g) (and not "shipper log-in" (feature 28a), not "load posting" (feature 28f) and not "truck searching" (feature 28e). Other EMs (*i.e.*, with entry logics that correspond to buyer and seller orientations, or with a unique neutral entry logic - feature 28h) are considered as "neutral".

Figures illustrating the re-codification process are not provided for other schemes although they all followed the same sort of process.

(B3) Market ownership: No EM in this study is identified as belonging to a consortium of participants. Therefore the EMs either belong to a trading party (*i.e.,* shipper or carrier) or a third party (EM operator or broker). This information is found in features 18a, b, c, d, e, f and 19 of the coding guide (Appendix B). Brokers do not have the same legal obligations as carriers and do not generate revenue like EM operators. Therefore, two third party categories have been created: Neutral third party are EMs owned by parties that do not belong to the transportation industry. Interested third party are EMs that introduce themselves as brokers or 3PL without a fleet (feature 19). EMs that mention possessing a fleet (feature 19) and not identified as a shipper in feature 18f were identified as carrier-owned. All EMs without a fleet and coded as EM/ software provider or financial service provider (features 18a) were identified as EM/ software provider-owned. Other EMs were coded as broker/shipper-owned.

(B4) Openness: EMs are considered private when they are not accessible to the coder (feature 20) because it imposed a registration process involving more than a motor carrier (MC) or department of transportation (DOT) number (feature 56d).

(C) Fee structure: this information was not always straightforwardly displayed on the EM's website (features 21aa, ab, ac, ad, ae, and af). The granularity of information available on the EM site supported differentiation into three categories: periodic and one-time fees (features 21aa and ab), Fees per transaction and/ or consumption (features 21ac, ad and ae), and Free of charge EMs (feature 21af).

(D) Market mechanism: If the EM returns one or multiple prices for a load instantly, the EM is categorized as "e-catalog" (feature 23a). If participants post their need or resource and when a match is found contact information is provided, it was categorized as "post-and-search" (feature 23b). If requesting several quotes or offers for a load takes time, the EM is categorized as auction.

The auction category is divided into "sealed auction" (feature 23e) when bidders cannot see each other's bids, "open auction" (feature 23d) when bidders see others' bids live and can counter them or if they are aware they are being outbid and can react live. An EM is considered as an "exchange" (feature 23f) if the EM both matches the offer and demand and fixes the price automatically. When the data was collected, some EMs were originally coded as belonging to several market mechanism categories. However, some categories when present were generally offered as a primary mechanism. For the statistical tests performed in this chapter, exclusive categories are needed. Therefore, each EM was categorized in its primary category. Eventually, the market mechanism variable includes the following categories: E-catalog, Post & Search, Open auction, Sealed auction.

(E) Participant behavior: An EM is categorized as systematic if it allows booking capacity per lane or forecasted needs. Otherwise it is considered as a spot market (only live loads). (Please see feature 24)

(F) Market maker's role: If the owner or the website describes itself as 3PL or consulting company (feature 18d), the EM is considered as SPO. Otherwise, it is classified as SSP.

(G1) Transaction phases: It is considered that all EMs imply the information stage. EMs classified as providing "Post & Search" (feature 23b) are considered as not offering the negotiation phase. EMs with a settlement phase are those with at least one of these: tracking (feature 46), status updates (feature 47) and documents management (e.g., printing Bill of Lading) (feature 45a). EMs offering backhaul matching (feature 40), escrow services (feature 50), payment facilitation (feature 51b), insurance (feature 53), warranties (feature 52b), dispute management (feature 54a, b, c), peer rating (feature 57a) and/or performance evaluation (feature 57b) are considered as performing after sales tasks. Since the categories are not exclusive of each other, combinations of categories were created to make the categories exclusive (e.g., "Information + settlement + after sales" or "Negotiation + after sales").

(G2) Decision support: EMs offering decision support are those that provide at least one of the following: weather and route conditions information (feature 37), miles calculation (feature 42), rate estimation (feature 38a), credit report (feature 43), analytics (feature 44c), trading parties review and ratings (feature52d), reputation systems (peer rating and performance evaluation, features 57a and b) and photo of the merchandise (feature 71a). Other information exchange are without decision support.

4.3.2. Reliability check

The database containing the records of features used by 206 EMs was constituted in chapter 3 through a grounded theory approach. This approach provided guidelines for building a rigorous survey instrument while data was collected simultaneously. However, it was decided to further enhance the credibility of the database by performing two coding reliability tests: a single coder test-retest procedure, and an inter-coder procedure with two independent coders. The test-retest procedure aimed at measuring the effect of fatigue on a single coder when coding 206 EMs. Out of the 206 EMs initially coded, a sub-sample of 37 was recoded with all features present in the instrument to verify if both coding sessions provided the same results, which is the desired outcome. The inter-coder procedure aimed at showing that the results of the coding process do not depend on the interpretation of the coders but are consistent between coders. The coders were trained following the procedures explained in chapter 2. First, the author (*i.e.,* first coder) explained the coding guide to the second coder. Second, 8 EMs were browsed together to see examples of features presenting subtleties. Third, two EMs were coded independently to allow the second coder to better understand the coding guide and ask questions. Fourth, four extra EMs were again coded independently to see if there were still discrepancies, solve them and start further coding. Finally, 27 additional EMs were coded independently to see if inter-coder reliability was high enough.

In this chapter, 41 features were selected for categorization purposes. For both reliability tests, the main measure of reliability adopted in this dissertation is Scott's pi because it is a conservative measure that does not suffer statistical bias (Krippendorff 2004).

Results of the test-retest procedure with a single coder:

Scott's pi could be calculated for 38 of the 41 features (3 features did not provide any variation and Scott's pi could not be calculated). 33 features (80% of the re-tested sample) exhibited a good or excellent coding reliability with Scott's pi above 0.6 (please see the scale adopted by Landis and Koch (1977) and Son *et al.* (2006) provided in Table 17 in chapter 3). Five features exhibited a moderate reliability (Scott's pi between 0.4 and 0.6). No feature displayed a reliability below 0.4 (*i.e.,* poor, slight or fair), which is satisfactory by Son *et al.* (2006) standards. Appendix C shows the reliability for each feature.

Results of the inter-coder procedure with two coders:

Out of the 41 features used in this chapter, 3 did not provide any variation and Scott's pi could not be calculated. 32 features (78%) exhibited a satisfactory reliability (above 0.4) and 6 features exhibited a too-low level of reliability. One of these features is feature 23a, "Market mechanism - E-catalog". Few e-catalogs were found in the database (seven). Also it was sometimes difficult to really make a difference between e-catalogs and Post and Search or Sealed Auctions as the two latter mechanisms allow hybrid mechanisms that come close to being catalogs (such as expressing a desired rate or a "book it now" price). Therefore, E-catalogs were merged with Post and Search when both E-catalog and Post and Search were offered at the same time. E-catalogs were merged with Sealed Auctions otherwise. Merging E-catalog with the other mechanisms actually boosts the reliability of these other features (23b switches from moderate reliability to excellent and 23e from good to excellent). Therefore, feature 23a "Market mechanism - E-catalog" was kept to be merged with other features. The 5 other features with low reliability (below 0.4) were dropped from the study. Appendix D shows the detailed reliability levels for each of the 41 features.

As seen in the previous section, features are often used concurrently to constitute variables. The study in this chapter and in chapter 5 rely on these variables. Therefore, the inter-coder reliability was also calculated for the variables defined in the previous section in order to make sure that the variables and therefore the results of the studies implemented in chapter 4 and 5 are reliable. Table 20 shows the inter-coder reliability (Scott's pi) when the variables are built based on the sample coded by coder one on the one hand and the sample coded by coder two on the other hand.

Table 20: Inter-coder reliability for the variables used in chapter 4 and 5.

VARIABLES	SCOTT's PI
(G1) Transaction phases	0.46
(G2) Decision support	0.54
(B2) Market orientation	0.63
(B4) Openness	0.63
(F) Market maker's role	0.66
(B1) Number of participants	0.67
(E) Participant behavior	0.71
(B3) Market ownership	0.74
(C) Fee structure	0.78
(D) Market mechanism	0.85
(A) Types of parties	0.87

Table 20 shows that 9 out of the 11 variables have a good or excellent level of reliability (please see the scale adopted by Landis and Koch (1977) and Son *et al.* (2006) provided in Table 17 in chapter 3). Two variables have a moderate level of reliability that is still acceptable by Son *et al.* (2006) standards.

Similarly to previous studies (Hackston and Milne 1996, Milne and Adler 1999, Tangpong 2011), based on the facts that both the test-retest reliability with a single coder and the inter-coder reliability were satisfactory, it was considered that a single coder could proceed with coding the 41 features used in this study for the entire 206 EM database.

4.3.3. Categorization schemes independence test methodology

EMs were assigned to categories using the different categorization schemes. Table 21 shows 8 EMs assigned according to the number of participants and market orientation categorization schemes (respectively B1 and B2 schemes). For example, 123Loadboard is an EM that falls into the "many-to-many" category within the "number of participants" scheme and into the "buyer-oriented" category within the market orientation scheme.

Table 21: Sample of 8 EMs categorized along two categorization schemes - number of participants and market orientation

Name	# of participants	market orientation
Uship	Many-to-many	Neutral
123Loadboard	Many-to-many	Buyer oriented
2 Buck Freight Company	Many-to-many	Neutral
DAT load boards	Many-to-few	Neutral
ACME Truck Line	One-to-many	Seller oriented
Addtran Logistics	One-to-many	Seller oriented
Agfreight.com	Many-to-many	Neutral
Aljex	Many-to-many	Neutral

With categorical data, the association/dependence between two categorization schemes (*i.e.,* two categorical variables) can be tested through Pearson's Chi square test (Anderson *et al.* 2009, Ott and Longnecker 2010) and likelihood ratio statistics (Ott and Longnecker 2010). A test of independence between two schemes provides statistical proof of whether one scheme has value for predicting the other scheme (Ott and Longnecker 2010). If two schemes are shown to be dependent, associations between schemes' categories can be inferred.

In order to conduct a test of independence between two variables/schemes, the observed frequency data of these schemes need to be arranged in a contingency table. The example in Table 21 shows two categorical variables (*i.e.*, schemes) with three categories each (one-to-many, many-to-few and many-to-many; buyer-oriented, seller-oriented and neutral). A cross tabulation of those two variables yields the 3 by 3 contingency table shown in Table 22. For example, Table 22 shows that of the 206 EMs, 70 are both "neutral" and "many-to-many".

Table 22: Cross tabulation of schemes B1 and B2 (number of participants and market orientation)

B2 vs. B1	**many-to-many**	**many-to-few**	**one-to-many**	**Total**
Buyer oriented	3	4	0	**7**
Neutral	70	36	27	**133**
Seller-oriented	4	8	54	**66**
Total	**77**	**48**	**81**	**206**

Based on the "total" row and column of the contingency table containing the observed distribution of the schemes being studied (e.g., Table 22), and assuming independence between schemes, a new contingency table can be built that contains the expected distribution of the data. In Table 22 for example, 81 out of 206 (39.3%) EMs are "one-to-many", and 133 out of 206 (64.6%) are "neutral". Assuming independence, the expected frequency for EMs that are both "one-to-many" and "neutral" should be: 0.39 x 0.65 x 206 = 52.30. This calculation can be completed for each cell of the contingency table. Figure 14 shows both contingency tables with observed and expected values side to side. It can be seen in Figure 14 that there are substantial differences in values between the observed and expected distributions but it is common for expected values to be different from observed values due to random variations. That is why a statistical test is needed to ascertain that the differences observed are not only due to chance. The test of independence shows whether these differences are statistically significant. If they are, it can be concluded that there is a dependence between both schemes (B1 and B2). When two schemes are dependent, one scheme has some value in predicting the other scheme. As a consequence, an EM being classified in one of the categories of one scheme allows predicting in what category of the other scheme that EM is.

The most popular way to test for independence between categorical data is Pearson's chi-square test (Ott and Longnecker 2010). For Pearson's chi-square test to be considered accurate, a conservative rule requires that all cells in the contingency table containing expected values be at least one and no more than 20% of the cells should be less than 5 (Ott and Longnecker 2010). Figure 14 shows that three out of nine (*i.e.,* 33%) cells of the contingency table with expected values have values lesser than 5. Thus, the tables studied do not meet the requirements for Pearson's chi-square test. The data in the contingency table is sparse, which can lead to unreliable Pearson's chi-square tests (Cohen *et al.* 2009). For that reason, the likelihood ratio test was also performed, which helped the results' analysis because it is not affected by the sparseness of the data (Cohen *et al.* 2009). It is to be noted that in this study the likelihood ratio test consistently corroborated the results of the chi-square test.

Figure 14: Pearson's chi-square test and likelihood ratio test of independence between variables B1 and B2

Observed values:

B2 vs. B1	many-to-many	many-to-few	one-to-many	Total
Buyer oriented	3	4	0	**7**
Neutral	70	36	27	**133**
Seller-oriented	4	8	54	**66**
Total	**77**	**48**	**81**	**206**

Expected values:

B2 vs. B1	many-to-many	many-to-few	one-to-many	Total
Buyer oriented	2.62	1.63	2.75	7
Neutral	49.71	30.99	52.30	133
Seller-oriented	24.67	15.38	25.95	66
Total	77	48	81	206

Pearson's test

$$\chi^2 = \sum\sum \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

or

SUM ((Observed Expected)^2/ Expected)

B2 vs. B1	many-to-many	many-to-few	one-to-many	
Buyer oriented	0.06	3.44	2.75	
Neutral	8.28	0.81	12.24	
Seller-oriented	17.32	3.54	30.32	**Total**
			Total	78.75

Likelihood ratio test

$$G^2 = 2\sum \left[O_{ij} \ln \frac{O_{ij}}{E_{ij}}\right]$$

or

2*SUM (observed*ln(observed/expected))

B2 vs. B1	many-to-many	many-to-few	one-to-many	
Buyer oriented	0.41	3.59	0.00	
Neutral	23.96	5.39	-17.85	
Seller-oriented	-7.28	-5.23	39.57	**Total**
			Total	85.12

Chi-square distribution table

The degree of freedom (df) for a 3*3 matrix is (3-1)*(3-1) = 4

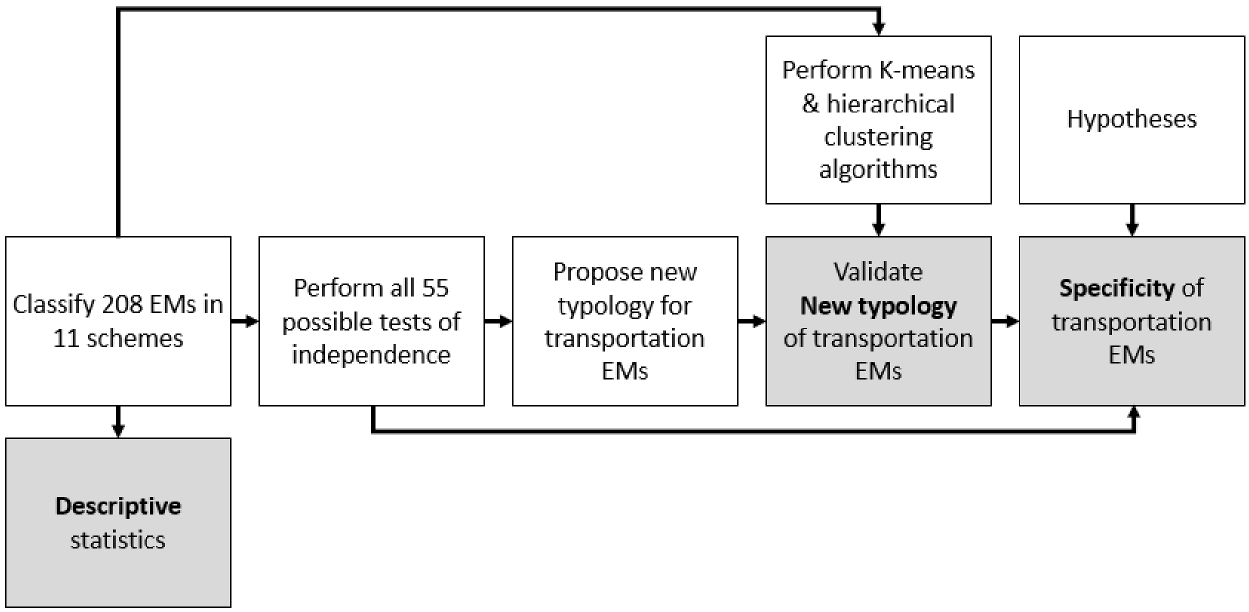
	α			
df	0.1	0.05	0.01	0.0001
1	2.71	3.84	6.63	15.14
2	4.6	5.99	9.21	18.42
3	6.25	7.81	11.34	21.11
4	7.78	9.49	13.28	**23.51**
5	9.24	11.07	15.09	25.74

Figure 14 shows the process for both Pearson's chi-square and likelihood ratio tests. Both tests try to determine whether the variables (*i.e.,* schemes) are independent. For both tests, the null hypothesis is that the two variables tested are independent and the alternative hypothesis is that they are dependent/ associated. Based on the observed and expected values, χ2 and G2 are calculated with the formulas provided on Figure 14 (Ott and Longnecker 2010). For a 3 by 3 contingency table, the degree of freedom is (3-1)*(3-1)= 4. For α=0.0001 (*i.e.,* very high confidence in the results), and a degree of freedom of 4, the chi square distribution table shows a Chi-square value of 23.51 or above is required to reject the null hypothesis. Since χ2= 78.75 and G2= 85.12, both Pearson's and likelihood ratio tests are statistically significant and reject the null hypothesis. This means that variables B1 (type of parties) and B2 (number of participants) are not independent (*i.e.,* are associated). In other words, it is very unlikely that the differences in distribution in the observed table and in the expected table are due to chance. Therefore, by comparing the expected contingency table with the original contingency table in Figure 14, it can for example be concluded that there are significantly more one-to-many EMs among the seller-oriented EMs whereas neutral EMs are more of the many-to-many type.

4.4. Data analysis process

Figure 15 shows the process suggested for exploiting the database constituted in chapter 3. In Figure 15, the grey boxes show the different outputs/ contributions of the study. First, classifying EMs within each of the eleven schemes identified in the literature provided the first output and contribution of this study: descriptive statistics (*i.e.,* the state of the transportation EM industry). Although abundant literature exists on different types of EMs used in the transportation industry, a thorough survey of the transportation EM industry does not exist. Second, based on the "categorized" database, tests of independence have been performed between all possible pairs of schemes (*i.e.,* 55 tests have been performed). Based on these results, a second contribution stemmed from this study: a new typology is proposed and validated through k-means and hierarchical clustering procedures. Finally, the results of the tests are used to support the analysis of relationships between schemes and to determine whether the hypotheses illustrated in Figure 9 are supported, contradicted or nuanced. This provided the third output of this study: the similarities with general EMs and specificities of transportation EMs. This knowledge helped identify to what extent literature on general EMs applies to transportation EMs, and whether the transportation context is specific enough to require its own studies. Additionally, the new typology will help guide further studies of the transportation EM industry by providing an explanation on how different classes of EMs are articulated to tackle the transportation market.

Figure 15: Process for studying transportation EMs based on the database created in chapter 3



4.5. Results

Table 23 shows the descriptive statistics of the study.

Table 23: Distribution of the EMs in the different categories

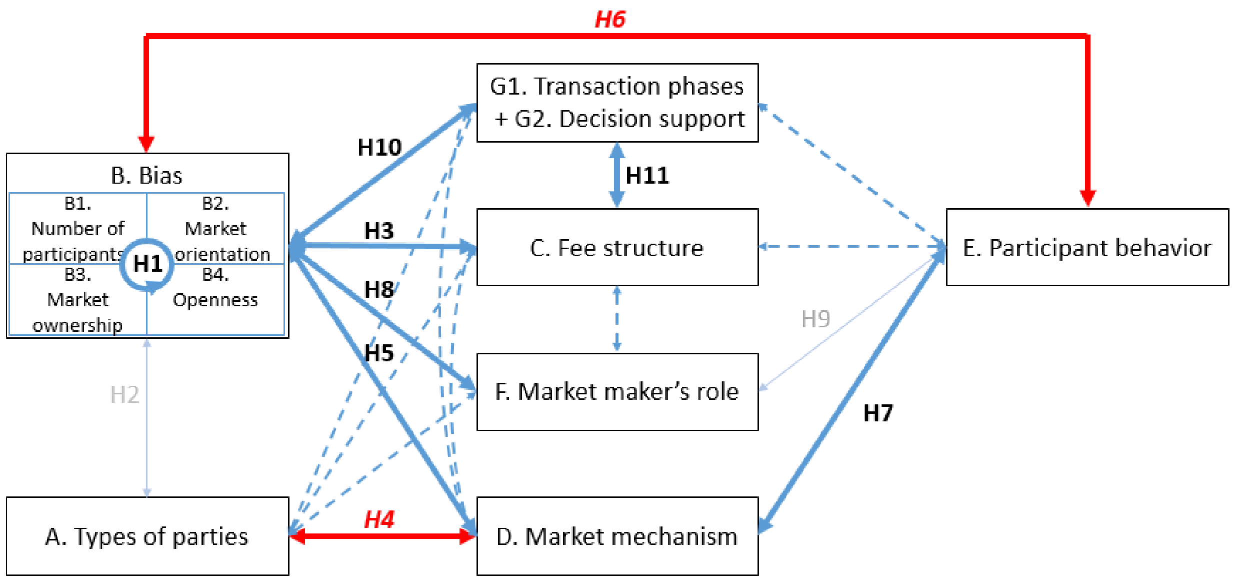
Categorization scheme	Count	%	Categorization scheme	Count	%	Categorization scheme	Count	%
TOTAL NUMBER OF EMs	**206**		**B4. Openness**			**G1. Transaction phases***		
			Open (public)	160	78%	Info only	54	26%
A. Types of parties			Closed (private)	46	22%	Info + Settlement	17	8%
B2B only	185	90%	**C. Fee structure**			Info + After sales	39	19%
B2B and/or B2C	21	10%	Periodic or one-time fee	69	33%	Info + Settlement+After sales	34	17%
B1. Number of participants			Per transaction/ consumption	19	9%	Negotiation only	10	5%
One-to-many/few	81	39%	Free	118	57%	Negotiation + Settlement	10	5%
Many-to-many	77	37%	**D. Market mechanism***			Negotiation + After sales	10	5%
Many-to-few	48	23%	Post and Search	144	70%	All phases	30	15%
B2. Market orientation			Open auction	19	9%	**G2. Decision support**		
Buyer-oriented	7	3%	Sealed auction	41	20%	With decision support	119	58%
Seller-oriented	66	32%	**E. Participant behavior**			Without decision support	87	42%
Neutral-oriented	133	65%	Systematic (with or w/o spot)	27	13%	**Ctrl1. Publicly traded or not**		
B3. Market ownership			Spot only	179	87%	Publicly traded	17	8%
Carrier	48	23%	**F. Market maker's role**			Privately owned	189	92%
Broker or shipper	45	22%	Tool only	179	87%	**Ctrl2. Commercial banners**		
EM/ software provider	113	55%	Consulting	27	13%	With banners	40	19%
						Without banners	166	81%

** Only 204 EMs could be categorized in the Market mechanism and Transaction phases schemes*

Some interesting insights can readily be observed: (A) the overwhelming majority of EMs can still be viewed as B2B. (B1) The distribution in terms of Number of participants is fairly even, showing a diversity in models. (B2) A fair amount of EMs are made so that carriers and brokers (*i.e.,* sellers) can sell their capacity by searching loads or posting trucks. That being said, the majority of the EMs are neutral, allowing all parties to find their benefit in participating to the EMs. (B3) Carriers and brokers/shippers constitute 45% of the EM owners *vs.* 55% for neutral third parties. It shows that the traditional participants of the transportation industry embrace the EM tool and try to offer their own. (C) As expected by Barratt *et al.,* (2002), there is a fairly high diversity in fee structure. The proportion of free EMs (57%) shows that the addition of that category through the exploratory process is justified. (D) The most popular market mechanism in the sample is post-and-search (70%), which is far ahead of open and sealed auctions (29%). However, this shows that auction mechanisms are far from being abandoned. (E) Participant behavior shows the overwhelming presence of spot behaviors on the sampled EMs (87%). (F) The sample studied is mainly made of SSP (tool only) EMs (87%) that let the customer deal with its business on its own. (G1&2) Finally, the content offered by the EMs is very diverse as shows the spread of the distribution over transaction phases and decision support. In addition to those statistics, it can be added that 8% of our sample is publicly traded (17 EMs), which correspond to the exact proportion found in Rosenzweig *et al.* (2011) and shows that limiting our study to publicly-traded EMs would be very restrictive and may lead to biased results.

Eleven hypotheses are formulated in this study. Nine hypotheses are supported or partially supported by statistically significant chi square tests and likelihood ratio tests. The tests for **Hypothesis 4** provides a statistically significant result but opposite of what was hypothesized. The tests for **Hypothesis 9** do not provide statistically significant results and **Hypothesis 9** is thus not supported. Eight interdependences are empirically supported that were not hypothesized. Figure 16 illustrates these results.

Figure 16: Empirical interdependences between categorization schemes for transportation EMs.



Legend: Bold solid line = significant, Faded solid line = non-significant, Dashed line = significant not-hypothesized dependence, Red and italicized = reversed

Table 24 gives a more detailed view of the statistical dependences found between sub-categorization schemes. Only the significance of the Chi square test is reported but dependences with a significant Chi square tests and an insignificant likelihood ratio are reported as being insignificant.

Table 24: statistical significance of the dependences between categorization schemes

Pearson Chi Square test * : p<0.05; ** : p<0.01 ***: p<0.0001	A Types of parties	B1 # of particip.	B2 Market orient.	B3 Owner.	B4 Open.	C Fee struct.	D Market Mech.	E Particip. behavior	F Mkt maker role	G1 Transact. Phases	G2. DSS	Ctrl 1 (public)
A. Types of parties												
B1. Number of participants	**											
B2. Market orientation	***	***										
B3. Ownership	*	***	***									
B4. Openness	NS	***	NS	NS								
C. Fee structure	***	***	***	***	NS							
D. Market Mechanism	**	***	***	**	***	***						
E. Participant's behavior	NS	**	*	**	NS	***	***					
F. Market maker's role	*	***	**	***	NS	**	NS	NS				
G1. Transaction phases	**	***	***	*	***	***	***	***	NS			
G2. Decision support	NS	***	**	***	*	***	**	NS	NS	***		
Ctrl 1 (publicly traded)	NS	*	**	NS	NS	NS	NS	NS	*	NS	NS	
Ctrl 2 (Commercials)	NS	***	**	***	NS	**	NS	NS	**	NS	**	NS

4.6. Discussion and Implications

In this section, the results of chapter 4 are analyzed. First, based on the results of the 55 independence tests, a new typology is suggested. Two unguided clustering procedures are used to confirm that new typology. Second, the results of hypotheses testing are discussed following the structure of the newly adopted typology. The specificity of transportation EMs is highlighted in order to emphasize the contribution the typology brings to the transportation EM literature.

4.6.1. Elaboration of a new transportation EM typology

Analytical procedure based on the contingency tables and tests of independence

The purpose of creating a typology is to better understand the dynamics in play in this industry in order to help further research endeavors. In a typology, within a type, members share similarities on multiple dimensions (*i.e.*, schemes) and across types members are dissimilar on these same dimensions. In this dissertation, the types will represent distinct truck transportation EM strategies. Each type/strategy will represent a way the 11 dimensions are articulated to answer specific needs of the industry. By understanding these articulations, it is hoped that practitioners will be able to better design or select EMs that fit their goals. Further, it will provide academics with a vision of what EMs are really being offered in the transportation services procurement industry. That will help future researchers embed their studies or experiments in settings that are pertinent to the industry.

As it is shown in Table 24, the scheme categorizing EMs by number of participants (B1) is associated (*i.e.,* shows a dependence) with all others schemes. It is the only scheme to present this characteristic and was then used as a starting point to identify EM types because it works as a link to all dimensions. In short, each contingency table with scheme B1 (presented in Appendix E) was analyzed to see if belonging to one of the categories of B1 allowed to predict what category of the other dimension an EM is likely to fall in. It was decided to proceed by elimination and focus on cells of the contingency tables where observed values are approximately half or less than the expected value (meaning that an EM in the observed B1 category is unlikely to be in the other dimension's observed category). For example in Table 25, an EM that belongs to the one-to-many category of scheme B1 has little chance to belong to the B2B and/or B2C category of scheme A; there is only one EM observed in that cell whereas 8 were expected. Therefore, in the new typology, it was considered that there is a type of EM with a one-to-many and B2B only strategy, whereas EMs that are many-to-many or many-to-few can be either B2B only or B2B and/or B2C. Even if the observed values in the B2C column are low for many-to-many and many-to-few as well; these values respect or exceed the expected distribution and justify considering that many-to-many-or-few EMs can offer B2B or B2C to the extent the whole population does.

Table 25: Contingency table between Number of participants (B1) and Types of parties (A)

B1 vs. A Observed Expected	B2B and or B2C	B2B only	Sum
One-to-many	1	80	48
	8.3	72.7	
Many-to-many	12	65	77
	7.8	69.15	
Many-to-few	8	40	81
	4.9	43.1	
Sum	21	185	206

By proceeding that way with all contingency tables containing scheme B1, a generic typology with three types was determined:

Type 1: "hierarchical EMs": One-to-many EMs that are B2B only (not B2C), seller-oriented (no other orientation), owned by a carrier or a broker (not EM/ software provider), open (not closed), free (no fee), with a post and search mechanism (no auctions), for spot needs (no systematic sourcing), with the information only and/or settlement and/or after sales and negotiation only decision phases (no other phases with negotiation). The market maker's role and decision support dimensions do not play a role in the definition of that type of EMs.

Type 2: "Mass EMs": Many-to-many EMs that are neutral- or buyer-oriented (but not seller-oriented), owned by an EM/ software provider (not a carrier or broker/ shipper), open (not closed), not free (with any kind of paying fee structure), only a tool (no consulting services), without the information + settlement and or after sales phases (but possibly any of the others, including information only). The types of parties, market mechanism, participant behavior, and decision support schemes do not play a role in the definition of that generic type of EMs.

Type 3: "Targeted EMs": Many-to-few EMs that are neutral-or buyer-oriented (not seller oriented), owned by EM/ software provider or broker/ shipper (not a carrier), closed (not open), not with information only and/ or settlement phase (but possibly with information + after sales and or settlement and all categories including negotiation), and with decision support (not without decision support). The types of parties, fee structure, market mechanism, participant behavior, and market maker's role dimensions do not participate to the definition of that type of EMs.

In addition to this 3 main types, the discussion showed that there was a duality in the many-to-many type. Some many-to-many market places tend to offer no other transaction phase than information only, whereas some provide negotiation, settlement and or after sales (a fair amount offer all phases). Therefore, it seems to make sense to divide Type 2 into Type 2a "basic mass EMs" (information only phase), and Type 2b "complex mass EMs" (with the negotiation phase and more). Table 26 recapitulates the preliminary knowledge of the new truck transportation EM typology.

Table 26: Preliminary New Truck Transportation EM Typology

Type 1: Hierarchical EMs	One-to-many, B2B only, seller-oriented, broker- or carrier-owned, free, post and search, spot, info only and or setllement and or after sales
Type 2: Mass EMs	Many-to-many, neutral- or buyer-oriented, owned by an EM/software provider, Open (public), with fees, tool only, either info only or with phases with negotiation
Type 2a: Basic Mass EMs	Mass EMs offering the info only transaction phase
Type 2b: Complex Mass EMs	Mass EMs offering negotiation and more transaction phases
Type 3: Targeted EMs	Many-to-few, neutral- or buyer-oriented, owned by a broker or EM/software provider, closed (private), information and after sales and or setllement and all negotiation phases, with decision support

This 3-type framework is a static generalization of reality. However, it shows evidence that the landscape of transportation EMs is quite diverse in its content and purpose.

In order to build the typology, it was decided to consider cells of the contingency tables in which observed values represented roughly only half or less of the expected values as under-represented. Based on that judgement, certain categories along different dimensions were excluded from each type of EM.

Next, two unguided clustering algorithms are used to identify the number of clusters and their content determined with such techniques. The content of the clusters is then compared with the new suggested typology to identify any bias in the methodology for reading the contingency tables in the analytical procedure and to determine whether the new typology is validated.

Validation of the new typology via clustering algorithms

Based on the types' definitions (Table 26), 47 EMs fall in the Type 1 category, 42 fall in the Type 2 and 23 in the Type 3. All other EMs might be close to one of the categories but not an exact fit. Consequently, a 4th miscellaneous group is required. The disadvantage of the methodology followed in the previous section to build the new typology is that it relies on the interpretation of the contingency tables. Some methodology and rules for interpreting the tables were stated in order to ensure reproducibility of the study but had the rules (*i.e.*, cutoff thresholds) been fixed differently, the results might have differed.

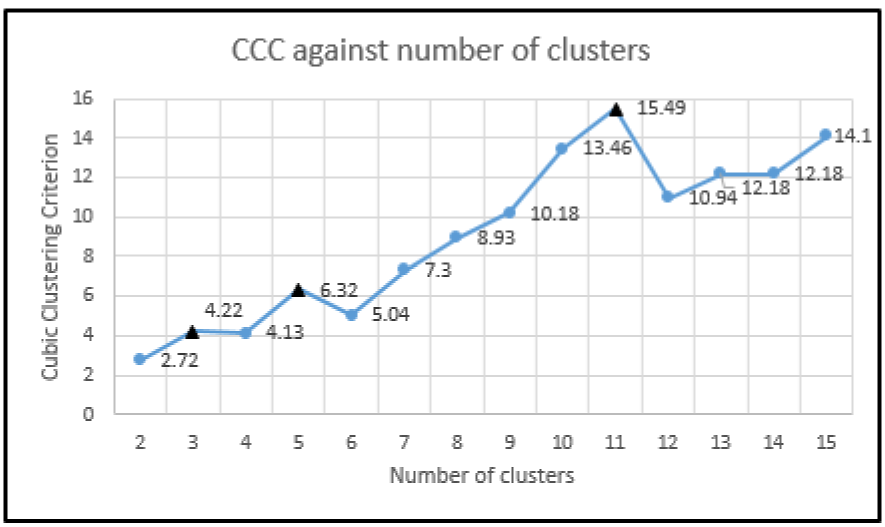
In order to test the robustness of the 3-type framework (4-type with the subcategories for Type 2), it was decided to complete unsupervised clustering analyses providing three, four or five clusters and compare the similarity of the clusters to the groups obtained through the analytical process. Two methodologies were selected to compare the results: k-means and hierarchical clustering. The clustering analyses were conducted using JMP Pro 11.

K-means clustering analysis

When the number of clusters desired is known, k-means clustering is a popular technique since it relies on the researchers to provide "k", the number of clusters to be obtained. In this case, it would be of interest to set "k" to three, four and five, so the algorithm could produce the same kind of framework provided through the analytical process and then observe the evolution of clusters' composition when their number increases.

If the number of clusters is unknown, when using a k-means clustering algorithm with SAS or JMP, prior literature recommends the cubic clustering criterion (CCC) (SAS 1983, 1990). For a specific number of clusters, the CCC is obtained by comparing the observed R^2 (variance explained by that specific number of clusters) with the expected R^2 if the data had been sampled from a uniform distribution (SAS 1983). A positive value of CCC shows R^2 is greater than expected and thus hints at the presence of clusters (SAS 1983). In order to find the appropriate number of clusters, it is recommended to plot the CCC against the number of clusters for a range of clusters going from 2 to one tenth of the population observed (the CCC becomes unreliable when the average size of a cluster is less than one-tenth of the sample) (SAS 1983). On the plot, one should look for peaks. The number of clusters to be adopted corresponds to the peak(s). A peak with a CCC greater than 2 or 3 shows good clustering (SAS 1983).

Figure 17: CCC against the number of clusters obtained through k-means clustering



As can be observed on Figure 17, the CCC is constantly positive and greater than 2 or 3, which means that the clustering method provides good results (SAS 1983). There are multiple peaks on Figure 17 (at 3, 5 and 11 clusters). That indicates a hierarchical structure of the clusters (SAS 1983). It is common to consider the first peak as the one providing the number of clusters to be analyzed but sharper subsequent peaks can be considered too (SAS 1990). The first peak is observed with 3 clusters. That is interesting since the proposed typology contains three main types of EMs. However, the drop in CCC between three and four clusters is relatively marginal. “Blunt peaks” can be an indicator that some clusters should be further divided (SAS 1983). Therefore it makes sense to extend the analysis to the next peak with 5 clusters. That peak is sharper, which is a desired characteristic. Therefore, it is interesting to see how the clustering algorithm divided the population into five clusters. The peak at 11 clusters is not considered in this study as it is thought that having a number of clusters corresponding to the number of dimensions was of little interest. Basically, the CCC confirms that the number of interest for “k” is between 3 and 5.

For “k” means, the algorithm starts by selecting “k” cluster seeds. Then it assigns all points to their nearest seed. This forms the first iteration of clusters. The initial seeds are then replaced by the means of the clusters. The points are then re-assigned to the new seeds, and the process continues until no further re-assignment are found.

The results of a clustering algorithm is that EMs within a cluster should be similar but not necessarily identical, while dissimilar to EMs from other clusters. As a consequence, contrary to a classification process that classifies EMs in a group only if they correspond strictly to classification criteria, a clustering analysis creates clusters containing EMs that present similarities without being strictly identical on all dimensions. This is an advantage of clustering analyses since it allows to identify the dimensions that create the similarities within clusters (Bailey 1994). For this analysis, the k-means algorithm was run in JMP Pro 11 with the default criteria except for the “scaling the variables” option that was unchecked since all variables are already measured on the same scale. Indeed, for the k-means algorithm to run, the categorical variables were transformed into binary variables. In order to do so, one variable per category of each categorization scheme was created and each EM was checked as belonging or not to that category (1 or 0 respectively). The right-hand side of Figure 10 provides an illustration of these binary variables for the "number of participants" categorization scheme.

The set of three tables below shows the results of the cluster analyses by distributing the content of obtained clusters across the types analytically identified in section 4.6.1. When three clusters are requested, Table 27 shows that cluster 1 contains all of the Type 2 EMs. Cluster 2 contains all Type 1 EMs. Cluster 3 contains all Type 3 EMs. The fact that the three clusters load distinctively on the three types, confirms the validity of the three main generic types suggested by the new typology. The "others" column contains EMs that were neither identified as Type 1, 2 nor 3. Since the clustering algorithm by design forces the whole population into the fixed number of clusters provided, it makes sense that some EMs that do not belong precisely to any of the types defined are still classified with the types they are the most similar to. Hence, for example, the 23 "other" EMs assigned to cluster 3 may not be exactly of Type 3 but are more similar to that type than to other types.

Table 27: Distribution of EMs based on 3 clusters and the 3 types of the suggested typology

3 Ks	Type 1	Type 2	Type 3	Others	Total
Cluster 1	0	41	0	35	76
Cluster 2	47	0	0	35	82
Cluster 3	0	0	23	23	46
					204

When four clusters are requested, Table 28 shows that Type 3 is divided into two parts. After analyzing the EMs belonging to these two clusters (2 and 4), it was determined that cluster 2 contained Type 3 EMs that offer their services for free whereas cluster 4 only contains Type 3 EMs that request a fee for their services. This subdivision of Type 3 EMs is not entirely surprising. Many-to-few EMs (mainly Type 3 EMs) are much less likely to be free than expected (please see contingency table C *vs.* B1 of Appendix E). In the suggested typology, free EMs are still included because the difference between observed and expected values barely missed the threshold for exclusion of free EMs. The fact that the clustering procedure does not divide the group in the 3-k procedure and does in the 4-k procedure brings support to the threshold chosen in the analytical process but also shows that the fee structure difference justifies subdividing Type 3 EMs into two parts, even though one is scarcely populated.

Table 28: Distribution of EMs based on 4 clusters and the 3 types of the suggested typology

4 Ks	Type 1	Type 2	Type 3	Others	Total
Cluster 1	0	41	0	33	74
Cluster 2	0	0	4	15	19
Cluster 3	47	0	0	29	76
Cluster 4	0	0	19	16	35
					204

When five clusters are requested (as suggested by the local optimum found in Figure 17), the subdivision of Type 3 EMs persists with the same logic explained with Table 28 and a subdivision of Type 2 EMs appears (Table 29). This subdivision actually correspond exactly to the Types 2a and 2b subdivision suggested in the new typology.

Table 29: Distribution of EMs based on 5 clusters and the 3 types of the suggested typology

5 Ks	Type 1	Type 2	Type 3	Others	Total
Cluster 1	0	0	18	16	34
Cluster 2	0	21	0	7	28
Cluster 3	0	20	0	30	50
Cluster 4	0	0	5	7	12
Cluster 5	47	0	0	33	80
					204

By further analyzing the differences found in the EMs in cluster 2 and 3 of Table 29, it could be determined that Type 2a EMs are not only Basic Mass EMs only offering the information phase but also resting on a post and search mechanism. On the contrary, Type 2b EMs are Complex Mass EMs that offer to support more transaction phases and rest on one of the auction mechanisms.

It can be concluded from these tables that the k-means clustering approach yields the same kind of partitioning into categories of transportation EMs. It validates the 3-type framework. When the k-means procedure is run with five clusters, the suggested typology with three main types and a sub-division into two sub-types of Type 2 EMs is confirmed. However, an additional sub-division is generated. Type 3 is sub-divided into two parts between paying and free Targeted EMs. Further, the cluster analysis shows that no generic strategy was ignored during the creation of the typology because all created clusters contain a substantial share of EMs corresponding to one of the types.

The issue with the k-means clustering technique is that it required transforming the categorical variables into multiple binary variables (one per category). Since the clustering results could be impacted by this transformation, it was decided to run another clustering technique for control purposes. It is common in the literature to run a hierarchical clustering analysis in addition to a k-means clustering analysis (Craighead *et al.* 2004). In this study, running a hierarchical clustering analysis is also justified by the CCC analysis that yielded several peaks on Figure 17, which indicates a hierarchical structure of the clusters. Thus, a hierarchical procedure was also performed with JMP Pro 11.

Hierarchical clustering analysis

The hierarchical clustering analysis presented two advantages compared to the k-means clustering analysis. First, the categorical data could be imported without transformation into JMP Pro 11. Second, there is no need for determining the number of clusters *ex-ante*. The hierarchical clustering procedure was performed using the default parameters suggested by JMP Pro 11. This procedure is an agglomerative procedure. It starts with 206 clusters (206 EMs) and looks at what pair of clusters is the most “alike” based on a distance criterion. A new set of clusters is hence formed and the procedure continues until all clusters have been agglomerated in a single cluster.

JMP Pro 11's default decision criterion for grouping clusters is Ward's distance. This criterion has been shown to outperform other ways of calculating distance between clusters in prior OM literature (Punj and Stewart 1983) and was therefore used.

Figure 18: Dendrogram and scree plot, outputs of the hierarchical clustering procedure in JMP Pro 11

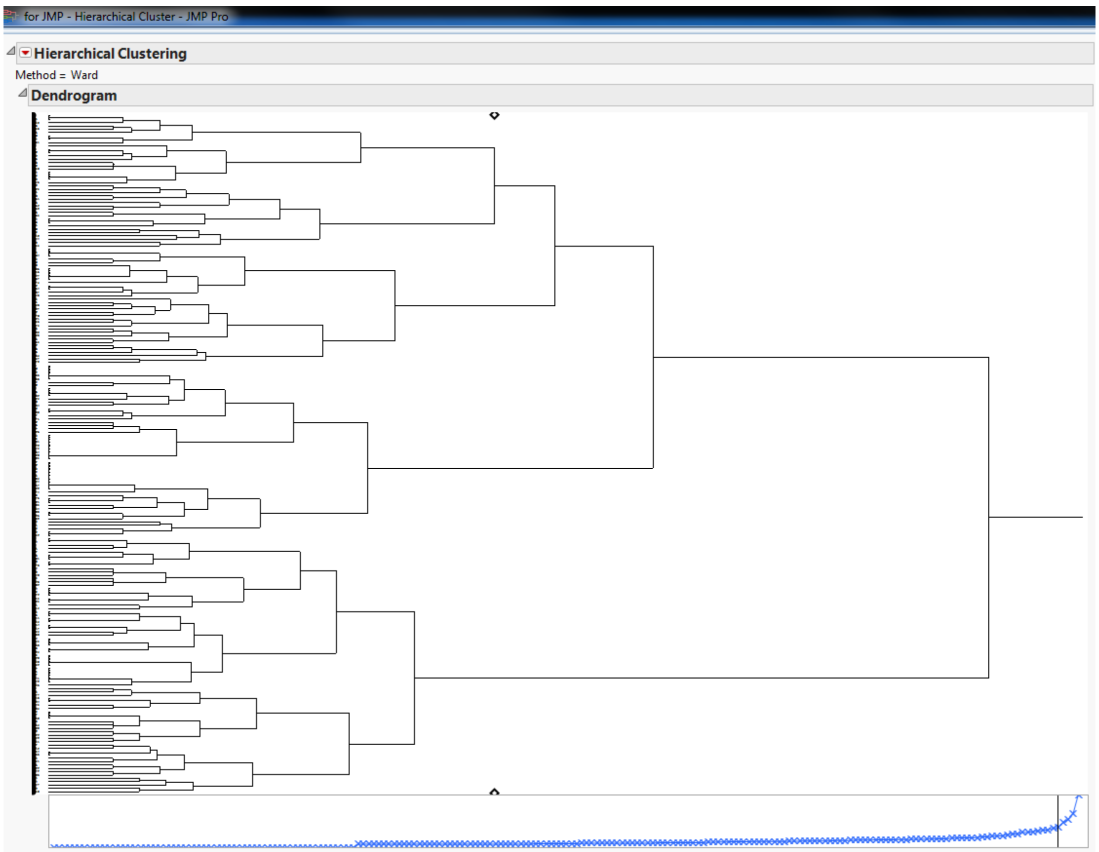


Figure 18 shows the output of JMP Pro 11. The dendrogram shows how EMs were grouped step-by-step until they all belonged to a single cluster. The reader can choose a point anywhere on the horizontal axis of the dendrogram and draw a vertical line from that point. All horizontal lines crossed by that vertical line point to a different cluster. Each horizontal line develops into a tree whose leaves are the names of the EMs belonging to the cluster being read. Thus the dendrogram enables the reader to know the content of each cluster depending on the number of clusters chosen. Prior literature suggests that the appropriate number of clusters should be determined based on the location of the elbow on the Scree plot (Segars and Grover 1995) found below the dendrogram on Figure 18. Reading from right to left, the Scree plot shows that increasing the number of clusters beyond 5 does not add much value (the slope is not steep after five clusters.) Therefore, it was decided to look at the results provided from three, four and five clusters.

Table 30: Distribution of EMs based on 4 clusters from the hierarchical analysis and the 3 types of the suggested typology

4Cs	Type 1	Type 2	Type 3	Others	Total
Cluster 1	0	21	0	19	40
Cluster 2	0	0	22	13	35
Cluster 3	0	20	0	32	52
Cluster 4	47	0	1	29	77
					204

Table 30 shows that when four clusters are selected on the dendrogram, the clusters generated correspond almost exactly to the suggested typology with the three main types and the subdivision of Type 2. Cluster 1 and 3 correspond respectively to Type 2b and Type2a. Cluster 2 contains almost all Type 3 EMs (one Type 3 EM is grouped with Type 1 EMs). Cluster 4 contains all Type 1 EMs. As a consequence, it can be concluded that the hierarchical analysis confirms the suggested typology as is, with four types (3 main strategies with one of them subdivided). The analysis with five clusters does not provide extra information, it divides cluster 1 from Table 30 into a group of 19 EMs and another of 2 EMs. With only two EMs, it is difficult to properly analyze the differences between groups. Therefore, the analysis was stopped with four clusters.

Table 31: Distribution of EMs based on 3 clusters from the hierarchical analysis and the 3 types of the suggested typology

3Cs	Type 1	Type 2	Type 3	Others	Total
Cluster 1	0	21	22	32	75
Cluster 2	0	20	0	32	52
Cluster 3	47	0	1	29	77
					204

When three clusters are observed with the hierarchical analysis (please see Table 31), Type 2b EMs (Complex Mass EMs) are grouped with Type 3 EMs (Targeted EMs) rather than with Type

2a EMs (Basic EMs). It shows that when using Ward's distance, the number of phases offered takes priority over the number of participants. Although this confirms the importance of distinguishing Mass EMs between basic and complex ones, it questions the definition of the three main types. Type 1 (Hierarchical EMs) would remain the same. Type 2 would be reduced to what was Type 2b (Basic Mass EMs). Type 3 would become Complex EMs with a subdivision into Complex Mass EMs and Complex Targeted EMs.

Table 32: Definitive Typology for truck transportation EMs

Type 1: Hierarchical EMs	One-to-many, B2B only, seller-oriented, broker- or carrier-owned, free, post and search, spot, info only and or setllement and or after sales
Type 2: Mass EMs	Many-to-many, neutral- or buyer-oriented, owned by an EM/software provider, Open (public), with fees, tool only, either info only or with phases with negotiation
Type 2a: Basic Mass EMs	Mass EMs based on post & search mechanism and offering the info only transaction phase
Type 2b: Complex Mass EMs	Mass EMs based on auction mechanisms (open or sealed) and offering negotiation and more transaction phases
Type 3: Targeted EMs	Many-to-few, neutral- or buyer-oriented, owned by a broker or EM/software provider, closed (private), information and after sales and or setllement and all negotiation phases, with decision support
Type 3a: Free Targeted EMs	Targeted EMs not requiring a fee
Type 3b: Paying Targeted EMs	Targeted EMs requiring either periodic or per transaction fees

Table 32 displays the typology adopted based on the analytical procedure and the clustering analyses. According to previous literature, a measure of similarity was used to measure the level of agreement between clustering procedures (Vinh *et al.* 2010). Following Wagner and Wagner (2007), Normalized Mutual Information (NMI) was calculated using the normalization by the geometric mean (Strehl and Gosh 2002) and found to be highest (*i.e.* NMI = 0.77) when comparing the results of the k-means and hierarchical procedures with respectively 5 and 4 clusters. NMI is close to 0 when the clustering procedures provide entirely independent results and equal to 1 when the clusters are strictly identical (Wagner and Wagner 2007). NMI = 0.77 indicates a very high level of agreement between procedures (Romano *et al.* 2014). Both clustering procedures confirm the division of the population into Type 1, Type 2a – 2b, and Type 3 EMs. The k-means procedure adds a subdivision of Type 3 EMs that is kept in the final typology as the analytical procedure pointed at that division as well (in retrospect). In chapter 5, further analysis is performed by running competing regression models to evaluate if the main types suggested by the hierarchical analysis are more pertinent when it comes to explaining performance.

In the following section, the results of hypotheses testing are used to highlight the specificity of each type of EMs in terms of EM categories' associations.

4.6.2. Specificity of the new typology

For each EM type, relationships between categories composing the EM are discussed. First relationships confirming the literature are presented. Second are the relationships that do not support the literature.

Type 1 EMs

As expected by Grieger (2003), Movahedi and Lassani (2012), Sharifi *et al.* (2006), and Wang and Archer (2007), the number of participants and ownership are related (H1a). Type 1 EMs are one-to-many EMs almost exclusively owned by carriers. These one-to-many/ carrier-owned EMs are generally oriented in the interest of one of the trading parties (Grieger 2003, Wang and Archer 2007) (H1d and H1e) and exclusively target businesses as their customers and thus are B2B EMs (please see tables displayed in Appendix E). Further, Fee structure is dependent on bias (H3). The logic described by Lucking-Reiley (2000) for merchant- and agent-owned EMs holds in the transportation industry. Carriers and brokers (the equivalent of merchants) offer their EMs free of charge because they generate revenues through the traditional model of the industry (gross margins on the transportation services). Transportation Type 1 EMs thus follow what Segev *et al.* (1999) formulated for procurement EMs in general, free EMs are more frequently offered by one-to-many EMs with a biased market orientation, either toward the buyer or the seller, but not neutral. These Type 1 EMs were termed "Hierarchical EMs" following Malone *et al.* (1987) who explain that "hierarchies" are electronic places serving as an extension of a company's management rather than as a market creator.

However the relationships between categories composing Type 1 EMs also reject some of the hypotheses formulated and previous EM literature. Grieger (2003) and Movahedi and Lavassani (2012) expect ownership to relate to market orientation. They expect EMs owned by one of the trading parties (*i.e.,* shipper or carrier) to display a buyer or seller orientation. The analysis confirms that EMs owned by trading parties are biased in their market orientation but not as expected in the literature. Although very cautiously, Movahedi and Lavassani (2012) explain that it is often assumed that seller-owned EMs are buyer-oriented in order to serve the interest of the owner/seller. However, in the population studied, 92% of the carriers (viewed as sellers in the transportation industry) create EMs that are seller-oriented. This can be explained by the fact that carriers actually act as buyers on their EMs. They post loads that they are unable to carry themselves for other carriers (acting as sellers) to make offers.

Similarly, carriers are associated with one-to-many EMs and often present themselves as 3PLs, a form of logistics provider aimed at offering advanced services (including consulting) to customers in the long term. Because of that definition of 3PL, following the OM literature, it was assumed that 3PLs would offer both systematic sourcing (from the participant behavior scheme) and consulting services (from the market maker's role scheme) (Alt and Klein 2011, Grieger 2003, Kaplan and Sawhney 2000, Kwon *et al.* 2009). One-to-many structures favored by carriers are associated to offering consulting services on top of an EM (H8) but no link was found between participant behavior (systematic sourcing) and market maker's role (offering consulting services) (H9). Also, carriers and one-to-many structures, are almost exclusively associated with EMs dedicated to spot market needs (against the logic of H6a and H6b). This tends to substantiate the belief that EMs are just an entry point for carriers and brokers whose business is to build strategic relationships. At the end of the 90s, Razzaque and Sheng (1998) explained that 3PL were not used for advanced services but mostly for basic transportation services and this is still the case today as the CSCMP (2013) reports. This study's perspective tends to strengthen that argument. Companies presenting themselves as 3PLs still offer EMs mainly for spot purposes - Type 1 EMs.

Type 1 EMs also only offer the post-and-search mechanism, thus the hypothesized dependence between market mechanism and participant behavior (**Hypothesis 7**). That dependence is nevertheless not as expected by Wang and Archer (2007) who thought auction mechanisms were adequate for the need for fluidity of the sport market. Spot markets overwhelmingly use post-and-search mechanisms, whereas systematic EMs tend to use a mix of mechanisms, including both types of auctions. To be noted, based on the literature (e.g., Caplice 2007), finding auction mechanisms for systematic sourcing in the studied population makes sense since the transportation industry has substantially used (combinatorial) auctions for strategic sourcing.

Finally, almost all public EMs classified in the new typology are to be found within Type 1 (9 out of 10). If the study had more conventionally only surveyed EMs belonging to companies that are publicly traded, only 8% of the pool of EMs present in this study would have been surveyed. Since being publicly traded is associated with one-to-many, seller-oriented EMs that offer consulting services, the study would have been severely biased toward analyzing only some Type 1 EMs whereas, Type 2 and Type 3 EMs also offer insight in the specificity of the transportation industry

Type 2 EMs

Type 2 EMs are the many-to-many kind, open, owned by EM/ software providers, in majority neutral-oriented and paying EMs. The latter point, following Lucking-Reiley's logic (2000), makes sense because fees are more crucial to a business whose revenues rests on the information systems it offers rather than on a primary activity (such as transporting goods).

The study provides good support for the logic behind **Hypothesis 10**. As expected by Grieger (2003), bias (in that case Openness) and transaction phases are dependent. Openness is inversely related to complexity. Type 2 EMs, the open third-party EMs, support fewer transaction phases than closed third-party EMs (Type 3). Notably, Type 2a EMs only offer support for the information phase. Type 2b EMs support more phases and the study shows a high non-hypothesized dependence between systematic sourcing and offering to manage all phases. EMs offering all phases or all but after sales contains almost all systematic EMs. This characteristic is shared with Type 3 EMs.

The findings regarding market mechanisms offered notably by Type 2 EMs are quite interesting. First, auctions have not disappeared (please see Table 23 for the distribution) but it is to be noted that the term "auction" has nearly never been encountered while coding! This shows that the (open) auction mechanism indeed suffered from treating transportation as a commodity and excessively eroding carriers' margins (Elmaghraby 2007, Goldsby and Eckert 2003, Lancioni *et al.*

2003, Nandiraju and Regan 2003, Purchasing 2001) and still carries the bad reputation it had at the very beginning (Lucking-Reiley 1999). Second, open auctions were supposed to be the main auction mechanism in this industry (Dans 2002) but they only represent 32% of the auction mechanisms in this EM population. In Dans' sample (Dans 2002), only 4% of the auctions are sealed auctions so almost the entire sample is made of different types of open auctions. The present study shows a different distribution (please see Table 23) with more sealed-bid auctions than open auctions. Given the previous history of the transportation industry, which refused to treat transportation services as a commodity (Dupin and Saccomano 2003, Elmaghraby 2007, Goldsby and Eckert 2003, Nandiraju and Regan 2003, Song and Regan 2001), it might be that the sealed-bid auction mechanism was deemed more appropriate. The fact that carriers and brokers never offer open auctions, whereas EM/ software providers sometimes provide open auctions, also seems to confirm the attitude of transportation professionals towards open auctions. It confirms the link between mechanism and ownership suggested by Wang and Archer (2007) and Mahadevan (2002) and transcribed in **Hypothesis 5**. Third, it is not in the B2B context that auctions are the most used (as expected by Dans (2002) and formulated in **Hypothesis 4**). Auctions (open or sealed) tend on the contrary to be used by EMs that target the final customer (B2C) on top of professionals (*i.e.,* shippers and carriers). It might be that when dealing with final customers, the volume of the market (there are many more final customers than professional shippers) combined with a need for the final customer to gain some bargaining power against professional carriers allowed the re-introduction of auction mechanisms. Finally, another specificity of the transportation industry that was not predicted in the literature review: there is a link between market mechanism and fee structure. Basically, the post-and-search mechanism may be free but auction mechanisms tend to require a fee to participants. To be noted, when the market owner charges for an auction, charging per transaction is more common for open auctions and charging a one-time or periodic fee is more common with sealed-bid auctions.

Type 2 EMs share some commonalities with Type 3 EMs. However, Type 3 EMs are closed, and also offer specific characteristics.

Type 3 EMs

Type 3 EMs are closed many-to-few EMs. They offer auction mechanisms more frequently than Type 1 EMs but also more frequently than Type 2 EMs, showing that a vetting process is favorable to the organization of auctions. Also, a difference can be made between types of auctions; some sealed-bid auctions are offered for free.

Type 3 EMs are the least open and offer the most transaction phases. Many-to-few EMs tend to offer all phases. This seems to confirm Grieger's idea that EMs filtering participants have a better opportunity to offer more phases (Grieger 2003). In addition, the offer of decision support tends to follow the transaction phases dynamics. The more closed an EM is, the more decision support is offered. One-to-many EMs (Type 1) tend to not offer decision support, whereas many-to-few (Type 3) tend to more frequently offer some and many-to-many EMs (Type 2a and 2b) are split on that matter.

Hypothesis 11 stating that third parties offering complex functionalities need to generate more revenue (Barratt and Rosdahl 2002) is supported. Indeed, free EMs (Type 1), mainly help with the information phase and offer little decision support. One-time and per transaction fees are particularly practiced when the EMs offer to manage all or almost all phases (Type 2b and Type 3b), in which case decision support is also provided to a greater extent.

The fact that Type 3 EMs are closed EMs comes as a contradiction to the literature. Based on Sharifi *et al.* (2006), neutral-owned (third-party owned) EMs are assumed to be open (H1c). This link is non-significant in this study because there are both open (Type 2) and closed (Type 3) neutral-owned EMs. It is likely that some third-party owned EMs are more private in order to inspire trust to their customers as transportation quality can be threatened by unreliable carriers (Boyle 2000, Janssen and Verbraeck 2008). Further research is necessary to study if creating barriers to entry favors attracting more participants thanks to a more trustworthy environment or if it prevents creating a necessary mass of participants as Markus (1987) would assume in the development of a Critical Mass Theory.

Implications

In this chapter, a new typology has been created that provides researchers and practitioners with an easy way to identify what strategies are being offered on the market today based on the 11 dimensions found in the traditional EM literature. Most works dedicated to EMs base their analysis on one or two dimensions and do not facilitate the complete understanding of EM strategies. The new typology takes all known dimensions into account and links these dimensions based on the specificity of EMs for truck transportation services procurement. For practitioners and academics interested in transportation EMs, fully understanding EM strategies matters with regard to EM selection or EM design. Indeed, the new typology enables a decision maker to select or design an EM based on one or two preferred dimensions, while knowing what is entailed regarding other dimensions. For example, a decision maker that wants an EM supporting most transaction phases will have to select a Type 2b or Type 3 EM. Type 2b, would offer the advantage to reach a massive audience, whereas Type 3 would offer a more protected private environment. If the decision maker does not know how to choose between these two environments (mass *vs.* targeted), it might be of use to know that Type 2b also imposes the use of paying auction mechanisms. If the decision maker is opposed to the idea of auction mechanisms, Type 3 EMs are the only remaining option. In that case, the decision maker who first started looking at EMs through the prism of supported transaction phases knows that he or she will look at EMs creating a closed environment that does not reach the masses.

For academics interested in conducting further research on EMs used for procuring truck transportation services, this typology gives a generalized picture of the profiles of EMs in which they can embed their studies. For example, Type 2b EMs show that there are EMs offering an auction mechanism in an unprotected environment (*i.e.,* with a light participants' vetting process). This has implications regarding the behaviors that can be expected on such platforms. Carter (2000) and Carter *et al.* (2004) explain the different unethical behaviors that can occur in online auctions. An EM that does not sort its participants is exposed to opportunistic behaviors that can lead to a loss of trust (Carter and Kaufmann 2007, Charki and Josserand 2008, Gattiker *et al.* 2007) and influence the outcome of using such platform (Ba and Pavlou 2002, Pavlou and Dimoka 2006). The trustworthiness of an EM is impacted by the design of the IS artifact, so it is important to look at the actual tools that generate trust. The new typology helps in providing a macro-perspective of the industry but more research is needed to understand the mechanisms of EMs down to the specific option level. This knowledge is crucial because 50% of the transportation volumes in the USA are impacted by EM mechanisms. Also, this chapter shows that there are conceptual differences between types of EMs but it does not show if these different offers are all equally favored by customers. In chapter 5, the link between EM types, their components (EM categories) and performance (measured by traffic) is tested to reveal how different strategies perform and the roots of theses strategies' performance.

CHAPTER 5

Performance analysis of truck transportation e-marketplaces models

Abstract:

The new typology of EMs for truck transportation services procurement (developed in chapter 4) is evaluated with respect to the impact of the differences in EM types on performance. Three metrics are adopted to measure performance: EM rank, number of unique visitors per day and number of page views per day. A set of three studies has been designed in order to reveal what EM categories/ characteristics contribute to performance (study 1), and as a consequence what EM types/ strategies perform best and why they perform best (study 2). The robustness of these results are then tested (study 3). EMs offering complex services to screened participants are shown to be more performant than others; bringing insight to what types of EMs should be studied in the future to increase the understanding of procurement of truck transportation services.

5.1. Introduction

Truck transportation EMs were the focus of attention for many researchers in the early 2000's. Since then, scant research efforts have been dedicated to truck transportation EMs and the academic literature consequently provides limited information about the EMs currently in use. In chapter 4, the preliminary analysis of interdependences between categorization schemes led to the identification of a new typology with three main EM types (five at sub-level):

- Type 1: "Hierarchical EMs": free, open EMs that are seller-oriented, belong to a carrier or a broker, and offer few services.

- Type 2: "Massive EMs": paying EMs belonging to a neutral third party and aimed at a large customer base with either few services offered (Type 2a – Basic Mass EMs) or many services offered (Type 2b – Complex Mass EMs).
- Type 3: "Targeted EMs": paying EMs belonging to a neutral third party and aimed at a narrower customer base with a wider range of services offered, either for free (Type 3a) or with a fee (Type 3b).

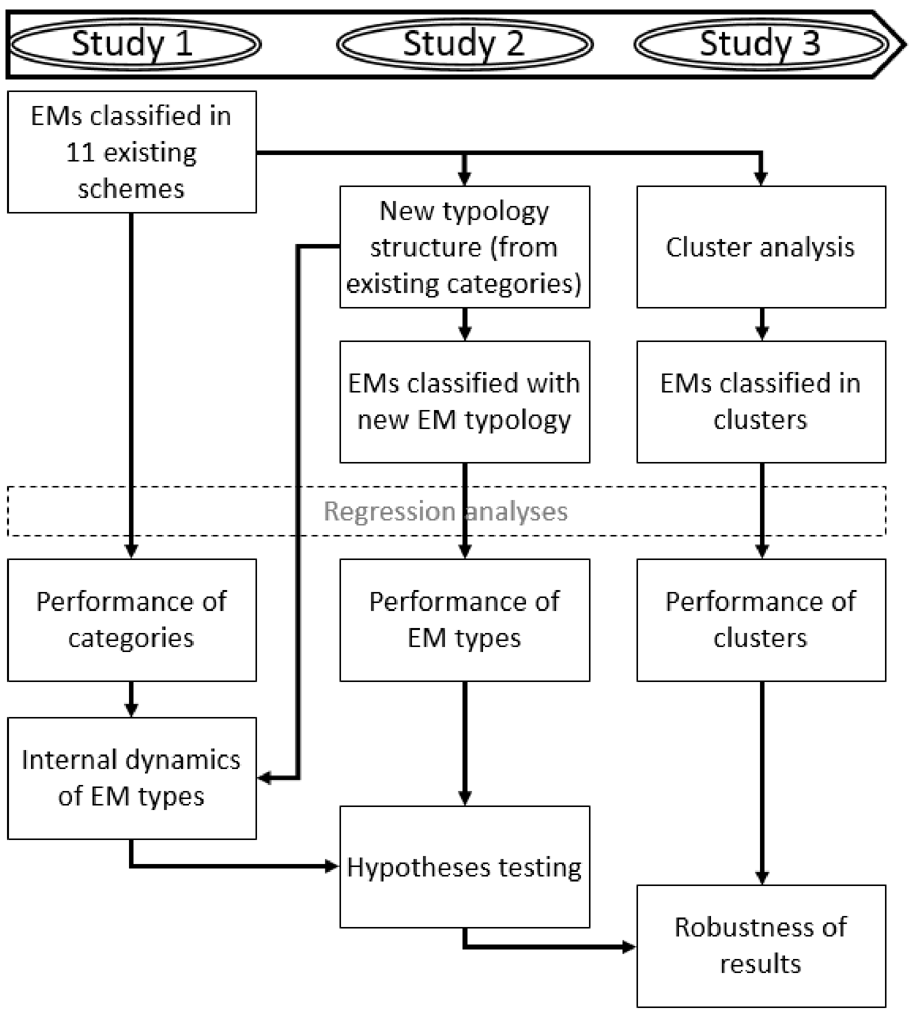
In chapter 4, this typology is validated via two clustering techniques. Chapter 5 aims at bringing external validation to this typology by investigating the link between EM types and performance. The results of the work in chapter 5 should contribute to answer the following question:

RQ4: How do different transportation EM strategies perform?

Wang *et al.* (2008) explain that factors that create EM success are still controversial and further research is needed. Anecdotal evidence from truckers' forums show that potential EM users are preoccupied by the volume of business they can find through an EM. The volume of business is itself strongly dependent on the traffic an EM creates on its platform. Therefore, like other interactive media before, transportation EMs are dependent on the creation of a critical mass for their survival and success. To answer the research question, transportation EMs are thus viewed as an interactive media and the tenets of Critical Mass Theory (Markus 1987) are explored to hypothesize the differences in performance that should exist across EM types based on their characteristics.

A set of three studies has been designed to verify if the transportation EMs evaluated in this research provide empirical support for the differences in EM types' performance drawn from the EM literature and Critical Mass Theory (please see Figure 19). First, in study 1, the link between EM categories/ characteristics and performance is analyzed. The outcome of study 1 should serve as an input for analyzing and understanding the results of study 2, which tests hypotheses regarding the performance of EM types. Finally, study 3 tests the robustness of the link between EM types and performance by testing the link between clusters from chapter 4 and performance.

Figure 19: Process for external validation of the new transportation EM typology and anlysis of performance of the new types of transportation EMs.



The remainder of this chapter is organized as follows. First, the results of a preliminary literature review are exposed and directions for further investigation are suggested. Second, the proposed methodology for each study exposed in Figure 19, is explained. Third, preliminary results provide some insight with regard to the validity of the suggested methodology for this chapter.

5.2. Background literature and dependent variables

In this section, the general EM literature reviewed for this dissertation is investigated to identify what constitutes EM performance and what constructs can measure it. Based on this literature review and the Critical Mass Theory (Markus 1987), EM traffic is selected as a measure of performance because it serves the purpose of this chapter: to differentiate the influence on performance of the strategies exposed in the new transportation EM typology. Further, hypotheses are developed regarding the effect of each type of EM on the performance measure.

5.2.1. Measuring EM performance

In the general EM literature, the notion of performance is very ambiguous. It is often used interchangeably with the term success (e.g., Wang *et al.* 2008) and is operationalized by heteroclite concepts. Therefore a broad body of EM literature was analyzed to identify "outcomes" of studies that constitute EM performance. Table 33 shows the categories of "outcomes" found in previous EM studies and a description of the categories and the "outcomes" follows.

Table 33: Types of dependent variables or "outcomes" found in the general EM literature

Outcomes in studies surveyed		Count
1 - Adoption/ continuation (or rejection) and EM growth (or survival)	Adomavivius et al. 2013b, Balocco et al. 2010, Brown and Lockett 2004, Caby Guillet et al. 2007, Carter et al. 2004, Charki and Josserand 2008, Clasen and Mueller 2006, Emiliani 2005, Galbreth et al. 2005, Gosain and Palmer 2004, Grieger 2003, Gumussoy and Calisir 2009, Hartley et al. 2006, Hawkins 2006, Hawkins et al. 2009, Hawkins 2010, Janssen and Verbaeck 2008, Jap 2002, Jap 2007, Johnson et al. 2007, Kauffman an Mohtadi 2004, Koch 2003, Kumar and Maher 2008, Matook 2013, Mitra and Singhal 2008, Moti et al. 2003, Mozaffari et al. 2012, O'Reilly and Finnegan 2010, Pavlou 2002, Peleg et al. 2002, Quaddus and Hofmeyer 2007, Radkevitch 2008, Rai et al. 2008, Rosenzweig and Roth 2007, Rosenzweig et al. 2011, Schoenherr and Mabert 2007, Son et al. 2006, Son and Benbasat 2007, Zhao et al. 2009, Zhu 2004	39
2 - Process improvement (e.g. productivity)	Agrali et al. 2008, Amelinckx et al. 2008, Carter et al. 2004, Giaglis et al. 2002, Jap 2002, Lewis 2001, Rai et al. 2009, Sankaranarayanan and Sundararajan 2010, Xia and Xia 2008	9
3 - Economic benefit for trading parties (revenue, profit, price, surplus, efficiency, etc.)	Adam et al. 2011, Adomavicius et al. 2012a, Adomavicius et al. 2012b, Adomavicius et al. 2013a, Agrali et al. 2008, Amelinckx et al. 2008, Arnold et al. 2005, Arora et al. 2007, Baker and Song 2007, Bapna et al. 2010, Beil and Wein 2003, Bolton et al. 2004, Carr 2003, Carter et al. 2004, Carter and Stevens 2007, Chen et al. 2009, Elmaghraby 2007, Elmaghraby et al. 2012,Gallien and Wein 2005, Greenwald et al. 2010, Hackney et al. 2007, Haruvy and Katok 2013, Jap 2002, Jap 2003, Jap 2007, Johnson et al. 2007, Jones et al. 2006, Kwon et al. 2009, Li and Zheng 2012, Liu et al. 2010, Mithas and Jones 2007, Mitra and Singhal 2008, Ozener et al. 2011, Peleg et al. 2002, Schoenherr and Mabert 2007, Shen and Su 2007, Sikora and Sachdev 2008, Snir and Hitt 2003, Vulcano et al. 2002, Walley and Fortin 2005	40
4 - Behavioral outcomes (trust, risk, satisfaction, opportunism, bidding behaviors, etc.) and conflict outcomes	Adam et al. 2011, Adomavicius et al. 2012a, Amelinckx et al. 2008, Baker and Song 2007, Bapna et al. 2010, Carter and Stevens 2007, Carr 2003, Carter et al. 2004, Carter and Kaufmann 2007, Charki and Josserand 2008, Daly and Nath 2005a, Elmaghraby et al. 2012, Engelbrecht-Wigans and Katok 2006, Gattiker et al. 2007, Greenwald et al. 2010, Hackney et al. 2007, Jap 2003, Jap 2007, Jap and Haruvy 2008, Jin and Wu 2006, Koch and Schultze 2011, Losch and Lambert 2007, Li and Zheng 2012, Mozaffari et al. 2012, Pavlou 2002, Radkevitch 2008, Rothkopf and Whinston 2007, Schoenherr and Mabert 2008, Sikora and Sachdev 2008, Snir and Hitt 2003, Yeniyurt et al. 2011, Zhu 2004	32

Adoption/continuation in use of EM and EM growth: This category shows the pieces of research for which the implicit or measured outcome is adoption (Son and Benbasat 2007, Gerow *et al.* 2013, Gumussoy and Calisir 2009) or rejection (Charki and Josserand 2008, Zhu 2004) of the EM by users, or the success or failure of the EM as a business (e.g., Matook 2013, Rosenzweig *et al.* 2011). The high failure rate at the beginning of the century of online businesses and EMs in particular explains why numerous studies are interested in the adoption, use and eventually sustained operation of EMs.

Process improvement: This category includes works that show repercussions of EM use on the internal procurement process of companies (Xia and Xia 2008, Amelinckx *et al.* 2008), on the decision to outsource that process or not (Sankaranarayanan and Sundararajan 2010) and also on broader operational processes such as logistics processes (Ağralı *et al.* 2008, Lewis 2001). Few studies adopt that perspective (9 in Table 33).

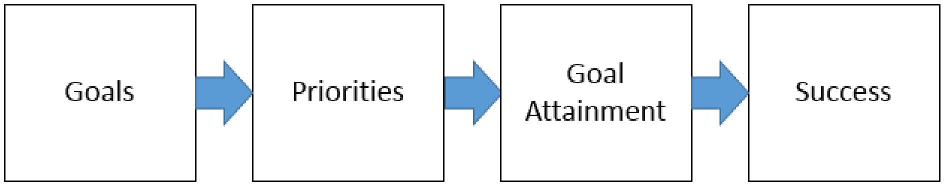
Economic benefits: The most common and most expected outcome of EM use is the reduction in price of the product or service procured or the increase in revenue surpluses gained by the different parties (Engelbrecht-Wiggans and Katok 2006, Haruvy and Katok 2013, Bapna *et al.* 2010).

Other economic benefits are not as straight forward. For example, Vulcano *et al.* consider revenue management optimization in repeated auctions (Vulcano *et al.* 2002), Schoenherr and Mabert (2007) explain that procurement auctions are profitable not only in the short-term but can remain so in the long-term as well. The popularity of this measure of performance is likely due to the general perception of EMs as a way to drive prices down. Also, the data is more easily available than process improvement measures. In the literature, this indicator of performance has often been measured using information available online. Sites such as e-bay or amazon allow access to the price at which items are sold. Then by comparing EMs selling identical products, the relative effect on price of using a specific EM can be measured.

Behavioral outcomes: Beyond economic considerations, some studies measure if participants are satisfied with the procurement process on EMs (Pavlou 2002). This satisfaction can notably come from the supplier's service (Carter and Kaufmann 2007). The supplier's conduct itself can be the dependent variable (Jiang 2009, Jap and Haruvy 2008). This kind of dependent variables is generally measured through users' surveys after using an EM or through the capture of electronic behaviors (e.g., number of clicks, of bids, *etc.*) during usage.

Based on Matook (2013), the performance measures within the process improvement, economic benefit and behavior categories capture goal attainment. Goal attainment, as illustrated by Figure 20 is a mean to reach success. Satisfying the customer, gaining his or her trust or fitting into existing processes are goals whose attainment contribute to success, which for an EM means staying in operation.

Figure 20: Simplified illustration of the goal-based measurement approach from Matook (2013)



Since the database constituted in chapter 3 is a snapshot of existing transportation EMs, all EMs were still in operation. Therefore, no difference can be made in terms of failure (*i.e.,* cessation of activity). A longitudinal study would be required for such an attempt, which could be done in a future study. Nevertheless, many studies approach success via one of its prominent antecedent/ requirement: volume of use. Bélanger *et al.* (2006) explain that traffic (*i.e.,* number of visitors) is the number one requirement to commercial websites' success and is widely accepted as a measure of success. Wang and Archer (2007) and Wang *et al.* (2008) explain that the number of users and participation are important, even crucial antecedents to EM success. In an empirical study, Matook (2013) finds that volume of use is substantially associated with success. Successful EMs are those that reach high volume of use whereas unsuccessful EMs are those with insufficient volume of use (Matook 2013). Finally, Johnson (2013) in a qualitative study shows that the primary factor associated with success cited by EM users is a critical mass of users. For interactive media, a critical mass is a threshold in the number of users below which the media cannot work because they do not have enough participants and beyond which the media can work and actually become attractive because of its broad reach, termed universal access by Markus (1987).

As a matter of fact, many transportation EMs (among others) display their market size in order to show their success. Market size can be expressed in terms of traffic (number of visitors), number of registered users, or number of transactions (counted or in dollars) but the same idea transpires: EMs try to persuade users that they have achieved a critical mass. In chapter 2, it is shown that transportation EMs display their market size (feature 62) 49% of the time. With the broader definition of EM adopted in chapter 3, this rate climbs up to 55%. In chapter 2, this usage proportion is one of the highest trust building features usage proportions after posting a privacy policy, disclosing one's longevity and screening members. This shows the importance EMs attach to their size.

EMs often disclose their market size by disclosing the number of participants they have registered or number of transactions they process. However, these numbers can be unreliable as they are self-reported without verification. Also, many EMs do not require registration and/ or are not the place where transactions are finally realized. Thus these EMs cannot display these numbers. Other EMs display their traffic in terms of website visitors often from systems that are automated and can be easily verified. Traffic takes any participant into account (registered or not) and has the advantage to work for all EMs. As said earlier, it has been acknowledged that gathering site traffic is the predominant way of gathering websites' (and EMs') success (Bélanger *et al.* 2006). Regarding EM studies, several studies have used traffic as their measure for success (Gosain and Palmer 2004, Clasen and Mueller 2006).

The relationship between volume of use and success of interactive media (e.g., phones or e-mails) has been theorized in the Critical Mass Theory (Markus 1987). Critical mass is a notion that entails media to reach a certain volume of use in order to be sustainable. Success in the Critical Mass Theory is visible by the increase in use of the medium by the community members (Markus 1987). In the Critical Mass Theory, usage and traffic are intimately related because the theory was built while focusing on communication media. With traditional phones, using the phone meant to place a call and thus creating traffic. Although some EM studies focus on traffic generation, the Critical Mass Theory has only been used in empirical EM studies by Son and Benbasat (2007) and Quaddus and Hofmeyer (2007) who used it as an antecedent to adoption. Both studies as well as previous studies on other technology such as EDI (Teo *et al.* 2003) did however support the principles of the Critical Mass Theory. Basically, Critical Mass Theory explains that as a medium's use increases, what users are seeking for is increasingly available on that medium and less and less available outside of that medium. That creates a virtuous dynamic in which the mass of users fuels its own growth. EMs share the characteristic of interactive media described by Markus (1987) that require the constitution of a critical mass: Users (e.g., suppliers) need be sure that they will be able to reach their counter parts (e.g., buyers) and find what they are looking for (e.g., available truck capacity). As traffic increases on EMs, the probability that a match between offer and demand will occur increases.

In the Critical Mass Theory, critical mass is a property of the community that cannot entirely be controlled by any actor but can be facilitated by some characteristics and behaviors (Markus 1987). This study focuses on the characteristics and strategies that one of the actors – EMs – put in place in order to reach success. In the next section, hypotheses are developed based on the Critical Mass Theory and current research regarding the link between the EM types developed in chapter 4 and success/ traffic.

5.2.2. Hypotheses development

As expressed earlier, the Critical Mass Theory explains that participants to an interactive medium such as EMs need to be sure that they will find the people or the desired service through that medium. The example given by Markus (1987) is that people who bought a phone should be sure that those they wanted to call had a phone. On EMs, people or companies that seek loads or trucks need to be sure that the EM they select has gathered enough participants to post a corresponding offer of loads or trucks. However, this logic of the Critical Mass Theory only makes sense if EMs try to create volume on both sides of the market, thus trying to serve both sides' interests. EMs of Types 2 and 3 do try to attract sellers and buyers but this is not the case for Type 1 EMs.

Hierarchical EMs (Type 1 EMs in the new typology) are EMs that, following the definition by Segev *et al.* (1999), only serve the purpose of the EM owner. They are an extension of the EM owner's organization. In Table 32 (from chapter 4), it can be seen that Type 1 EMs are one-to-many EMs and seller-oriented. This means that only one actor posts loads for many sellers to offer their transportation services. These EMs allow the EM owner to find transportation capacity. However, carriers have limited opportunities, with a single poster, to find many loads that will meet their capacity. This goes against Markus (1987) to create value on both sides in order to influence the attainment of a critical mass. Type 2 and Type 3 EMs conversely try to "crowd" their markets on both sides. Thus, the following hypothesis is formulated:

H1: Type 1 EMs will gather less traffic than Type 2 and Type 3 EMs

In the Critical Mass Theory, creating barriers to entry to interactive media poses a risk of creating a microcosm of users disconnected from non-users who do not participate due to those barriers (Markus 1987). Isolating users from non-users by dissuading new entries entails reduced benefits since participants may find few opportunities on the EM they belong to and may miss out on what happens outside of it. Type 2 EMs are reportedly more open than Type 3 EMs, which screen their participants from undesired ones. Based on the Critical Mass Theory it can hence be assumed that Type 2 EMs will gather more traffic than Type 3 EMs. . In addition, in the EM literature, Clasen and Mueller (2006) have shown that offering more information services (offering DSS in this study) is negatively related to the number of hits/ visitors. Since Type 3 EMs are the ones offering DSS more frequently, it leads to the hypothesis that Type 3 EMs will gather less traffic than Type 2 EMs:

H2a: Type 3 EMs will gather less traffic than Type 2 EMs

A competitive hypothesis to H2a is also proposed based on the Critical Mass Theory. Another way to isolate part of the transportation community is to charge for the use of an EM. Fees can act as a barrier that may shrink the community of users and the benefits returned, increasing thereof the cost per user while lowering returns (Markus 1987). Empirical research brings mitigated support to that perspective. Johnson (2013) found that critical mass is indeed perceived as a way to higher benefits while keeping costs low. Nevertheless, Rafaeli and LaRose (1993) find no support for a link between restricting access (by fees) and participation to bulletin boards with similar workings to some of the EMs in this study. However, an EM study by Clasen and Mueller (2006) is closest to the present study. This study finds that fees are negatively related to number of hits/visitors. Based on the Critical Mass Theory, partial support from prior literature and given that the Type 2 category is exclusively made of paying EMs unlike the Type 3 category, an alternative hypothesis to H2a is formulated:

H2b: Type 3 EMs will gather more traffic than Type 2 EMs

Also, because the Type 3 category is subdivided into paying (Type 3b) and non-paying (Type 3a) Type 3 EMs, the same argument can be put forward that the paying type will encounter less success in terms of traffic than the free type. Hence the following hypothesis:

H3: Type 3b EMs will attract less traffic than Type 3a EMs

Markus (1987) in the Critical Mass Theory does not take into account the quality of the participants on both sides. Based on Matook (2013), it can be said that EMs that better target their priorities and customers are more successful. Therefore, EMs that have better identified their target customers should be more successful than EMs that try to reach everyone. This perspective also justifies formulating hypothesis H2b since Type 3 EMs are designed to only serve members that are better identified as these members have been sorted out by a screening process. In addition, Matook (2013) explains that EMs that deliver a greater amount of services are more successful. It has been shown by Clasen and Mueller (2006) that complementary services (which can be equated to offering more transaction phases in this study), impacted positively the number of page views. Mass EMs with complex services (Type 2b) should therefore be more successful than mass EMs with basic services (Type 2a), which leads to the following hypothesis:

H4: Type 2b EMs will gather more traffic than Type 2a EMs

The concept of EM traffic has been selected as a marker of success in this study and the relationships between strategies identified in chapter 4 and traffic have been hypothesized. The following section explains how the variables are operationalized and what research methodology is used in this chapter to test the hypotheses.

5.3. Methodology:

In order to understand the impact of different strategies on EM performance, several regression analyses are performed. In this section, the operationalization of the variables selected for this research are explained because the choices made impact all subsequent models presented. A set of three studies and their corresponding models are then explained. The goals are to understand the inner dynamics of EM types towards performance by studying the link between categories and performance (study 1), link EM types directly to performance and test the hypotheses formulated in the previous section (study 2), and observe the robustness of the strategies identified in the new typology through the observation of the link between clusters and performance (study 3).

5.3.1. Construct operationalization: Traffic data and strategies

The background section (5.2.1.) of this chapter shows that many performance measures have been adopted in the academic EM literature. Site traffic is the relevant performance measure that will be described in this section. Traffic is measured using websites, such as Alexa.com, that provide web analytics services to make these data available. Rosenzweig *et al.* (2011) use alexa.com for collecting secondary data on the EMs they studied. Gosain and Palmer 2004 and Clasen and Mueller 2006 use it specifically for three measures of traffic: rank (Gosain and Palmer 2004), number of visitors and number of page views (Clasen and Mueller 2006).These measures are dependent variables since they serve as proxies for success – the outcome of the studied strategies.

Alexa.com, founded in 1996 and now owned by amazon.com, provides web analytics services that have been trusted for a few years already (http://www.searchenginejournal.com/3-ways-to-explore-website-traffic/7199/). Alexa.com provides a measure that is of interest for this chapter: a ranking of websites defined as follows:

> *"Our global traffic rank is a measure of how a website is doing relative to all other sites on the web over the past 3 months. The rank is calculated using a proprietary methodology that combines a site's estimated average of daily unique visitors and its estimated number of pageviews over the past 3 months."* (www.alexa.com/about)

Alexa data has two advantages. First, its collection is automated and therefore not biased by human interpretation (Clasen and Mueller 2006). Second, Alexa uses a very large sample that is geographically and demographically diverse (Gosain and Palmer 2004). The second point is of importance to this research since the surveyed EMs originate from 14 different countries.

Alexa.com only provided the ranking of websites for free based on the combination of undisclosed data: unique visitors per day and page views per day. Hence, it was decided to complement Alexa.com's rank measure with measures from another website, working with the same principles, and disclosing de-combined data: Hypestat.com. This site provides two statistics of interest to this research: number of unique visitors per day and number of page views per day. The definitions of the measures and modes of calculation are not displayed on the website and consequently cannot be independently verified. The community of web-statistics' users tends to agree that measures provided by the different websites are not identical (https://www.quora.com/Which-web-traffic-measurement-service-is-the-most-accurate-Compete-Quantcast-Alexa-Comscore-etc). However, comparison between EMs is possible when data is collected through the same source. In this research, two different sources are used for collecting data for three measures of performance (Alexa.com for rank, Hypestat.com for number of unique visitors per day and number of page views per day) but each model, taken independently uses a single source for the measure of the performance dependent variable.

Using two sources for different performance measures presents an advantage because the coherence of the data between the two sources can be observed. Alexa's rank is a function of number of visitors per day and number of page views per day that Alexa collects. Therefore a relationship should be found between Alexa's rank and Hypestat's number of page views and number of visitors per day if the data collected by Hypestat is coherent with Alexa's. Figure 21 plots the number of page views collected by Hypestat against Alexa's rank. It can be seen in this scatter plot that there is a negative relationship between number of page views and rank. The greater the number of page views, the lower the rank (which is what is expected since a low rank means higher traffic). However, that relationship seems to be impacted by at least one other factor because some points with a relatively small amount of page views per day still have a low rank. Indeed a cloud of points can be found at the bottom-left-hand corner of the plot where a rank of 100,000 crosses a number of page views of 10,000. This cloud of point is crowded with non-U.S. EMs (e.g., U.K., Spain, *etc.*). Although it is not mentioned in Alexa's explanation of rank cited earlier, Alexa does explain on its website that EMs' country of origin impacts ranking. This mitigation effect of country is basically that smaller countries (in terms of population) have a harder time gathering online traffic (especially if it addresses only the local population's need as it can be the case for transportation EMs.) Therefore, for a small country, a small number of visitors and page views can still be considered a success. That is why Alexa.com considers the country of origin in its rank formula.

Figure 21: Scatter plot relating Hypestat's number of page views and Alexa's rank

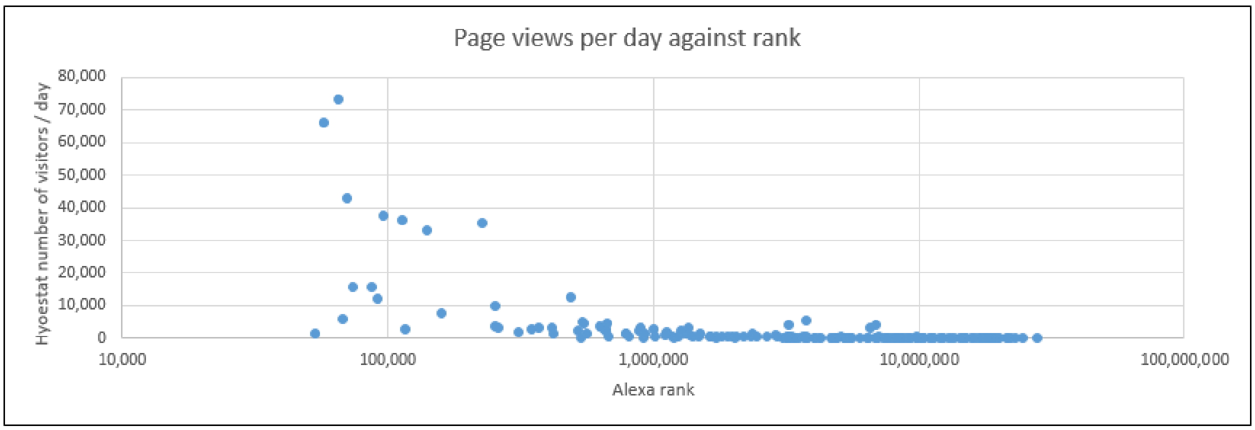
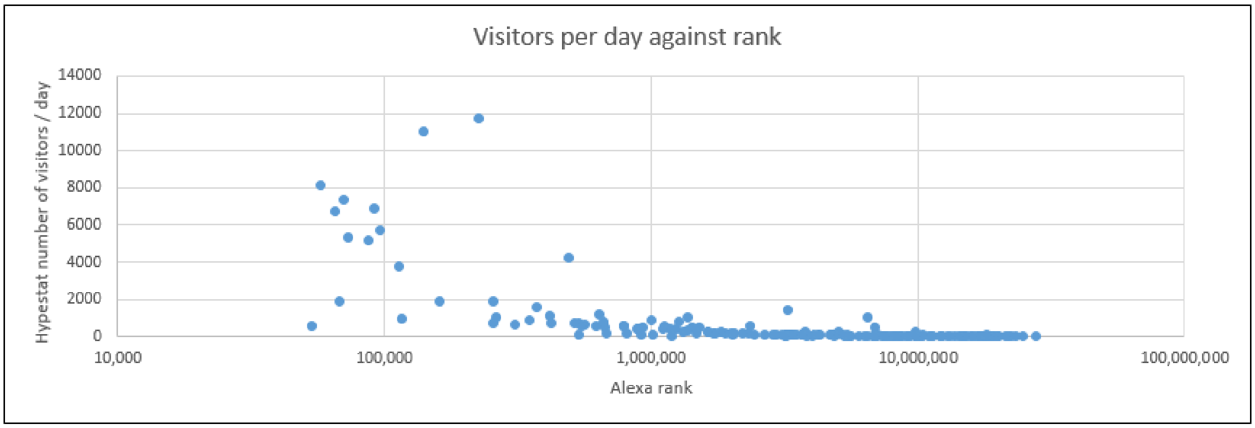


Figure 22 shows the same relationships between number of visitors per day and rank that could be observed between page views per day and rank in Figure 21. This verifies that both Hypestat.com's measures of performance are coherent with Alexa.com's rank. Rank is higher (*i.e.,* smaller number) when the number of visitors and/or the number of page views is higher. The fact that rank is a combination of number of visitors and page views can be seen when looking at Figure 21 and Figure 22 at the same time. Indeed, if analyzed point by point, it can be observed that EMs with a high number of visitors that do not rank quite as well as could be expected are actually being penalized by a low number of page views per day. These EMs have numerous people visiting who perform few operations, which is bad for ranking. Similarly, EMs with a high number of page views but few visitors also tend to fare worse than EMs who both enjoy a high number of visitors and a high number of page views. This observation helps confirm that the rank information from Alexa.com is coherent with the number of visitors and the number of page views from Hypestat.com, which brings credibility to the data sources and supports the use of these three dependent variables in the studies presented below.

Figure 22: Scatter plot relating Hypstat's number of visitors per day and Alexa's rank



Both Figure 21 and Figure 22 show the impact of country of origin on traffic. Therefore, a control variable will be introduced in the models for this chapter to observe the impact of country of origin on the chosen dependent variables (*i.e.*, rank, number of page views and number of visitors per day). Information about country of origin was collected in the database constituted in chapter 3. Thus, each EM can be associated to a country and its population. Population size is logically the variable of interest in this study because it can be assumed that a country with a greater population increases EMs' chances to gather greater traffic. It is to be noted that there is a great difference in population size between the USA (324 million people) and other countries in the database that do not have a population exceeding 80 million people. The dichotomous nature of population size led to coding the control variable as a binary variable (1 for the USA, 0 otherwise).

In their studies, Clasen and Mueller (2006) and Gosain and Palmer (2004) use the log transformation of traffic measures in their regression analyses. They do so because their data is heavily skewed and therefore do not respect the normal distribution assumption expected for the dependent variables (Ott and Longnecker 2010). Since the same measures are used in this study, skewedness was checked. Figure 23, Figure 24 and Figure 25 show that the respective measures for rank, visitors per day and page views per day are indeed heavily skewed.

Figure 23: Distribution of EM rank

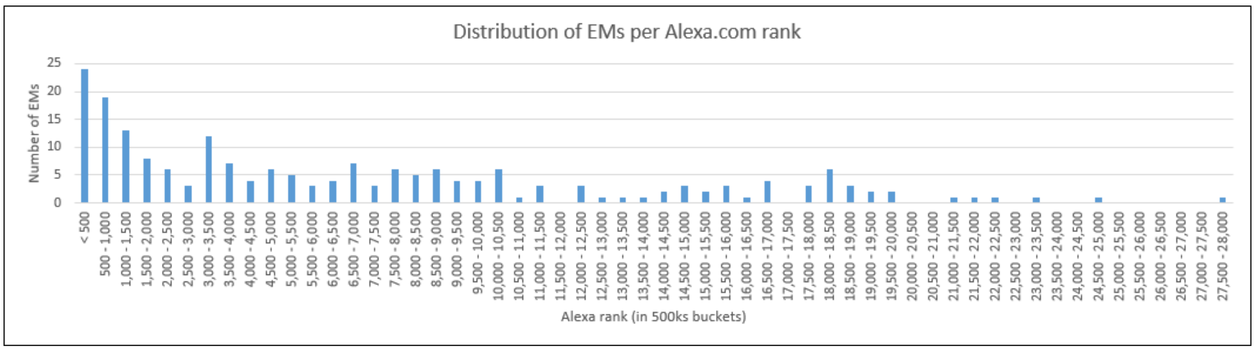


Figure 24: Distribution of visitors per day

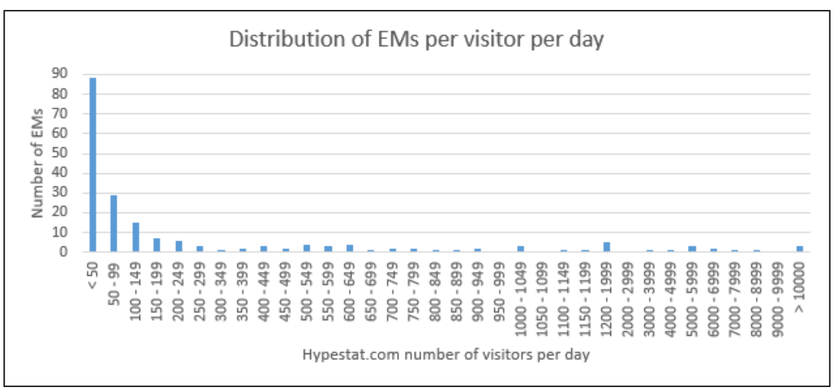
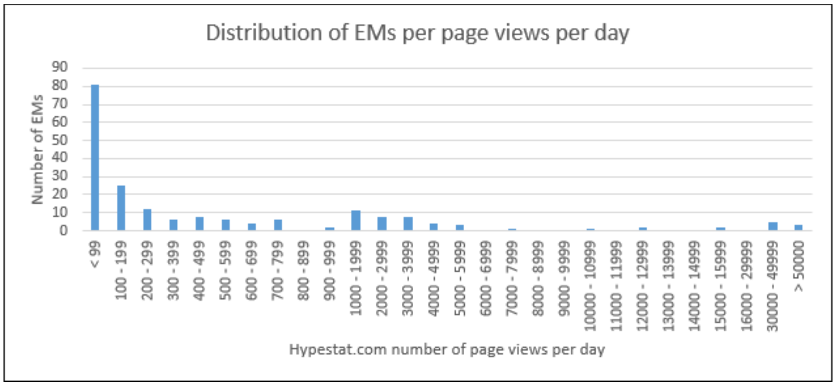


Figure 25: Distribution of page views per day



Neter *et al.* (1989) recommend several transformation methodologies for dependent variables that are heavily skewed in order to increase the fit of tested models. Several of the recommended transformations were tested (e.g., inverse and square root) but the logarithmic transformation yielded the best results. Thus it was decided to follow what was done in prior literature (Clasen and Mueller 2006, Gosain and Palmer 2004). Concerns are sometimes expressed with regard to logarithmic transformations when the variables to be transformed often have the value of 0. The log of 0 indeed cannot be calculated and useful data can be lost. It is not the case in this study since none of the dependent variables ever have a value of 0.

On top of the logarithmic transformation, the original variables will also be tested in the models to better show the effect of the transformation. However, as much as two EMs can have the same number of visitors and the same number of page views, rank is by definition unique to an EM. It is therefore not appropriate to include it under its original form in a regression analysis. Therefore it was also decided to transform rank into a binary variable of success (1 = successful = belonging to the 10% best ranked EMs, 0 otherwise). This way successful and unsuccessful EMs are associated with the same values of the dependent variable (*i.e.,* 1 and 0 respectively) and regression analyses can be performed.

. The overall goal of this chapter is to understand how the different types of EMs perform. To do so, the association between the different types of EMs and performance will be measured as will the effect of categories and clusters. The effect of categories of EMs will help understand what characteristics, within a type of EM explain the performance level of that type. The clusters effect on performance will help show the robustness of the results obtained with types. Therefore, the independent variables included in the models of this chapter are the classification schemes' categories, the types and the EM clusters. These variables are categorical (also termed nominal). For example, in the "number of participants" scheme, an EM is either "one-to-many", or "many-to-few", or "many-to-many". These categories are not numerical and there is no order between them. Similarly, an EM is either of Type 1 or Type 2, cluster 1 or cluster 2, *etc.*

In order to include nominal variables in regression models, they have to be transformed into numerical variables. Several methodologies are suggested in the literature and by professional statistical packages (SAS, STATA, SPSS). The most popular procedure is to use dummy variables (binary variables) as described by Cohen *et al.* (2009). This coding methodology works well with truly nominal data (Davis 2010), which is the case for the variables in this study. Also, it is very simple to implement and to understand. This coding methodology is the one adopted in this study and the results displayed in the results section are obtained through this methodology. For a variable with k categories, k-1 new variables are created because one is used as an implied referent (Rosenzweig *et al.* 2011). Each new variable can only take a value of 0 or 1. 1 if the instance being coded belongs to the category the new variable stands for, 0 otherwise.

Table 34: Example of categorical variable transformed into dummy variables

EM Name	Type	Type2	Type3
Uship	Type 2	1	0
123Loadboard	Type 2	1	0
DAT load boards	Type 3	0	1
ACME Truck Line	Type 1	0	0
Addtran Logistics	Type 1	0	0

Table 34 shows an example of the categorical variable "Type" with three categories being transformed into 2 dummy variables. There are 3 categories/ types, two new variables are thus needed. It was decided for this study to take Type 1 EMs as the reference category against which the effect of belonging to other types are tested. Therefore, this category is not transformed into a dummy variable, but Type 2 and Type 3 are. In the Type2 column, all EMs belonging to the Type 2 category are coded as 1 and all others as 0. In the Type3 column, all EMs belonging to the Type 3 category are coded as 1 and all others as 0. By elimination, when an EM is not coded as 1 in column Type2 nor in column Type3, it means it is a Type 1 EM.

Simple contrast coding is also recommended for analyses of variance and regression analyses (http://www.ats.ucla.edu/stat/sas/webbooks/reg/chapter5/sasreg5.htm). Table 35 shows how the "Type" categorical variable is transformed into two new numerical variables through simple contrast coding for regression analyses. When there are k categories, k-1 new variables are created that can take the value of (k-1)/k or -1/k. Because there are three types in the "Type" categorical variable, two variables are created. "Type2" takes the value of 2/3 when an EM belongs to category "Type 2", -1/3 otherwise. "Type3" takes the value of 2/3 when an EM belongs to the Type 3 category, -1/3 otherwise. As expected (http://www.ats.ucla.edu/stat/sas/webbooks/reg/chapter5/sasreg5.htm), this coding methodology returned the same results as the dummy variable methodology. The simpler and more popular dummy variable methodology was therefore preferred.

Table 35: Example of a categorical variable transformed into numerical variables through simple contrast coding for regressions

EM Name	Type	Type2	Type3
Uship	Type 2	2/3	-1/3
123Loadboard	Type 2	2/3	-1/3
DAT load boards	Type 3	-1/3	2/3
ACME Truck Line	Type 1	-1/3	-1/3
Addtran Logistics	Type 1	-1/3	-1/3

Another form of simple contrast coding is displayed in Table 36. That form is normally recommended for analyses of variance (http://www.ats.ucla.edu/stat/sas/webbooks/reg/chapter5/sasreg5.htm) but is applied by some statistical software packages such as JMP Pro 11 for regression analyses when nominal variables are imported under their categorical form (http://www.jmp.com/support/help/The_Factor_Models.shtml). The software codes the nominal variable in the background by associating the values of 1, 0 or -1 to the different categories. In Table 36, it can be seen that the new variable "Type2" takes the value of 1 when an EM belongs to the Type 2 category, a value of 0 when it belongs to the other non-referent category, and -1 when the EM belongs to the referent category. Same for Type3.

Table 36: Example of a categorical variable transformed into numerical variables through simple contrast coding for analysis of variance

EM Name	Type	Type2	Type3
Uship	Type 2	1	0
123Loadboard	Type 2	1	0
DAT load boards	Type 3	0	1
ACME Truck Line	Type 1	-1	-1
Addtran Logistics	Type 1	-1	-1

The simple contrast methodology illustrated in Table 36 produces results that are mostly consistent with the dummy variable methodology but that sometimes sheds a different light on a model. Therefore, although the results displayed in this study are the fruit of dummy variable coding, results from analyses with the coding from Table 36 are sometimes mentioned in further sections. In the literature, contrast coding is sometimes deemed more appropriate for testing hypotheses that are defined *a priori* (Davis 2010).

5.3.2. Research method and models to be tested

As illustrated in Figure 19, three steps or studies have been adopted to reach validated results in this chapter. In study 1, the categorized database from chapter 4 is used to perform a regression analysis and observe if EM categories can be used to explain performance. Using this knowledge of categories' performance, the performance of combinations of categories can be explained. The types of EMs discovered at the end of chapter 4 are made of combinations of categories. Thus, under the light of the results of study 1, the performance of the new types of EMs can be explained. Study 2 aims at revealing the performance of EM types and at testing the hypotheses developed in this chapter. Based on the sample of EMs that are an exact fit within one of the types described in chapter 4, regression analyses are performed to better understand how EM types relate to performance. Finally, in study 3, regression analyses are performed with the whole population of EMs to see if the clusters found in chapter 4 link to performance. Clusters are the equivalent of loose types/ strategies. Within a cluster some EMs correspond to the strict definition of one of the EM types, and the remaining EMs of that cluster correspond most closely to that same type in spite of slight variations *vis-à-vis* the type's definition. As a consequence, the results of study 3 reveal the robustness of models using EM types as predictors of performance when including all EMs in the analysis, even those that do not strictly belong to one of the types. As a consequence, the results of study 3 allow the confirmation of how different strategies (*i.e.,* types) adopted by EMs impact performance and also how slight variations in these strategies alter that impact. Below, the conceptual model of each study is explained.

Study 1:

Figure 26: Research model relating EM categories to performance

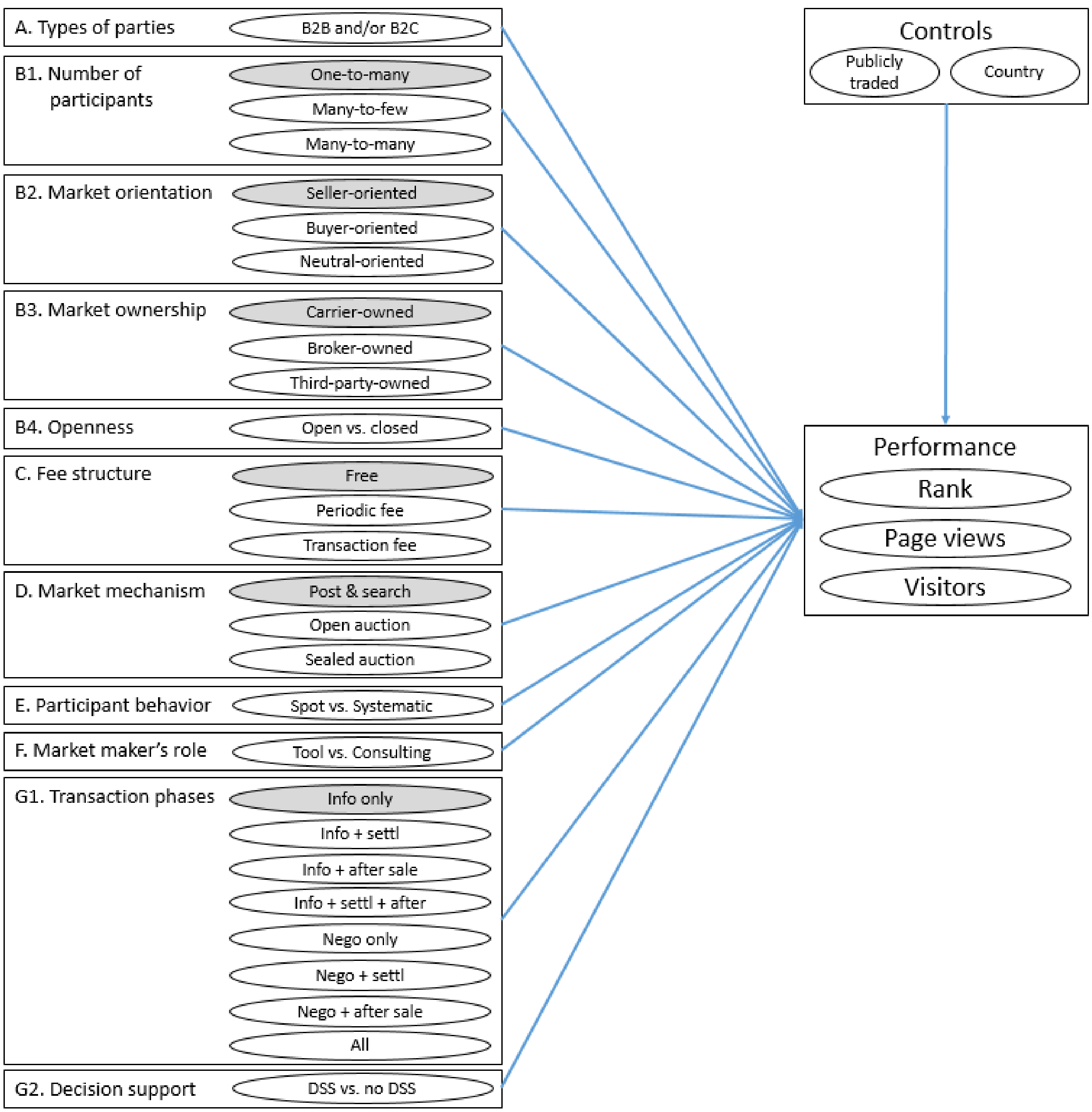


Figure 26 shows there are 11 EM categorization schemes containing a total of 28 categories/binary variables plus one "control" scheme with two binary variables. All 11 EM schemes are comprehensive of all EMs and contain categories that are exclusive of each other. Therefore, within a scheme, knowing the values of all categories minus one is enough to know the value of the last one. In this case, for regression analyses, it is recommended to test all variables minus one against the one left, which is used as a reference (Rosenzweig *et al.* 2011). In Figure 26, the shaded variables are not part of the model as they are used as references. Doing so avoids computational difficulties (Neter *et al.* 1989). Six binary variables were withdrawn from the regression model in order for the model to work. It was decided to withdraw the categories that correspond most closely (based on the conclusions from chapter 4) to Type 1 EMs (e.g., "carrier-owned EMs" is excluded in order to test the other variables against it.) Type 1 EMs are supposed to perform below other types (**Hypothesis 1**). Thus, taking a category that is associated with Type 1 EMs as a reference within a scheme means the performance of that category relative to the other categories of its scheme should be lower. Keeping the same logic for all schemes makes interpretations clearer. The model should therefore include 22 (28 – 6) binary variables from the categorization schemes as independent variables.

It was determined that two control variables were needed in the models: country of origin (USA or not), and publicly traded or not. Since one measure of performance (rank) is mitigated by the country of origin, whereas the two other measures (page views and visitors) are not, it was decided to include "country of origin" in the model to better understand the effect of that variable. The other control variable is included because a substantial part of the EM literature focuses on publicly traded EMs as there is easier access to data for a publicly traded company. Although it can be assumed that publicly traded companies can generate trust by disclosing more information on their financial health, size, *etc.*, no model was studied with such a control variable. Hence, the effect of that variable cannot really be hypothesized. In the end, the regression model should contain 24 binary independent variables.

Table 37: Variables' naming based on the schemes they belong to

A. Type of parties		B4. Openness		G1. Transaction phases	
B2B and/or B2C	xA1	Open (public)	xB41	Info only	xG11
B1. Relationship dimension		**C. Fee structure**		Info + Settlement	xG12
One-to-many/few	xB11	Free	xC1	Info + After sales	xG13
Many-to-few	xB12	Periodic fee	xC2	Info + Settlement+After sales	xG14
Many-to-many	xB13	Transaction-consumption	xC3	Negotiation only	xG15
B2. Market orientation		**D. Market mechanism**		Negotiation + Settlement	xG16
Seller-oriented	xB21	Post and Search	xD1	Negotiation + After sales	xG17
Buyer-oriented	xB22	Open auction	xD2	All phases	xG18
Neutral	xB23	Sealed auction	xD3	**G2. Decision support**	
B3. Market ownership		**E. Participant behavior**		With decision support	xG21
Carrier	xB31	Systematic (w/ spot or not)	xE1	**H. Control variables**	
Broker or Shipper	xB32	**F. Market maker's role**		Publicly traded	xH1
EMP, software provider	xB33	Consulting	xF1	Country USA	xH2

Table 37 shows the variable names for the regression model. The model to be tested where Y is the dependent variable, I is the intercept and E the error term, is presented in equation [1]:

$$[1]\ Y=I+\beta1xA1+\beta2xB12+\beta3xB13+\beta4xB22+\beta5xB23+\beta6xB32+\beta7xB33+\beta8xB41+\beta9xC2+\beta10xC3+\beta11xD2+\beta12xD3+\beta13xE1+\beta14xF1+\beta15xG12+\beta16xG13+\beta17xG14+\beta18xG15+\beta19xG16+\beta20xG17+\beta21xG18+\beta22xG21+\beta23xH1+\beta24xH2+E$$

The variables that are not explicitly in the model are the categories designated as reference categories within a scheme (shaded variables in Table 37).

Since all variables are known and there are few enough of them, they can exhaustively be included in the model. As a consequence, a backward elimination process can be used to look for a model that explains the level of the dependent variable. Backward selection is preferred to forward selection because it reduces the chances of ignoring sets of variables that are significant only as a set but not individually (Sun *et al.* 1996). In forward selection, variables are added one by one and variables that are not statistically significant are rejected. Consequently, two variables that can be non-significant on their own but significant as a set (*i.e.*, negatively confounded sets of variables) might be ignored. On the contrary, in backward elimination, since all variables are included from the start of the procedure, confounded sets remain in the model. Also backward elimination is preferred in exploratory studies (Kleinbaum *et al.* 1987).

With backward elimination, the model is first tested with all variables included. Then, the least significant variable (lowest F-value or highest p-value) is withdrawn and the model is tested without it. This process is repeated until a predetermined stop rule is hit (Neter *et al.* 1989, Ott and Longnecker 2010). Budtz-Jørgensen *et al.* (2006) recommend stopping the elimination of variables when none of them have a p-values that exceeds 0.20. This cut-off value should lower the risk of getting rid of confounded sets of variables. Therefore, in this study, variables have been eliminated until no variable was left with a p-value above 0.20.

In study 1, nearly all EMs can be classified within each categorization scheme. Therefore, the entire population of EMs surveyed in this dissertation can be used to test the model. Nevertheless, as is done in prior EM literature, the model will be tested with the entire population and also with the population minus some outliers. Clasen and Mueller (2006) test their models without e-bay (an outlier) to see if their models are influenced by the presence of an outlier. In the EM population of this study, there also is an EM that outperforms the others to such an extent that its inclusion in the model might bias the results: Uship.com. Additionally, 6 EMs are performing much worse than other EMs on all performance measures. Therefore, it was decided to test the models both with the entire population (study 1a) and with a sample rid of these 7 outliers (study 1b).

Study 2:

Figure 27: Research model relating the 3 generic EM types from the analytical procedure to performance (study 2.1)

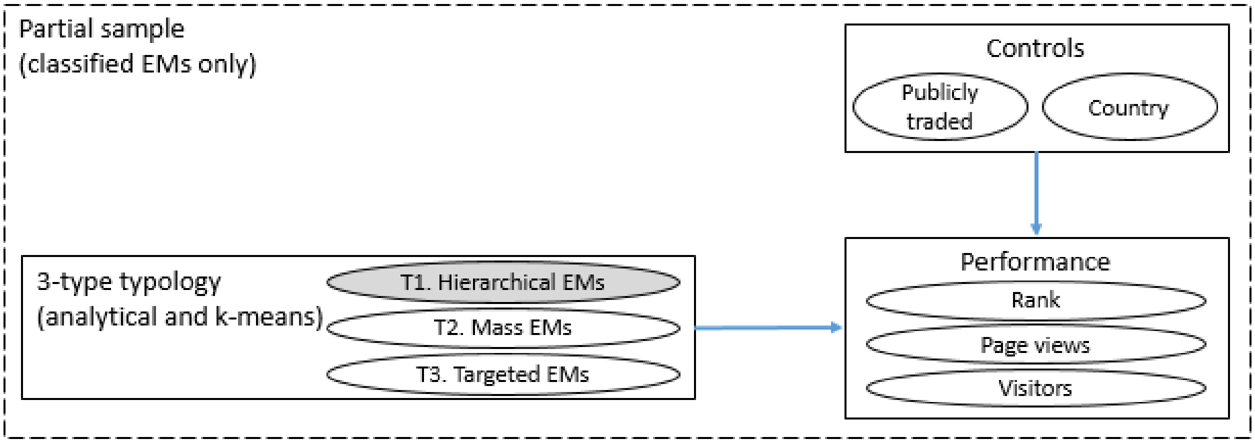
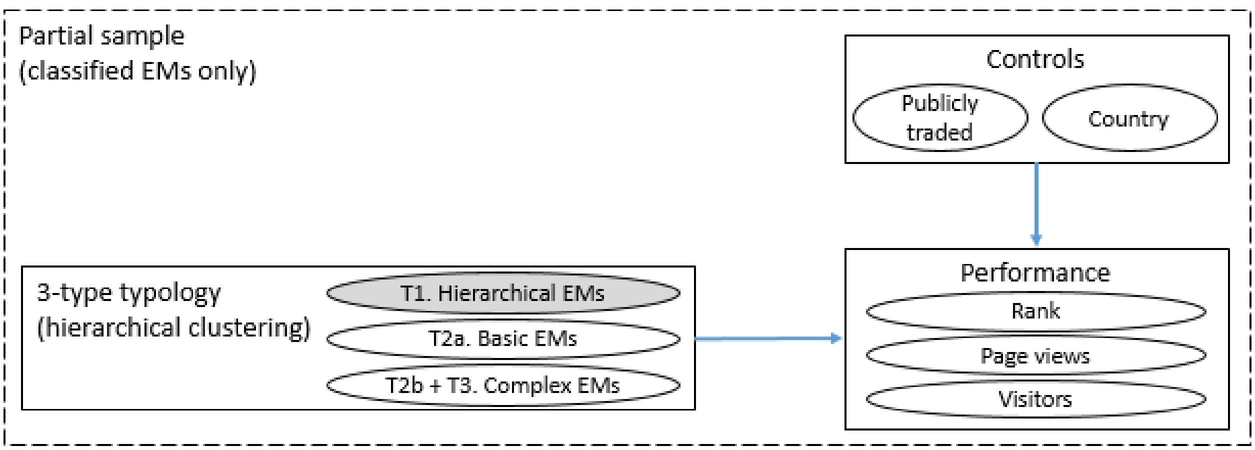


Figure 28: Research model relating the 3 generic EM types suggested by the hierarchical clustering procedure to performance (study 2.2)



In chapter 4, 111 EMs have been determined as strictly belonging to type 1, 2 or 3 of the new typology (or Types 1, 2a, 2b, 3a or 3b). The other EMs differ from any generic type identified in chapter 4 and thus are excluded from study 2.

Figure 27 shows the research model with the 3 types obtained through both analytical and k-means clustering procedures. This model is termed study 2.1. It shows that the effect of Type 2 and Type 3 EMs on each performance measure is studied in comparison to Type 1 EMs that serve as a reference. In this model, the same control variables as in study 1 are included (publicly traded or not, and from the USA or not.) In chapter 4, the hierarchical clustering procedure yielded a different model for the 3-type typology with Types 1 and 2a as their own category and Types 2b, 3a and 3b in the third category. Therefore it was deemed interesting to test that model against performance as well. Figure 28 illustrates that model, named study 2.2, which is similar to study 2.1 but for the fact that Type 2b EMs are not associated with Type 2a but with Type 3 EMs.

Figure 29: Research model relating the 5 generic EM types to performance (study 2.3)

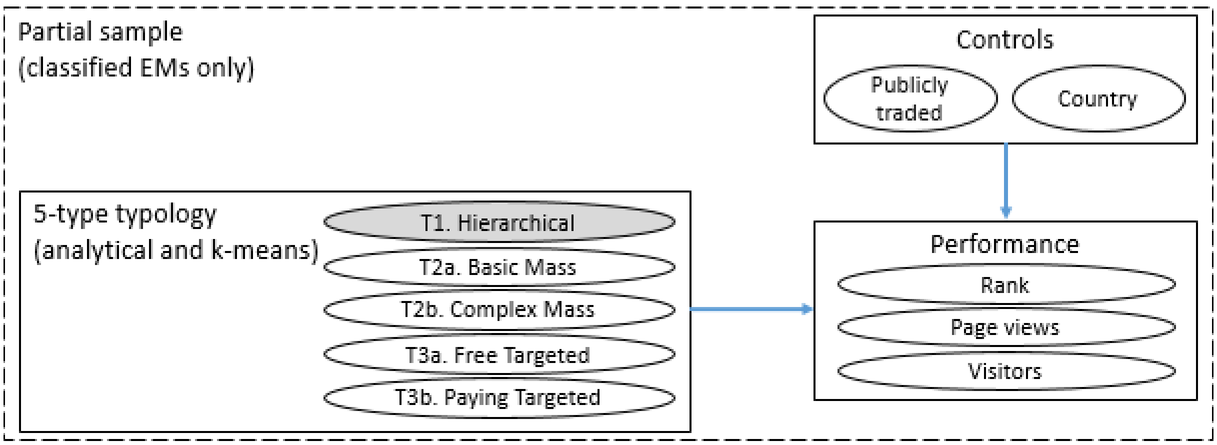


Figure 29, shows the research model adopted to study the effect of generic strategies to the finer level allowed by the new typology. Once again, the effects of Types 2a, 2b, 3a and 3b are studied in comparison to Type 1.

In study 2.1 with three exclusive categories (Type 1, 2, and 3), belonging to Type 2 or 3 is tested *versus* belonging to Type 1. Consequently, the model to be tested is as shown in equation [2] with the sample of 111 classified EMs being used for testing the model:

[2] $Y= I +\beta 1x2+\beta 2x3+\beta 3xH1+\beta 4xH2+E$

Where Y is the dependent variable, I the intercept, E the error term, x2 and x3 the binary variables standing for whether the EM respectively belongs to Type 2 or 3, and xH1 and xH2 the binary control variables (publicly traded and being from the USA). The model is strictly identical for study

2.2, except that x2 stands for Type 2a EMs alone and x3 stands for Type 2b and Type 3 EMs together.

In the case of study 2.3 with five types (Types 1, 2a, 2b, 3a and 3b), the model is shown in equation [3]:

[3] $Y= I +\beta1x2+\beta2x3+\beta3x4+\beta4x5+\beta5xH1+\beta6xH2+E$

In any version of study 2, the results for the entire model can be presented without using a procedure for eliminating variables because there are only 4 to 6 variables in the models. Similarly to study 1, models in study 2 are tested with and without outliers. Thus there will be a version "a" and a version "b" for each variation of study 2.

Study 3:

Figure 30: Research model relating 3 clusters obtained through k-means clustering to performance (study 3.1)

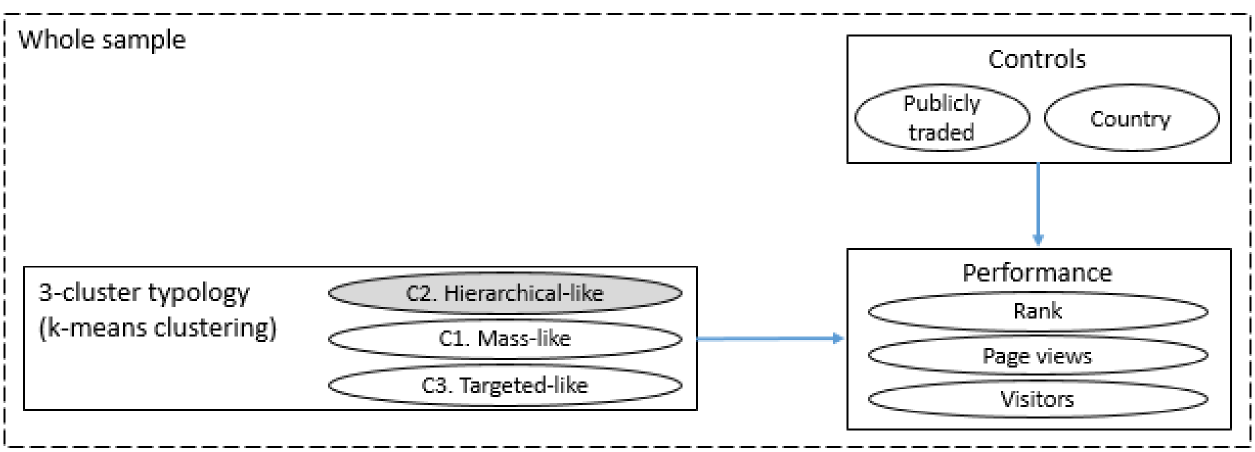


Figure 31: Research model relating 3 clusters obtained through hierarchical clustering procedure to performance (study 3.2)

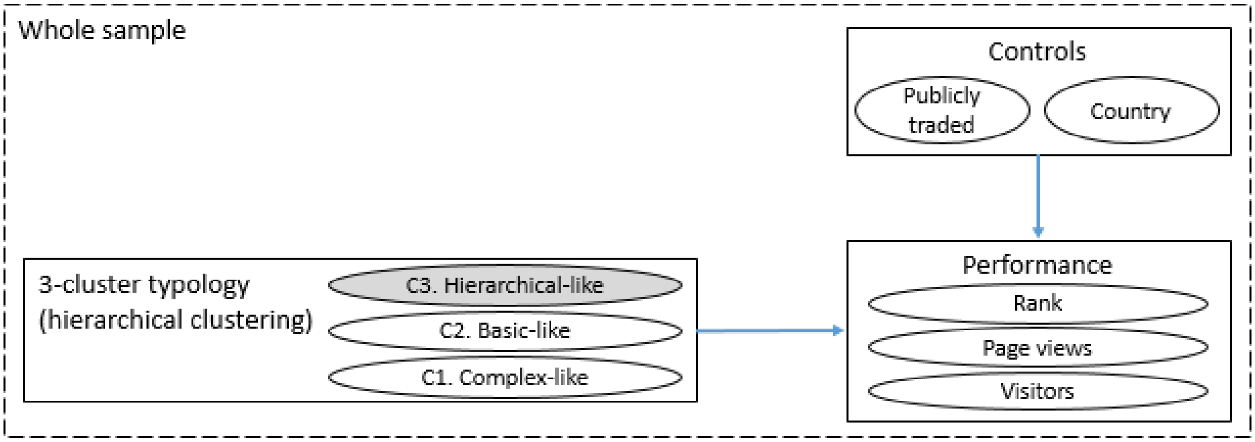
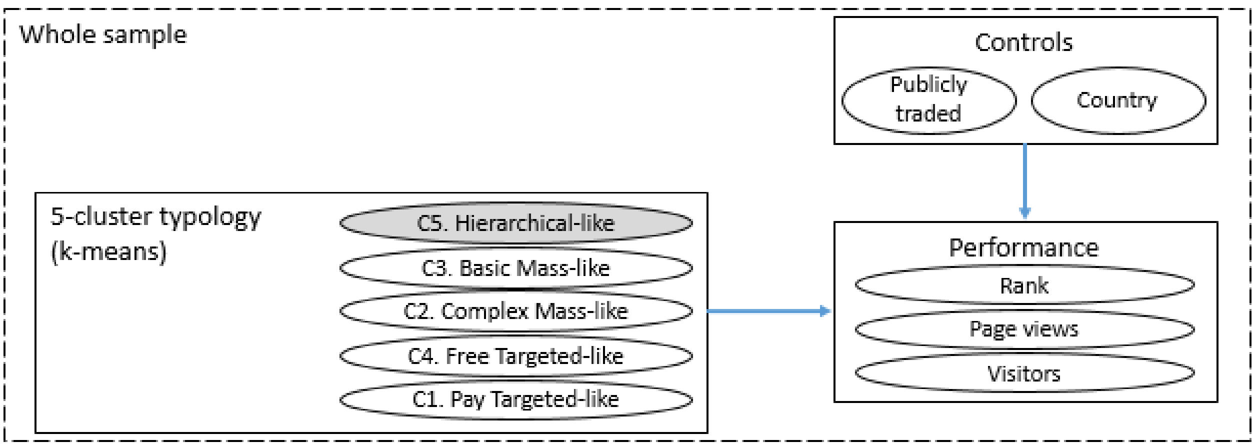


Figure 32: Research model relating 5 clusters obtained through k-means clustering to performance (study 3.3)



All versions of Study 3 shown in Figure 30, Figure 31, and Figure 32 follow the same structure as study 2 except that types will be replaced by clusters. Studies 3.1 and 3.2 shown in Figure 30 and Figure 31 use equation [2] whereas study 3.3 shown in Figure 32 uses equation [3]. Contrary to study 2, the cluster analyses are inclusive of all EMs (*i.e.,* all EMs were classified in one of the clusters). Therefore, these models are tested based on the entire population of EMs surveyed in this dissertation. This fact is what constitutes the interest of study 3. It was shown in chapter 4 that each cluster corresponds to a type of EM. However clusters contain EMs that strictly correspond to the definition of a type as well as EMs that are close to that definition but with slight variations. As a consequence, observing models' behaviors in study 3 permits evaluation of the robustness of the studied strategies when some EMs adopt slight variations of these strategies. Finally, similarly to study 1 and 2, each model will be studied based on samples with or without outliers (version a and b).

5.4. Results

The main focus of this chapter is to understand the link between EM strategies (represented by EM types) and performance. In this section results of analyses are reported with regard to three measures of performance – rank, number of visitors, and number of page views. First the descriptive statistics are presented. The descriptive statistics show that, except maybe for Type 3a, all types of EMs are fairly well represented in the sample studied (Table 38) and that substantial differences in performance are observed across types (Table 39). Second a correlation analysis is performed. Since no collinearity issues were identified between the variables used for any of the three studies designed in section 1.3 (please see Appendix F, Table 40, Table 41, Table 42, and Table 44), all three studies can be implemented. Third, study 1 reveals that 10 EM categories impact performance (Table 40). Knowing the link between categories and performance is essential to understand the performance of EM types. Fourth, hypotheses are tested. Study 2.1 and 2.2 demonstrate that Type 2 and Type 3 EMs perform better than Type 1 EMs (Table 41). At the 5-type level, it is mostly Types 2b, 3a and 3b that perform better than Type 1 and Type 2a EMs (Table 42). These studies bring support to three of the five hypotheses drawn from the Critical Mass Theory (Table 43). Fifth, additional analysis is run with study 2.2 to nuance the three-type typology. Finally, in a sixth sub-section, the robustness of study 2 is checked with study 3. Study 3 shows the loss of predictive power when regression models are based on EM clusters rather than EM types (Table 41, Table 42 and Table 44). The implications of these results are further developed in section 5.5.

5.4.1. Descriptive statistics

Two hundred four EMs are originally part of the database and 111 EMs are "typed" (*i.e.,* attributed to one of the types identified in the new typology) (Table 38). There is a fairly diverse choice of strategies implemented by surveyed truck transportation EMs as seen by the distribution of EMs between categories.

Table 38: Distribution of EMs by types, clusters and control variables

	Descriptive stats			K-means clusterization								Hierarchical clusterization		
Types	**Count**	**Public**	**Non US**	**Cluster 1**	**Cluster 2**	**Cluster 3**	**Cluster 1**	**Cluster 2**	**Cluster 3**	**Cluster 4**	**Cluster 5**	**Cluster 1**	**Cluster 2**	**Cluster 3**
Type 1	47	9	1	0	**47**	0	0	0	0	0	**47**	0	0	**47**
Type 2a	20	0	6	**20**	0	0	0	0	**20**	0	0	0	**20**	0
Type 2b	21	0	8	**21**	0	0	0	**21**	0	0	0	**21**	0	0
Type 3a	6	0	1	0	0	**6**	2	0	0	**4**	0	**5**	0	1
Type 3b	17	1	7	0	0	**17**	**16**	0	0	1	0	**17**	0	0
Not specified	93	7	16	35	35	23	16	7	30	7	33	32	32	29
Total	**204**	**17**	**39**	**76**	**82**	**46**	**34**	**28**	**50**	**12**	**80**	**75**	**52**	**77**
			Public	2	11	4	4	0	2	0	11	4	2	11
			Non US	21	2	16	16	9	12	0	2	23	14	2

Whether one looks at rank, number of visitors per day or number of page views per day, the mean values for Types 2b, 3a and 3b point to stronger performance than for Type 1 and Type 2a EMs (Table 39). Among Type 2b, 3a and 3b EMs, Type 3a EMs seem to rank much higher than Type 2b and Type 3b EMs, with a mean rank of 1,780,179 against 4,438,676 and 4,668,278 respectively for the two others (note: rank is higher when the measure is lower => thus, the type of EMs with the lowest mean rank is the type that seems at an advantage).

Interestingly, Type 2b EMs that have a greater mean rank than Type 3a also have greater mean numbers of visitors per day and page views per day than Type 3a. Since rank is a reversed composite of the two other variables, it might seem contradictory. The standard deviations around number of visitors and page views for Type 2b EMs are however much higher than for Type 3a EMs. Hence, it shows that some very high performing Type 2b EMs must be pulling the numbers of that type of EMs artificially up. The logarithmic transformation that corrects for skewedness indeed seems to compensate for that phenomenon as the order between EM types when looking at rank, visitors and page views seems more coherent (*i.e.,* EM types with a greater number of visitors and page views is also higher ranked).

Table 39: Performance descriptive statistics by type of EMs

<table>
<tr><th></th><th colspan="4">Rank</th><th colspan="6">Log Rank</th><th></th></tr>
<tr><th>5 Types</th><th>Max</th><th>Min</th><th>mean</th><th>Std Dev</th><th>Max</th><th>Min</th><th colspan="2">Mean</th><th colspan="2">Std Dev</th><th>3 Types</th></tr>
<tr><td>Type 1</td><td>24,649,613</td><td>112,626</td><td>7,749,557</td><td>6,684,627</td><td>7.39</td><td>5.05</td><td colspan="2">6.63</td><td colspan="2">0.58</td><td>Type 1</td></tr>
<tr><td>Type 2a</td><td>27,670,687</td><td>531,489</td><td>7,489,807</td><td>7,066,407</td><td>7.44</td><td>5.73</td><td>6.67</td><td rowspan="2">6.41</td><td>0.47</td><td rowspan="2">0.72</td><td rowspan="2">Type 2</td></tr>
<tr><td>Type 2b</td><td>18,528,505</td><td>15,424</td><td>4,438,676</td><td>5,609,109</td><td>7.27</td><td>4.19</td><td>6.16</td><td>0.85</td></tr>
<tr><td>Type 3a</td><td>4,896,150</td><td>70,219</td><td>1,780,179</td><td>2,119,830</td><td>6.69</td><td>4.85</td><td>5.86</td><td rowspan="2">6.05</td><td>0.71</td><td rowspan="2">0.81</td><td rowspan="2">Type 3</td></tr>
<tr><td>Type 3b</td><td>19,281,046</td><td>57,398</td><td>4,668,278</td><td>6,377,435</td><td>7.29</td><td>4.76</td><td>6.11</td><td>0.85</td></tr>
<tr><td>All Types</td><td>27,670,687</td><td>15,424</td><td>6,286,666</td><td>6,517,386</td><td>7.44</td><td>4.19</td><td colspan="2">6.43</td><td colspan="2">0.72</td><td>All Types</td></tr>
<tr><th></th><th colspan="4">Visitors per day</th><th colspan="6">Log Visitors</th><th></th></tr>
<tr><th>5 Types</th><th>Max</th><th>Min</th><th>mean</th><th>Std Dev</th><th>Max</th><th>Min</th><th colspan="2">Mean</th><th colspan="2">Std Dev</th><th>3 Types</th></tr>
<tr><td>Type 1</td><td>3,774</td><td>3</td><td>262</td><td>629</td><td>3.58</td><td>0.48</td><td colspan="2">1.72</td><td colspan="2">0.80</td><td>Type 1</td></tr>
<tr><td>Type 2a</td><td>1,402</td><td>5</td><td>197</td><td>332</td><td>3.15</td><td>0.70</td><td>1.81</td><td rowspan="2">2.09</td><td>0.70</td><td rowspan="2">0.88</td><td rowspan="2">Type 2</td></tr>
<tr><td>Type 2b</td><td>39,121</td><td>3</td><td>2,321</td><td>8,447</td><td>4.59</td><td>0.48</td><td>2.32</td><td>0.98</td></tr>
<tr><td>Type 3a</td><td>7,399</td><td>39</td><td>1,704</td><td>2,822</td><td>3.87</td><td>1.59</td><td>2.70</td><td rowspan="2">2.44</td><td>0.83</td><td rowspan="2">0.91</td><td rowspan="2">Type 3</td></tr>
<tr><td>Type 3b</td><td>8,146</td><td>5</td><td>1,327</td><td>2,486</td><td>3.91</td><td>0.70</td><td>2.35</td><td>0.94</td></tr>
<tr><td>All Types</td><td>39,121</td><td>3</td><td>888</td><td>3,935</td><td>4.59</td><td>0.48</td><td colspan="2">2.00</td><td colspan="2">0.89</td><td>All Types</td></tr>
<tr><th></th><th colspan="4">Page Views per day</th><th colspan="6">Log Pages</th><th></th></tr>
<tr><th>5 Types</th><th>Max</th><th>Min</th><th>mean</th><th>Std Dev</th><th>Max</th><th>Min</th><th colspan="2">Mean</th><th colspan="2">Std Dev</th><th>3 Types</th></tr>
<tr><td>Type 1</td><td>36,230</td><td>5</td><td>1,486</td><td>5,514</td><td>4.56</td><td>0.70</td><td colspan="2">2.17</td><td colspan="2">0.88</td><td>Type 1</td></tr>
<tr><td>Type 2a</td><td>5,668</td><td>5</td><td>1,058</td><td>1,693</td><td>3.75</td><td>0.70</td><td>2.34</td><td rowspan="2">2.58</td><td>0.89</td><td rowspan="2">0.98</td><td rowspan="2">Type 2</td></tr>
<tr><td>Type 2b</td><td>244,504</td><td>3</td><td>13,021</td><td>53,062</td><td>5.39</td><td>0.48</td><td>2.79</td><td>1.06</td></tr>
<tr><td>Type 3a</td><td>42,913</td><td>39</td><td>8,433</td><td>16,942</td><td>4.63</td><td>1.59</td><td>3.07</td><td rowspan="2">2.95</td><td>1.10</td><td rowspan="2">1.01</td><td rowspan="2">Type 3</td></tr>
<tr><td>Type 3b</td><td>73,068</td><td>46</td><td>9,871</td><td>23,421</td><td>4.86</td><td>1.66</td><td>2.90</td><td>1.01</td></tr>
<tr><td>All Types</td><td>244,504</td><td>3</td><td>5,278</td><td>25,582</td><td>5.39</td><td>0.48</td><td colspan="2">2.48</td><td colspan="2">0.99</td><td>All Types</td></tr>
</table>

Overall, the results of descriptive statistics analysis reported in Table 39 suggest Type 3 EMs perform better that Type 2 EMs, which perform better than Type 1 EMs (please see the right-hand side of Table 39). Contrary to Type 2 EMs that seem to show a difference in performance between Type 2a and Type 2b EMs (the latter having a higher performance), both Type 3 EMs seem to perform similarly well, which explains why the Type 3 overarching group appears to perform more strongly than the two other types.

The descriptive statistics give hints at the pecking order between types of EMs in terms of performance but further statistical analyses are required to confirm these results.

5.4.2. Regression analysis – Collinearity

Before running the regression models, Ott and Longnecker (2010) recommend checking for collinearity between variables. Each type and cluster of EMs contains both US and non-US EMs, indicating that the regression models shown later in this section do not suffer from collinearity between the country of origin variable and the variables for types and clusters (please see Table 38). Conversely, EMs owned by a publicly traded company are essentially concentrated within Type 1 EMs (please see Table 38), suggesting the possibility of collinearity between variables. Collinearity between EM categories, types, clusters and control variables has been checked by building Spearman rank correlation matrices (Neter *et al.* 1989) shown in Appendix F (results were consistent with Pearson's correlation matrices). None of the correlations between variables for types and clusters to be included in the models of study 2 and 3, and control variables are above 0.7 (please refer to Tables F2, 3, 4, 5, 6 and 7 of Appendix F). This cut-off value is used by Rothaermel and Deeds (2006) to explain that collinearity is not an issue and thus all variables can be kept in the regression models. There is one red flag in study 1. Being an "Open" EM has a strong negative correlation with being "Many-to-few" (please see Table F1 of Appendix F). This makes sense since many-to-few EMs are closed/ private EMs (although not all closed/ private EMs are many-to-few). Since study 1 is designed to exclude variables that do not impact performance (backward elimination), all variables are included at the start of the study. Later in the results section, the red flag is taken into account by swapping highly collinear variables in the models obtained after backward elimination to makes sure of the robustness of the results

Additionally, Cenfetelli and Bassellier (2009) as well as Ott and Longnecker (2010) recommend measuring collinearity when running regression models using the Variance Inflation Factor (VIF). This factor shows how much variance of each coefficient found in a model is due to collinearity. The most conservative cut-off value not to exceed found in the literature for VIF is 3.33 (Diamantopoulos and Siguaw 2006). In the models shown in this chapter, the VIF was consistently below 3.33. The highest VIF in any of the models of chapter 5 is 1.924 in study 1 and is associated with the variable marking EMs as sealed auctions (please see Table 40). In all studies displayed in this chapter, all VIFs are calculated when running the regression models towards log rank. Some very minor variations in VIFs are observed when running other models in the same study as the pool of EMs for each model slightly varies (by maximum 2 EMs) depending on whether the measure for the dependent variable is available. These variations are so minimal that it was considered unnecessary to display almost identical VIFs for each model in a single study.

Although collinearity is not an issue in this chapter, regression models with the top 10% ranked EMs as a dependent variable are unstable when the "publicly traded" control variable is included (please refer to Table G1 of Appendix G for this model without said control variable). Thus, this chapter mainly relies on the analysis of models using the log-transformed dependent variables because all models can be run with the same control variables and levels of variance explained can be compared. Furthermore, models with log-transformed dependent variables provide the best results with regard to variance explained. For the same reason, models are run taking into account all possible EMs, without excluding any outliers. Results of models run with non-transformed dependent variables, dummy dependent variables (top 10% ranked EMs) and without outliers are available in Appendix G. These analyses provide results that are consistent with the ones reported in the body of this chapter with only few exceptions (please see the discussion section).

5.4.3. Regression analysis – Study 1

The regression analysis started by including all 24 independent variables in the model (22 categories that are not shaded in Table 40) and 2 control variables (country of origin and being publicly traded). After the backward elimination process is performed, 10 categories as well as the two control variables are found to play a role into the performance of EMs (please see Table 40). Depending on the measure of performance used in the model, between 31% and 34% of the variation in performance of EMs is explained by the models. The results of the regressions (please see Table 40) show that the two control variables are positively related to the number of visitors and the number of page views (increased performance), and are negatively related to rank (increased performance since lower measure of rank indicate higher performance). It means that being publicly traded and a US company helps in boosting traffic. Five categories of EMs are associated with higher traffic: targeting the final customer (B2C), being owned by a third-party (software provider), offering open auctions, offering sealed auctions and providing information, settlement and after sales phases as parts of the EM package. At the same time, five other categories are found to be associated with lower traffic. Being buyer-oriented, being open to all and offering systematic (long-term) procurement procedures impacts the volume of page views and visitors negatively and increases ranking. EMs offering the negotiation phase rank higher too but no significant effect of these EM categories on page views and number of visitors is found. In contrast, offering the information and after sales phases (but not the other phases) appears to impact the number of visitors negatively without affecting rank.

Table 40: Regression analyses' results for study 1, influence of EM categories on performance

Study 1	OLS Regression (standard betas, *p-values*) Log Rank	Log Visitors	Log Pages	VIF
N	198	198	198	
R-square	0.34	0.31	0.32	
Adj. R-square	0.30	0.27	0.29	
Prob>ChiSq	<0.0001	<0.0001	<0.0001	
Intercept	0 *<.0001*	0 *<.0001*	0 *<.0001*	-
(Ctrl1) Publicly traded	-0.319 *<.0001*	0.310 *<.0001*	0.314 *<.0001*	1.052
(Ctrl2) US EM	-0.115 *0.098*	0.189 *0.009*	0.178 *0.013*	1.357
(A) B2C	-0.149 *0.033*	0.224 *0.002*	0.189 *0.008*	1.343
(B1) O-to-M	Ref.	Ref.	Ref.	-
(B1) M-to-F	-	-	-	-
(B1) M-to-M	-	-	-	-
(B2) Seller-O	Ref.	Ref.	Ref.	-
(B2) Buyer-O	0.150 *0.025*	-0.127 *0.064*	-0.102 *0.134*	1.258
(B2) Neutral-O	-	-	-	-
(B3) Carrier-Own	Ref.	Ref.	Ref.	-
(B3) Broker/ shipper-Own	-	-	-	-
(B3) Third-party-Own	-0.189 *0.007*	0.276 *<.0001*	0.292 *<.0001*	1.343
(B4) Open	0.197 *0.003*	-0.196 *0.003*	-0.198 *0.003*	1.204
(C) Free of Fee	Ref.	Ref.	Ref.	-
(C) Periodic Fee	-	-	-	-
(C) Transact. Fee	-	-	-	-
(D) Post & Search	Ref.	Ref.	Ref.	-
(D) Open auction	-0.270 *0.000*	0.149 *0.044*	0.198 *0.006*	1.51
(D) Sealed auction	-0.270 *0.001*	0.195 *0.016*	0.232 *0.002*	1.924
(E) Systematic	0.191 *0.006*	-0.201 *0.004*	-0.226 *0.001*	1.302
(F) Consulting role	-	-	-	-
(G1) Info only	Ref.	Ref.	Ref.	-
(G1) Info + Settl	-	-	-	-
(G1) Info + After sales	0.097 *0.147*	-0.112 *0.100*	-	1.263
(G1) Info + Settl + After	-0.178 *0.010*	0.166 *0.018*	0.218 *0.001*	1.299
(G1) Nego. only	0.131 *0.046*	-	-	1.207
(G1) Nego + Settl	-	-	-	-
(G1) Nego + After sales	-	-	-	-
(G1) All phases	-	-	-	-
(G2) With decision support	-	-	-	-

Ref. means the variable was taken as a reference within its categorization scheme

EM openness is one of the significant predictive factors in study 1. Because of their previously observed collinearity, the "Open" variable was swapped with the "Many-to-few" variable and the models were re-run. The results are very similar. All coefficients show the same level of significance and are of similar magnitude. While being open is bad for the ranking of an EM, being many-to-few (closed) is good. The "Open" variable may hold more predictive power since R-square is one point higher with the "Open" variable in the model rather than with the "Many-to-few" variable. Therefore, the model with the "Open" variable is reported in Table 40.

The results of study 1 (Table 40) show that different categories have different effects on performance. Therefore, it can be expected that types and clusters of EMs made of differing categories also have differing impacts on performance.

5.4.4. Regression analysis – Hypotheses testing (Study 2.1 and 2.3)

The results show that, in general, Type 1 EMs perform worse than any other type of EMs (please see Table 41, Table 42 and Table 44). This brings support to **Hypothesis 1** that states that Type 1 EMs will gather less traffic than Type 2 and Type 3 EMs. Type 2 and Type 3 EMs have significant negative coefficients when regressing towards log rank, and have positive coefficients when regressing towards log visitors and log pages (Table 41).

Table 41: Regression analyses' results for study 2.1 and 3.1, influence on performance of the three generic types from the new typology and their cluster equivalents (k-means clustering analysis)

Study 2.1	OLS Regression (standard betas, *p-values*)			VIF
	Log Rank	Log Visitors	Log Pages	
N	108	109	109	
R-square	0.24	0.24	0.25	
Adj. R-square	0.21	0.22	0.22	
Prob>ChiSq	<0.0001	<0.0001	<0.0001	
Intercept	0 *<.0001*	0 *<.0001*	0 *<.0001*	-
(Ctrl1) Publicly traded	-0.376 *<.0001*	0.375 *<.0001*	0.391 *<.0001*	1.146
(Ctrl2) US EM	-0.142 *0.134*	0.166 *0.076*	0.150 *0.108*	1.184
Type 1	Ref.	Ref.	Ref.	-
Type 2	-0.338 *0.002*	0.395 *0.000*	0.401 *0.000*	1.491
Type 3	-0.489 *<.0001*	0.494 *<.0001*	0.483 *<.0001*	1.412

Study 3.1	OLS Regression (standard betas, *p-values*)			VIF
	Log Rank	Log Visitors	Log Pages	
N	198	198	198	
R-square	0.17	0.15	0.17	
Adj. R-square	0.15	0.14	0.16	
Prob>ChiSq	<0.0001	<0.0001	<0.0001	
Intercept	0 *<.0001*	0 *<.0001*	0 *<.0001*	-
(Ctrl1) Publicly traded	-0.319 *<.0001*	0.301 *<.0001*	0.312 *<.0001*	1.038
(Ctrl2) US EM	-0.040 *0.569*	0.076 *0.282*	0.077 *0.272*	1.146
Cluster 2 (T1)	Ref.	Ref.	Ref.	-
Cluster 1 (T2)	-0.148 *0.056*	0.210 *0.007*	0.213 *0.006*	1.366
Cluster 3 (T3)	-0.326 *<.0001*	0.330 *<.0001*	0.359 *<.0001*	1.367

The results of study 2.1 suggest that Type 3 EMs have a stronger positive impact on traffic than Type 2 EMs because the standardized coefficients are greater (in absolute values) for Type 3 EMs than for Type 2 EMs (Table 41). However, comparing Betas can be misleading if there is collinearity in the model and if the scales used to measure the independent variables are different (Neter *et al.* 1989). Therefore, although VIFs are low (low collinearity) and all variables are binary, caution was used when interpreting the results of the models and when comparing Betas. All models were run while changing the group of reference in accordance with the hypotheses to be tested in order to make sure that differences in Betas are statistically significant. In the case of Study 2.1, the same model was run with Type 2 EMs as a reference. It allowed to observe that Type 3 EMs perform better than Type 2 EMs with a statistical significance level below 0.05. This brings support to **Hypothesis 2b** and rejects the competing **Hypothesis 2a**.

Table 42: Regression analyses' results for study 2.3 and 3.3, influence on performance of the five generic types from the new typology and their cluster equivalents (k-means clustering analysis)

Study 2.3	OLS Regression (standard betas, *p-values*)			VIF
	Log Rank	Log Visitors	Log Pages	
N	107	108	108	
R-square	0.29	0.28	0.27	
Adj. R-square	0.25	0.24	0.22	
Prob>ChiSq	<0.0001	<0.0001	<0.0001	
Intercept	0 *<.0001*	0 *<.0001*	0 *<.0001*	-
(Ctrl1) Publicly traded	-0.376 *<.0001*	0.376 *<.0001*	0.391 *<.0001*	1.145
(Ctrl2) US EM	-0.150 *0.111*	0.166 *0.078*	0.156 *0.100*	1.225
Type 1	Ref.	Ref.	Ref.	-
Type 2a	-0.123 *0.210*	0.190 *0.055*	0.220 *0.028*	1.347
Type 2b	-0.416 *<.0001*	0.433 *<.0001*	0.418 *<.0001*	1.418
Type 3a	-0.322 *0.000*	0.330 *0.000*	0.287 *0.002*	1.109
Type 3b	-0.410 *<.0001*	0.408 *<.0001*	0.422 *<.0001*	1.383

Study 3.3	OLS Regression (standard betas, *p-values*)			VIF
	Log Rank	Log Visitors	Log Pages	
N	198	198	198	
R-square	0.19	0.17	0.19	
Adj. R-square	0.17	0.15	0.17	
Prob>ChiSq	<0.0001	<0.0001	<0.0001	
Intercept	0 *<.0001*	0 *<.0001*	0 *<.0001*	-
(Ctrl1) Publicly traded	-0.323 *<.0001*	0.304 *<.0001*	0.313 *<.0001*	1.051
(Ctrl2) US EM	-0.061 *0.401*	0.098 *0.181*	0.103 *0.158*	1.243
Cluster 5 (T1)	Ref.	Ref.	Ref.	-
Cluster 3 (T2a)	-0.063 *0.400*	0.128 *0.094*	0.134 *0.075*	1.330
Cluster 2 (T2b)	-0.214 *0.004*	0.244 *0.001*	0.241 *0.001*	1.286
Cluster 4 (T3a)	-0.170 *0.014*	0.158 *0.023*	0.164 *0.017*	1.105
Cluster 5 (T3b)	-0.322 *<.0001*	0.333 *<.0001*	0.366 *<.0001*	1.426

The five-type typology (Table 42) explains more performance variation than the three-type typology with 27 to 29% of the variance explained. It also provides more insight in the influence of the different sub-types because the standardized Betas are slightly different from one group to the other. It can also be seen that Type 2b EMs outperform Type 2a EMs (this result was checked by running a similar model taking Type 2a as a reference), which brings support to **Hypothesis 4**. Conversely, although the Betas in Table 42 appear to suggest that Type 3a performs worse than Type 3b, **Hypothesis 3** stating that Type 3b will outperform Type 3a, is rejected (support was found for neither the predicted nor the opposite relationship) as could be seen in models taking Type 3a as a reference.

In sum, three out of four hypotheses are supported. Type 1 EMs that serve as a reference in all models displayed in this chapter perform worse than Type 2 and Type 3 EMs (H1). Type 3 EMs gather more traffic than Type 2 EMs (H2b) and Type 3b EMs perform better than Type 2a EMs (H4). One hypothesis is rejected while its competing alternative is supported (H2a). One hypothesis is not supported because the results are not statistically significant. Type 3a EMs have not shown a performance that is significantly better than Type 3b EMs. Table 43 summarizes the results of hypotheses testing in chapter 5.

Table 43: Summary of hypothesis support found in the studies of chapter 5

Hypotheses		Results
H1	*Type 1 EMs will gather less traffic than Type 2 and Type 3 EMs*	Supported
H2a	*Type 3 EMs will gather less traffic than Type 2 EMs*	Reverse
H2b	*Type 3 EMs will gather more traffic than Type 2 EMs*	Supported
H3	*Type 3b EMs will attract less traffic than Type 3a EMs*	Not-supported
H4	*Type 2b EMs will gather more traffic than Type 2a EMs*	Supported

5.4.5. Regression analysis - Additional analysis (Study 2.2)

The three-type framework suggested by the hierarchical clustering analysis explains 27 to 29% of the variance (Table 44) and actually provides better predictive power than the three-type framework presented in the new typology (Table 41). In the hierarchical clustering model, the third type (composed of Type 2b, Type 3a and 3b) greatly outperforms the other types on all performance measures. The second group loses its advantage on Type 1 as no difference is found in terms of rank performance, although Type 2 EMs still attract more visitors and more page views; probably just not enough to impact rank significantly. The fact that the models in study 2.2 outperform those in study 2.1 show that despite a theoretical difference in the openness characteristic of Type 2b and Type 3a and 3b EMs (Type 2 are open whereas Type 3 are closed), it is the mutually shared characteristic of complexity of services offered by those three types that explains performance the best.

Table 44: Regression analyses' results for study 2.2 and 3.2, influence on performance of EM types inspired by the hierarchical clustering analysis and their cluster equivalents

Study 2.2	OLS Regression (standard betas, *p-values*) Log Rank	Log Visitors	Log Pages	VIF
N	107	108	108	
R-square	0.29	0.28	0.27	
Adj. R-square	0.26	0.25	0.24	
Prob>ChiSq	<0.0001	<0.0001	<0.0001	
Intercept	0 *<.0001*	0 *<.0001*	0 *<.0001*	-
(Ctrl1) Publicly traded	-0.376 *<.0001*	0.376 *<.0001*	0.391 *<.0001*	1.145
(Ctrl2) US EM	-0.160 *0.084*	0.176 *0.057*	0.159 *0.088*	1.198
Type 1	Ref.	Ref.	Ref.	-
Type 2a	-0.126 *0.198*	0.192 *0.051*	0.221 *0.026*	1.345
Type 2b + 3	-0.564 *<.0001*	0.573 *<.0001*	0.556 *<.0001*	1.527

Study 3.2	OLS Regression (standard betas, *p-values*) Log Rank	Log Visitors	Log Pages	VIF
N	198	198	198	
R-square	0.17	0.16	0.17	
Adj. R-square	0.15	0.14	0.15	
Prob>ChiSq	<0.0001	<0.0001	<0.0001	
Intercept	0 *<.0001*	0 *<.0001*	0 *<.0001*	-
(Ctrl1) Publicly traded	-0.327 *<.0001*	0.309 *<.0001*	0.321 *<.0001*	1.040
(Ctrl2) US EM	-0.024 *0.729*	0.060 *0.392*	0.058 *0.411*	1.127
Cluster 3 (T1)	Ref.	Ref.	Ref.	-
Cluster 2 (T2a)	-0.053 *0.493*	0.116 *0.136*	0.122 *0.114*	1.365
Cluster 1 (T2b + T3)	-0.317 *<.0001*	0.339 *<.0001*	0.351 *<.0001*	1.428

5.4.6. Regression analysis – Robustness checks (Study 3)

In addition to study 1 and 2 that give a first idea of how EM types relate to performance, models with clusters (study 3) show that the results of study 2 are robust since the relationships between types and clusters hold for the whole population, when types are replaced by clusters. The five-cluster model explains the most variation in performance of all cluster models with a variance explained between 17% and 19% (Table 42). This means that the finer grained typology not only explains a maximum of performance variation for EMs that belong to a type, but also when including EMs that do not apply strict type definitions. Although models with clusters still explain a substantial part of performance (between 15% and 19%), they explain substantially less variance than models with types (between 24 and 29%).

In order to better understand the differential in variance explained between study 2 and study 3, additional tests were run. Assuming EMs that strictly apply the generic strategies ("typed" EMs) perform better than EMs applying them loosely ("not-typed" EMs), a one-tailed t-test has been conducted to observe the performance of "typed" *vs.* "not-typed" EMs. The test provides statistical support (with a p-value of 0.0411) that "typed" EMs perform better than "non-typed"

EMs in terms of rank (although statistical support is not found in terms of visitors and page views). Also EMs that do not fit into types display less variation in any measure of performance than typed EMs. As a consequence, no difference is found between clusters' performance when only studying "not-typed" EMs (except for cluster 3 providing more page views).

The following section discusses the implications of these results by linking the findings on categories to the new typology. Contributions to the literature are explained to the light of the Critical Mass Theory and limitations of this research are used to call for further research.

5.5. Discussion

The purpose of this chapter is to contribute novel insight to answer the question: "*How do different transportation EM strategies perform?*" In order to answer that question, three studies and several additional tests have been performed that, for the first time, involved all categorization schemes known in the EM literature, as well as a new *ad hoc* typology of truck transportation EMs. A variety of methods and variables' operationalization allowed to conduct a comprehensive analysis of the direction and magnitude that various categories, types and clusters of EMs have on three performance metrics: EM rank, number of unique visitors per day, and number of page views per day. Below, the results of the various studies help understand how differences between EM types are at the origin of differences in performance and why these differences generate differences in EM performance.

How do differences in characteristics impact EM differences in performance?

In this section, the different studies are linked together in order to understand what explains that difference in performance. A graphical illustration (Table 45) helps link the results of study 1 (categories) with those of study 2 (types). The rows are the EM categories known to impact performance and the columns are the different EM types from the 5-type typology. When a sign (plus or minus) is present at the intersection of a row and a column, it means that the corresponding category is part of the corresponding type's definition. For example "Open" EMs can be found exclusively in Type 1, Type 2a and Type 2b EMs. Therefore, in Table 45 at the crossing of the "open" row, the columns for Type 1, 2a and 2b contain a sign whereas the columns for Type 3a and Type 3b do not (because they are closed EMs only.) Since being "Open" reduces traffic and damages ranking, the sign shown in the "open" row are all minuses. Conversely, offering sealed auction capabilities is positive for traffic and Types 2b, 3a and 3b are the one offering that option. Thus, Pluses can be found at the intersection of the "sealed auction" row and the Type 2b, 3a and 3b columns. The TOTAL row shows how many pluses and minuses are contained in each column/ type. Although pluses and minuses do not convey the strength of a category's influence, Table 45 provides insight on the way EM types generate traffic by being part of certain categories rather than others.

Table 45: EM categories' influence on the performance of EM types

	T1	T2a	T2b	T3a	T3b
(A) B2C		+	+	+	+
(B2) Buyer-O		–	–	–	–
(B3) Third-party-Own		+	+	+	+
(B4) Open	–	–	–		
(D) Open auction			+	+	+
(D) Sealed auction			+	+	+
(E) Systematic		–	–	–	–
(G1) Info + After sales	–			–	–
(G1) Info + Settlt + After	+			+	+
(G1) Nego. only			–	–	–
TOTAL MINUS	2	3	4	4	4
TOTAL PLUS	1	2	4	5	5

Type 2 and Type 3 EMs include EMs that are third-party-owned EMs (e.g., owned by a software company). Contrary to Type 1 EMs that are generally owned by carriers who are often the sole buyers on their market places, Type 2 and Type 3 EMs need to attract both buyers and sellers in order to create a market because the third party company is neither a buyer nor a seller. Third-party owned EMs are positively correlated with EMs that try to attract both buyers and sellers (*i.e.,* neutral-oriented) (please see Table F1 of Appendix F). The models displayed in this chapter show that being third-party-owned favors performance (Table 40). Also neutral orientation is positively associated with being in the top 10% best performing EMs in terms of rank (Table G1 of Appendix G). Therefore, the work reported in this research brings support to the Critical Mass Theory that suggests interactive media that create volumes of users on both sides of the media will be more successful (Markus 1987). The types that create volume on both sides are Type 2 and Type 3 EMs. The new typology as a consequence is a tool that gives a quick insight of EMs that aim at creating traffic – Mass EMs (Type 2) and Targeted EMs (Type 3), *vs.* EMs that only aim at fulfilling pre-existing needs without creating much traffic – Hierarchical EMs (Type 1).

Type 2a EMs, like Type 1 EMs, are associated with few of the categories that influence performance and the majority of the ones they are associated with are negative in influence (Table 45). In contrast, Types 2b, 3a and 3b contain EMs that belong to categories that are associated with better performance, notably auction mechanisms. Auction mechanisms are a form of complexity for EMs. The three most complex types of EMs, Type 2b (Complex Mass EMs), Type 3a (Free Targeted EMs) and Type 3b (Paying Targeted EMs) are found to generate more online traffic than the other types, supporting the idea that complexity favors traffic and the lack of it can be detrimental. When Types 2b, 3a and 3b only offer the negotiation phase (negotiation only), they do not offer enough complexity and performance is negatively impacted.

Why do EM differences generate differences in performance?

Elaborating on the idea that interactive media such as EMs need to create volume on both side, the Critical Mass Theory (Markus 1987) suggests that barriers to the medium usage might reduce the success of the medium. In this study, two forms of barriers are identified: screening participants (being closed as opposed to open) and charging fees. Screening participants is enforced by asking participants (especially carriers) to show their credentials (e.g., letters of recommendation, insurance papers, *etc.*) and aims at ensuring participants are companies that are competent and trustworthy. Therefore, screening by design limits the pool of potential participants. Similarly, charging for participation reduces the pool of potential participants as only participants who consider the return on investment to be worth it will pay. In the new typology one EM type exclusively contains paying EMs that do not screen their participants (Type 2 – Mass EMs) and one type exclusively consists of EMs that screen participants and may or may not charge fees (Type 3 EMs – Targeted EMs). The results of this chapter point to Targeted EMs as being more successful than Mass EMs (Type 3). Critical Mass Theory suggests that any kind of barrier is detrimental to creating a critical mass because a barrier is supposed to limit traffic. Actually, both kinds of barriers appear to increase traffic/ performance. Being open is detrimental to traffic while periodic fees tend to be associated with success or higher traffic (please see models without outliers in Table G1 of Appendix G). This phenomenon shows that transportation EMs manage to create volume in spite of these barriers and that the focus is now more on letting the right participants in. Although there were reasons to think that Type 3 EMs perform better than Type 2 EMs based on the Critical Mass Theory, the results contradict the logic of this theory. Contrary to Critical Mass Theory, barriers to entry have a positive impact on performance in current transportation procurement EMs. Therefore Type 3 EMs that screen participants and generally charge for their services, and thus most of the time use both types of barriers, are the most successful.

The influence of the fee barrier was also assumed to favor Type 3a EMs (that are free) compared to Type 3b EMs (paying EMs). However, the corresponding hypothesis is rejected (H3). Since the fee barrier is actually favorable to performance, Type 3b should be more performant than Type 3a. However, no significant difference was found most likely due to the small sample size for the types to be compared (6 Type 3a *vs.* 17 Type 3b).

Finally, the research in chapter 5 brings support to previous EM literature (Matook 2013) with regard to a positive link between better services and greater traffic. The notion of better customer service in this research can be associated with customer support in different phases of transaction and with decision support. EMs that offer support in the information phase as well as the after sales and settlement phases are associated with better performance. EMs that offer decision support rank better than those that do not (Table G1 of Appendix G). In the end, Type 2b EMs, which offer to support more transaction phases and offer decision support more frequently than Type 2a EMs, tend to perform better. This brings support to **Hypothesis 4**.

Contributions and implications

The studies presented in this chapter make the following contribution to the literature. First, this chapter brings support and nuances to the Critical Mass Theory (Markus 1987) and to existing EM literature. Specifically, it shows that EMs need to attract participants on both ends of the EM in order to create traffic. However, it might not be in a carrier's interest to create its own competition by attracting many participants on both sides of its market. In this chapter carrier-owned EMs (Type 1) are shown to be negatively related to traffic. Consequently it is arguably in the interest of a third party to create traffic on both sides of an EMs. In this chapter, contrary to what is found in other industries (Gosain and Palmer 2004), EMs owned by third parties (*i.e.,* software providers, *etc.*) are indeed associated with higher traffic. In the transportation services industry, the types of EMs that attract traffic the most are actually mostly owned by neutral third parties (Type 2 and Type 3). Consequently, studies set in a context of a third-party-owned EM should not assume a negative influence of the third party in terms of participation or adoption of the EM by potential participants.

Additionally, in contrast with the literature, gathering traffic can be done and is actually encouraged when imposing some barriers to entry. The Critical Mass Theory (Markus 1987) would lead to the conclusion that EMs that screen participants and increase barriers to entry would have lower traffic. In the same gist, Clasen and Mueller (2006) showed that charging fees is negatively related to traffic. However, chapter 5 shows that barriers to entry such as fees and screening processes are actually associated with higher traffic in transportation EMs. This is crucial knowledge for academics who study the effect of competition on EM mechanisms. While the barriers to entry do not impact the volume of competition, it is possible that transportation EMs with higher screening and sorting standards are creating an environment where competition is more ethical (e.g., illegal carriers are screened out when credentials are requested.) Further research would be required to support the idea that barriers to entry can enhance competition by assuring participants that competition will be ethical.

Second, the new typology, with 3 or 5 types, contributes to the academic literature by providing a framework to understand the strategies adopted by EMs in the truck transportation industry and their impact on performance. The five-type typology gives a fine grain view at strategies and explains almost as much variance as the more complex model with categories. This chapter is the first attempt at linking all EM categories found in the literature to measures of performance. Out of 22 categories included in the original model of study 1, 10 are found to impact traffic. This study supports the understanding of the characteristics of an EM that can impact performance. The five-type typology advances knowledge by showing how some EMs are structured around combinations of characteristics/ categories that are associated with higher traffic. These types, so far ignored in the academic literature, are essential to guide future research towards mechanisms that are indeed in use within the truck transportation industry and also to ensure that researchers know what these types entail in terms of user participation.

Third, this research sheds light on ways to use performance metrics when studying general EMs or transportation EMs. For EMs of any industry, this study shows a certain reliability of measures found on web-analytics sites (Alexa.com and Hypestat.com). Based on the results of the model studied, the rank measure by Alexa.com indeed tends to follow the same trends as the number of visitors and number of page views provided by Hypestat.com. However, it is necessary to integrate the country of origin control variable in the models using the measures of performance used in this chapter as dependent variables. Being a US EM is associated with more visitors and more page views in all models. The rank variable is corrected for the country of origin and it is true that in most of the models studied, the coefficient associated with the country of origin variable is either statistically non-significant or weakly significant with the smallest magnitude across significant coefficients.

The second control variable, "publicly traded", is also of interest for academics studying transportation EMs. Publicly traded companies as shown in the results of all models run in this chapter offer more successful EMs in this industry. Researchers need to be aware of that result since they sometimes are tempted to limit their studies to publicly traded EMs, which are required by law to report more performance information for stakeholders to see. Limiting research to publicly traded EMs gives a very biased view of transportation EMs. Publicly traded companies mainly offer Type 1 EMs (Table 38) that are supposed to attract lower traffic. Consequently studying publicly traded transportation EMs gives a view of a very small sample of EMs that are successful in spite of a strategy that is not favored by participants.

With regard to performance measurement, a limitation of this research is that performance is only measured through traffic. As expressed by Segev *et al.* (1999), hierarchical EMs (*i.e.,* Type 1) are designed as an extension of a company's management. Type 1 EMs do not target high traffic because they only aim at fulfilling the engagement the parent company took offline. Therefore, although the results confirm that Type 1 EMs do not attract high traffic, it cannot be concluded that Type 1 EMs are not successful. Further research measuring the degree of fulfilment of posted offers are needed to really know if Type 1 EMs are successful.

Fourth, for practitioners, the new typology can serve as a tool to help selecting an EM. A potential participant can look at EMs based on one particular characteristic/ category and know what other characteristics are likely to be involved and whether they lead to high traffic or not. For example a potential user who looks at EMs that try to reach to massive audiences (Type 2 EMs), is confronted with choosing between auction mechanisms and post and search mechanisms. Although many actors of the transportation industry are dubitative regarding auction mechanisms, it might help the decision process to know that if they choose to avoid auctions (and go with post and search) they are more likely to choose an EM with lower participation.

CHAPTER 6

Conclusions

Despite growing popularity of EMs in truck transportation services procurement industry, research in this context has been scant. A current view in existing literature on transportation is that EMs are not appropriate tools for procurement. In particular, according to accepted supply chain paradigms a buyer would be better off partnering with a few suppliers in the long-term rather than going on the market every day to find *ad hoc* offers (Figliozzi 2004). However, existing evidence indicates that nearly half of the truck freight transportation in the U.S. is procured through EMs. Thus, this dissertation aimed to fill the existing research gap and advance our understanding of the nature of EMs in truck transportation services procurement industry. In particular, this dissertation's key research question was as follows:

What are the keys to the performance of transportation EMs?

First, it was decided to investigate whether findings from existing research on EMs in non-transportation contexts could be generalized to the truck transportation EMs. To do so, a survey tool developed by Son and colleagues (2006) was used to compare characteristics of transportation EMs to non-transportation EMs. This survey tool focuses on trust generation mechanisms, which are known to be essential to EM performance. The results of the comparative study presented in chapter 2 show a clear difference in the way transportation EMs approach trust generation versus non-transportation EMs. Specifically, transportation EMs tend to focus more frequently than non-transportation EMs on highly visible and actionable features that create a sense of safety (*i.e.,* structural assurances). These features are highly visible because they are located on what this dissertation suggests to call an EMs' "operational path", *i.e.,* a sequence of operations (clicks or links) that users need to perform if they want to conduct transactions on the platform. Transportation EMs, first, frequently vet their participants and/ or allow participants to isolate themselves in private places within EMs. Once in an EM, the EM provider offers to monitor participants (credit score, safety score, payment facilitation options, *etc.*) thanks to links (generally under the form of icons) conveniently situated where EM users have to look when operating the EM. Finally, icons of trusted trucking associations are omnipresent as they are found on first pages and banners along the "operational path".

Although chapter 2 established pertinence of this dissertation's research subject by showing differences between transportation EMs and non-transportation EMs, it did so only in terms of trust generation features. Since no tool was available to holistically analyze the content of transportation EMs, chapter 3 was dedicated to building a survey tool that seizes all features that could potentially contribute to performance. These features were identified relative to five main research topics in the academic literature on EMs: trust and uncertainty/risk, services offered, website quality, strategic factors and behavioral factors. As a result of a thorough literature review, 141 features were identified and data showing their usage was collected for 208 transportation EMs. This database provides usage proportions for each feature in the surveyed transportation EM population. Most essentially, it was a necessary component for subsequent chapters of this dissertation.

Chapter 4 used the data described in chapter 3 to categorize the EMs along 11 categorization schemes. These categorization schemes represent all known analysis angles used in the general EM literature. By adopting these schemes and testing for dependences between schemes, chapter 4 makes two major contributions to the EM and truck transportation literature. First, a new typology for truck transportation services procurement EMs is developed, which paves the way for future studies in need of identifying the EM environment in which transportation services are procured.

Second, a comparison of associations between categories in the truck transportation EM industry as compared to general EMs is provided. Key insights related to the above contributions are provided below.

A five-type typology emerges from this chapter (with three generic types, two with two sub-types). Type 1 EMs – Hierarchical EMs, are one-to-many EMs owned by carriers and offering relatively few services for free. This type reflects 3 specific characteristics of transportation EMs that challenge current EM knowledge. (1) Seller/ carrier-owned EMs are seller-oriented. Carriers try to attract other carriers solely to fulfill the requirements of surplus jobs. (2) Carriers presenting themselves as elaborate logistics providers (3PLs) do not offer to manage long-term/ systematic sourcing through their EMs. (3) EMs dedicated to spot needs overwhelmingly use the post-and-search matching mechanism.

Type 2 EMs – Mass EMs, are subdivided into two new types: Basic Mass EMs (low complexity of services offered and post-and-search mechanisms), and Complex Mass EMs (complex services offered and auction mechanisms). This type and its sub-types show that third-party-owned EMs are generally not free and unexpectedly still can offer low levels of service. Contrary to what was expected based on the general EM literature, it also shows that the favored auction mechanisms are not open auctions but rather sealed-bid auctions. Type 2 EMs are also the type of EMs that innovatively try to target the final customer (*i.e.,* some are B2C).

Finally Type 3 EMs – Targeted EMs (for free Type 3a, or not Type 3b), show that although some auctions are offered with a superficial vetting process (Type 2b), most auctions are offered with additional vetting procedures (Type 3). Type 3 EMs identified in this dissertation also challenge the generally accepted postulate that third-party-owned EMs need to be open to the mass in order to convey a sustainable strategy. They are closed to the general public by imposing the strongest vetting requirements of all types but try to attract users by offering more complex services as well as more decision support tools.

Overall, insights revealed and condensed in this new typology are crucial for both academics and practitioners as they provide a framework for further studies concerned with the selection process or the design of truck transportation EMs. In particular, the new typology identifies "key" strategies being employed by transportation EMs.

Having completed the above mentioned steps – establishing pertinence of the research subject, collecting and describing empirical data, and establishing new typology and association analysis – the final step of this dissertation is a study of the link between key strategies employed by transportation EMs and performance (chapter 5).

Performance was measured using three metrics: website rank, number of unique visitors per day, and number of page views per day. A set of three studies was designed to test the differences in performance hypothesized based on the Critical Mass Theory (Markus 1987). Chapter 5 shows that Type 2b and Type 3 EMs attract more traffic than Type 1 and Type 2a EMs. This difference in performance comes essentially from the bundle of complex services and auction mechanisms offered by third-party-owned EMs. Auction mechanisms being a source of attractiveness is surprising since transportation grey and academic literature tend to point at the rejection of auction mechanisms by the transportation industry. Also, contrary to what was expected, barriers to entry (either fees or vetting process) appear to have a positive impact on traffic; meaning that, for transportation EMs' users, protected environments are more attractive than open ones. In the end, chapter 5 provides an answer to what transportation EM strategies are the most successful in terms of traffic.

Following the summary of the general logic and key insights of this dissertation is a discussion of research contributions, limitations and potential for future research. First, this dissertation shows that industry context matters when considering how EMs work. Although some studies have acknowledged the role of industry in explaining the success of EMs (Rosenzweig *et al.* 2011), other works tend to generalize the dynamics of EMs without considering the industries they belong to as a factor (Movahedi *et al.* 2012).

Within the specific context of truck transportation services procurement, this dissertation supports some of the components of the Critical Mass Theory while rejecting others. As theorized by Markus (1987), the interactive media (*i.e.,* EMs in this case) that try to attract participants on both sides of the media (in this case buyers and sellers) are more successful than those biased towards one side. However, as a contradiction to the Critical Mass Theory, it is suggested that the creation of barriers to entry do not impede the attractiveness of transportation EMs. The success of Type 3 EMs (Targeted EMs), which reduce their audience by vetting participants more strictly even advocates for creating barriers as a way to attract participants. A protected environment appears to appeal to potential EM participants, which explains why transportation EMs use vetting processes more frequently than non-transportation EMs. The findings of this dissertation regarding the success of transportation EMs that screen participants also supports the most recent conceptualization regarding the role of information technologies that can be used in place of traditional procurement intermediaries.

In the late 80s, Malone *et al.* (1987) presented the electronic market hypothesis suggesting that in the presence of somewhat cheap electronic market technologies, buyers would move away from traditional procurement with intermediaries and few suppliers. Later, Clemons *et al.* (1993) nuanced that hypothesis and supported the idea that buyers would indeed move to electronic tools but would, nevertheless, still favor dealing with a reduced number of suppliers rather than going onto pure markets with unleashed competition. This conceptual role of EMs was termed the "move to the middle" hypothesis (Clemons *et al.* 1993). This dissertation's findings provide an empirical test of the electronic market and move to the middle hypotheses. The results generally support that the move to the middle is indeed the favored frame in the transportation services procurement context. EMs like Sylectus appeal to their potential members by acknowledging that their primary role is not to become the sole source of business for their users but rather by providing quality opportunities between a trusted community of participants.

Trust is an omnipresent concept in this dissertation and as such this dissertation also contributes to the trust literature by showing which trust features are used in the specific context of transportation procurement EMs. Transportation EMs, use trust generating features that are highly visible and actionable because they are placed where users have to go to transact on the EMs – the "operational path". The purpose of highly visible features is to generate trust immediately to attract and hopefully retain participants. A nascent stream of literature in need of further research is dedicated to the study of the immediate development of trust termed "swift trust". This dissertation shows that transportation EMs appear to be a relevant population to study swift trust and provides key elements to do so. This dissertation shows that transportation EMs are using trust features that can be involved in the generation of swift trust. However, this dissertation does not show if these trust features are used differently by different types of EMs. Thanks to later results in the dissertation, the research community now possesses a typology that can be used to study differences in trust generation strategies between types of EMs. In general, the new typology provides ground for many studies in both the Information Systems and Operations Management fields.

The new typology provides us with a big picture of the current artifacts being offered by transportation services procurement EMs. Some of the features inventoried in order to develop that typology are supposed to shape users' behaviors. Although, this dissertation shows that different types of artifacts impact traffic, it does not study how behaviors are being shaped because users' behaviors were not captured in this research. For future research, the new typology can help study whether some EM types are more prone to prevent unethical behaviors that are hindering EMs' adoption (Carter *et al.* 2004).

Finally, this research studied each EM independently. Anecdotal evidence as well as previous academic research point to the fact that EM participants actually use portfolios of EMs in order to reach their goals. It would be interesting to see if practitioners include several of the different types of EMs identified in this dissertation in their portfolios, and how they choose one type rather than the other.

These research avenues are certainly of utmost importance for the future of truck transportation industry. With nearly half of the truck freight being dealt through EMs, the complete understanding of transportation services procurement EMs is essential but so far relatively ignored. Therefore, this dissertation can serve as a corner stone for future research.

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APPENDIX A: Features found in the general EM literature that impact EM adoption, use and success

Guiding topic	**Features**	**Reference**	**Expected impact on**	**Features/ Variables collected**
Behavioral	LT or ST relationship	Hill et al. 2009	Trust	Based on live loads or forecast?
Behavioral	Number of competitors	Carter and Stevens 2007	Behaviors	no
Behavioral	Private events (limited to qualified suppliers)	Emiliani 2005	Behaviors	Upon Invitation marketplace option
Behavioral	Rank visibility *vs.* price visibility	Carter and Stevens 2007	Behaviors	no
Behavioral/ Quality/ Services/ Trust-uncertainty	Customer support	Koch 2003, Otim and Grover 2006	Use	customer support
Behavioral/ Quality/ Trust-uncertainty	Fulfillment capability, Operational information disclosure	Hackney et al. 2007, Losch and Lambert 2007, Qureshi et al. 2009, Yen and Lu 2008 , Zhang et al. 2011	Satisfaction, trust, uncertainty	Possess own fleet?
Behavioral/ Quality/ Trust-uncertainty	Management team disclosure/ education	Kim and Ahn 2007, Losch and Lambert 2007, Son et al. 2006	Satisfaction, trust	Disclosing Management Team Profile
Behavioral/ Quality/ Trust-uncertainty	Usability (navigation, organization), website quality (navigation, organization, working links, etc.)	Everard and Galetta 2006, Gregg and Walczac 2008, Kim and Ahn 2007, Kim and Benbasat 2006, Kincl and Strach 2012, Qureshi et al. 2009, Yen and Lu 2008 , Zhang et al. 2011	Satisfaction, trust, Use	Bad Layout/ organization Bad navigation Incompleteness Errors
Behavioral/ Services/ Strategic/ Trust-uncertainty	fee structure, entrance fee	Dellarocas 2005, Koch 2003, Stockdale and Standing 2002	Uncertainty, use	Fee
Behavioral/ Services/ Strategic/ Trust-uncertainty	Market information disclosure/ market acuity	Losch and Lambert 2007, Rosenzweig and Roth 2007	Satisfaction, trust	analytics

Behavioral/ Services/ Strategic/ Trust-uncertainty	marketplace process/ mechanism design (e.g. price visibility, buy-it-now, reserved price, starting price)	Dimoka and Pavlou 2008, Elmaghraby 2007, Goes et al. 2010, Goes et al. 2012, Jap 2003, O'Reilly and Finnegan 2010, Rosenzweig et al. 2011, Stockdale and Standing 2002	Behaviors, success, trust, uncertainty, use	Market mechanism - Catalog/ Buy-it-now/ Desired-reserve price/ Post and Search/ Post only, no pricing, no nego/ Auction (open)/ RFQ (sealed auction)/ exchange/ get a quote/ provide a quote
Behavioral/ Strategic/ Trust-uncertainty	Number of customers disclosure/ critical mass	Losch and Lambert 2007, Quaddus and Hofmeyer 2007, Stockdale and Standing 2002	Satisfaction, trust, use	Registered Shipping Customers/ brokers Number of users Registered Transporters
Behavioral/ Trust-uncertainty	Affiliation with respected organizations, Referral	Kim 2008, Kim and Benbasat 2006, Losch and Lambert 2007, Son et al. 2006	Satisfaction, trust	Affiliation with Respected Organizations - association & partnership
Behavioral/ Trust-uncertainty	Business profitability/ volume of business	Koch 2003	Use	Total business transactions in $
Behavioral/ Trust-uncertainty	Code of conduct/ethics, ethics statement	Carter et al. 2004, Charki and Josserand 2008, Emiliani 2005, Son et al. 2006	Behaviors, trust	Codes of Conduct, Safe Shipping Guide/ help to fight or identify fraud
Behavioral/ Trust-uncertainty	Cost information disclosure	Losch and Lambert 2007	Satisfaction, trust	No
Behavioral/ Trust-uncertainty	Expected transaction patterns	Son et al. 2006, Tangpong et al. 2010	Behaviors, trust	Expected Transaction Patterns, Videos/ screenshots

Behavioral/ Trust-uncertainty	Feedback comments/ ratings /mechanism/ reputation system/ review system	Ba and Pavlou 2002, Carter et al. 2004, Chang et al. 2013, Dellarocas 2005, Dewan and Hsu 2004, Dimoka and Pavlou 2008, Dimoka et al. 2012, Ghose 2009, Kim and Ahn 2007, Kim and Benbasat 2006, Losch and Lambert 2007, Mavlanova et al. 2012, McKnight and Chervany 2001, Ou et al. 2014, Pavlou 2002, Pavlou and Dimoka 2006 , Pavlou and Gefen 2004, 2005, Son et al. 2006, Wu and Gaytan 2013	Behaviors, satisfaction, trust, uncertainty, use	Reputation Systems - peer ratings
Behavioral/ Trust-uncertainty	Financial information disclosure	Losch and Lambert 2007	Satisfaction, trust	No
Behavioral/ Trust-uncertainty	Labor union information	Losch and Lambert 2007	Satisfaction, trust	No
Behavioral/ Trust-uncertainty	Major customers disclosure	Losch and Lambert 2007, Son et al. 2006	Satisfaction, trust	Disclosing Well-Known Participants
Behavioral/ Trust-uncertainty	Number of employees disclosure	Losch and Lambert 2007	Satisfaction, trust	Number of Employees
Behavioral/ Trust-uncertainty	Payment info	Losch and Lambert 2007	Satisfaction, trust	Payment speed (in days)
Behavioral/ Trust-uncertainty	Product characteristics	Carter et al. 2004, Hackney et al. 2007, Son and Benbasat 2007	Behaviors, uncertainty, use	no
Behavioral/ Trust-uncertainty	Product review and rating, monitoring of products/services traded,	Carter et al. 2004, Pavlou 2002, Son et al. 2006	Behaviors, trust	Product Review and Rating FMCSA and SAFER scores
Behavioral/ Trust-uncertainty	public filings/ claims	Hackney et al. 2007, Losch and Lambert 2007	Satisfaction, trust, uncertainty	no

Behavioral/ Trust-uncertainty	Quality standards, product quality claim	Losch and Lambert 2007, Mavlanova et al. 2012, Son et al. 2006	Satisfaction, trust, uncertainty	Quality of merchandise claim
Behavioral/ Trust-uncertainty	Training	Carter et al. 2004, Koch 2003	Behaviors, trust, use	Training/ webinars
Behavioral/ Trust-uncertainty	Visual product description/ visual complexity	Dimoka and Pavlou 2008, Dimoka et al. 2012, Hong and Pavlou 2014, Jiang and Benbasat 2007, Yeh and Li 2014	Trust, uncertainty, use	photo display of merchandise
Quality/ Services	Product search and evaluation support	Otim and Grover 2006	Use	Search/ directory
Quality/ Services	Transparency of billing	Otim and Grover 2006	Use	no
Quality/ Services	Website aesthetic	Kincl and Strach 2012, Otim and Grover 2006	Use	Poor style - visual appeal Poor style - colors
Quality/ Services/ Strategic/ Trust-uncertainty	Interaction between users, use of message box, , responsiveness, fluid partnering	Kim and Benbasat 2006, Ou et al. 2014, Otim and Grover 2006, Rosenzweig and Roth 2007 , Yen and Lu 2008	Satisfaction, trust, use	interaction between carrier and shipper (posting party) before deal
Quality/ Services/ Strategic/ Trust-uncertainty	Order status (tracking info)	Mavlanova et al. 2012, Otim and Grover 2006	Uncertainty, use	Status Updates
Quality/ Services/ Trust-uncertainty	Delivery date claim/ on-time delivery	Mavlanova et al. 2012, Otim and Grover 2006	Uncertainty, use	delivery date claim
Quality/ Strategic/ Trust-uncertainty	Coherence of the EM, selling unsold capacity	Balocco et al. 2010, Yeh and Li 2014	Success, trust	Entry logic - Shippers, brokers, carriers, load post/ get quotes, load search, truck post, truck search, Single Sign-up entry
Quality/ Trust-uncertainty	Contact availability, Interaction between users and EM	Kim and Benbasat 2006, Mavlanova et al. 2012, McKnight and Chervany 2001, Yen and Lu 2008	Satisfaction, trust, uncertainty	Interactivity - contact info of website (e-mail form, e-mail address, phone)
Quality/ Trust-uncertainty	Legibility	Yeh and Li 2014	Trust	No

Quality/ Trust-uncertainty	Product diagnosticity, Clearly states specifications	Dimoka and Pavlou 2008, Dimoka et al. 2012, Jiang and Benbasat 2007 , Pavlou et al. 2007, Smeltzer and Carr 2003	Uncertainty, Use	no
Quality/ Trust-uncertainty	Reputation profile (summary of text comments)	Dellarocas 2005, Qureshi et al. 2009, Zhang et al. 2011	Trust, uncertainty	Reputation Systems - evaluate performance
Quality/ Trust-uncertainty	Safe payment mechanism, security protection mechanisms (e.g. secure socket layer encryption)	Kim 2008, Kim and Ahn 2007 Mavlanova et al. 2012, Yen and Lu 2008	Satisfaction, trust, uncertainty	secure payment
Quality/ Trust-uncertainty	Seller expertise - product desired	Kim and Ahn 2007	Trust	Specialized activity - Local, long-distance, general freight, types of equipment, truckload, less than truckload/ partial, small package delivery, courier, about us
Quality/ Trust-uncertainty	social presence	Pavlou et al. 2007	Uncertainty	Interactivity - desktop sharing
Quality/ Trust-uncertainty	Social presence/ live chat	Mavlanova et al. 2012, Ou et al. 2014, Pavlou et al. 2007	Trust, uncertainty	Interactivity - live chat with website people
Quality/ Trust-uncertainty	Social presence/ socialization capacity, online forum	Charki and Josserand 2008, Hong and Pavlou 2014, Pavlou et al. 2007	Uncertainty	no
Quality/ Trust-uncertainty	website informativeness	Pavlou et al. 2007	Uncertainty	FAQ, Help
Services/ Strategic	Information technology	O'Reilly and Finnegan 2010, Stockdale and Standing 2002	Success, use	Integration with other Transportation EMPs (powered by, etc.), Mobile app/ mobile compatible, Integration with TMSs

Services/ Strategic	Ownership/ independence	O'Reilly and Finnegan 2010, Rosenzweig et al. 2011, Stockdale and Standing 2002, Zhao et al. 2009	Success, trust, use	Primary activity Public or Private Possess own fleet? Are the loads exclusively posted by the EM owner?
Services/ Strategic	Revenue mechanism	Johnson 2013, O'Reilly and Finnegan 2010, Stockdale and Standing 2002	Success	See fees + commercial banners
Services/ Strategic/ Trust-uncertainty	Privacy and security policy	Kim and Benbasat 2006, Mabert and Skeels 2002, Mavlanova et al. 2012, McKnight and Chervany 2001 , Son et al. 2006, Stockdale and Standing 2002	Trust, uncertainty, use	Privacy Policy
Services/ Trust-uncertainty	Status updates (coordinated logistics)/ order tracking/ location of participants	Hackney et al. 2007, Mavlanova et al. 2012, Otim and Grover 2006 , Rosenzweig and Roth 2007	Trust, uncertainty, use	Tracking/ locator
Strategic	Neutrality	Balocco et al. 2010	Success	emphasize neutrality
Strategic/ Trust-uncertainty	Brand reputation	Johnson 2013, Kim and Benbasat 2006	Trust	photo display of users
Strategic/ Trust-uncertainty	Dispute resolution mechanism (cooperative norms)	Pavlou 2002, Rosenzweig and Roth 2007, Son et al. 2006	Trust	Cooperations Norms - dispute resolution Cooperations Norms - dispute resolution AAA Cooperations Norms - dispute resolution NAF
Strategic/ Trust-uncertainty	Domain specific content, links to other reputable sites	Johnson 2013, Kim and Benbasat 2006, Mavlanova et al. 2012, McKnight and Chervany 2001	Success, trust, uncertainty	Transportation additional specialized content/ resources
Trust-uncertainty	actual delivery date	Mavlanova et al. 2012	Uncertainty	automated confirmation of delivery
Trust-uncertainty	actual product quality	Mavlanova et al. 2012	Uncertainty	no

Trust-uncertainty	Alternative electronic payment mechanisms	Mavlanova et al. 2012	Uncertainty	Payment facilitation (quick pay or factoring)
Trust-uncertainty	Awards earned by the EM	Son et al. 2006	Trust	Displaying Awards Earned
Trust-uncertainty	credit card guaranties	Pavlou and Gefen 2004, 2005	Trust	No
Trust-uncertainty	Credit card logos	Mavlanova et al. 2012	Uncertainty	No
Trust-uncertainty	e-mail confirmation after purchase	Mavlanova et al. 2012	Uncertainty	No
Trust-uncertainty	Escrow services	Pavlou and Gefen 2004, 2005, Son et al. 2006	Trust	Escrow
Trust-uncertainty	Excerpts from the media	Son et al. 2006	Trust	Excerpts from News Media Outlets
Trust-uncertainty	financial situation of participants	Hackney et al. 2007	Uncertainty	Credit reports
Trust-uncertainty	Identity of the seller (individual or dealer)	Dimoka and Pavlou 2008, Dimoka et al. 2012	Uncertainty	does the load board emphasize the difference between direct shippers and others?/ Population targeted - commercial shippers, non-commercial shippers, brokers, carriers, private carriers, Owner operators
Trust-uncertainty	In stock availability claim	Mavlanova et al. 2012	Uncertainty	no
Trust-uncertainty	Insurance	Son et al. 2006	Trust	Insurance
Trust-uncertainty	Legal framing of the transaction	Pavlou 2002	Trust	Terms and Conditions
Trust-uncertainty	longevity of EM	Son et al. 2006	Trust	Disclosing E-marketplace Longevity, Online Marketplace Launched (date of incorporation and/or foundation)

Trust-uncertainty	Member screening (accreditations, credit checks, sponsored membership), Qualifying suppliers	Baker and Song 2007, Elmaghraby 2007, Pavlou 2002, Sashi and O'Leary 2002, Son et al. 2006	Success, trust, use	Emphasis on screening, Screening real?, Technique for screening, accessed actual tool?
Trust-uncertainty	Multimedia product description, Virtual experience	Dimoka and Pavlou 2008, Dimoka et al. 2012, Jiang and Benbasat 2007	Uncertainty, use	No
Trust-uncertainty	policy regarding missing feedback	Dellarocas 2005	Uncertainty	no
Trust-uncertainty	Product inspection	Dimoka and Pavlou 2008, Dimoka et al. 2012, Son et al. 2006	Trust, uncertainty	Product Inspection
Trust-uncertainty	Product price/ product appraisal	Son et al. 2006, Wu and Gaytan 2013	Trust, use	Rate estimation
Trust-uncertainty	Regulatory compliance	Mavlanova et al. 2012	Uncertainty	Member Screening (MC#, VAT#, etc.)
Trust-uncertainty	Reliability of system	Kim 2008	Trust	no
Trust-uncertainty	Reputation of the EM (testimonials/ popularity/ referrals)	Kim 2008, Kim and Ahn 2007, Kim and Benbasat 2006, Son et al. 2006, Wang and Chiang 2009	Trust, use	Testimonials from Current Participants
Trust-uncertainty	Rewards/ compensation program - cash back, Coupon for next purchase, Coupon redemption, return policy	Mavlanova et al. 2012	Uncertainty	No
Trust-uncertainty	shipping method	Mavlanova et al. 2012	Uncertainty	no
Trust-uncertainty	Size of the EM	Son et al. 2006	Trust	Disclosing E-Marketplace Size/ activity level in number of loads
Trust-uncertainty	Textual product description	Dimoka and Pavlou 2008, Dimoka et al. 2012	Uncertainty	no

Trust-uncertainty	third party Assurance, seals of approval	Chang et al. 2013, Kim 2008, Kim and Benbasat 2006, Mavlanova et al. 2012, McKnight and Chervany 2001 , Son et al. 2006	Trust, uncertainty	Third-party Assurance Seals
Trust-uncertainty	Third party product history report	Dimoka and Pavlou 2008, Dimoka et al. 2012	Uncertainty	no
Trust-uncertainty	Third party product inspection	Dimoka and Pavlou 2008, Dimoka et al. 2012, Son et al. 2006	Trust, uncertainty	no
Trust-uncertainty	Third party product warranty	Hackney et al. 2007, Dimoka and Pavlou 2008, Dimoka et al. 2012	Trust, uncertainty	no
Trust-uncertainty	Video description	Jiang and Benbasat 2007	Use	no
Trust-uncertainty	Warranties and Guarantees	McKnight and Chervany 2001, Son et al. 2006	Trust	Product Warranties and Guarantees
Additional				Headquarters
Additional				Number of Countries Served
Additional				Culture statement/ vision/ mission
Additional				operating documents/ paperwork tools
Additional				Instant/ automated matching
Additional				planner/ fleet management
Additional				complementary load tools/ backhaul …
Additional				POD imaging
Additional				posting documents capacity
Additional				routing
Additional				Weather and road conditions
Additional				mileage calculation

APPENDIX B: Coding guide for transportation EMs

GENERAL CODING METHODOLOGY OF EM FEATURES

When the listings from which the websites were taken provided the url, the websites were accessed via that url. If the url were not provided, then the websites were searched for via Google, based on the listed name. Google searches sometimes returned several hits that were investigated, which explains that the final list of websites expanded beyond the original listing found.

If a website name was not found via Google, I coded "not found" in the "about us" field. If the website name/ url was found but not exploited, I coded "not exploited domain" in the "about us" field.

Once a website was accessed:

- I looked at the homepage to understand the type of website offered and the company that was offering it.
- If the homepage did not confirm the presence of an EM, I look for the existence of an EM on the website under investigation. If no EM was found, I coded "no online purchasing tool" in the "about us" field.
- A better understanding of the company and the offer was reached via accessing the "about us", "company", *etc.* menus of the websites. The vocabulary used to describe the EM was partially found during that process and helped fill the "name used" field.
- Finally, each link was clicked on in order to exhaustively browse the website and quickly determine the outstanding features of the investigated website (FAQs were read thoroughly,

terms and conditions and privacy policies were browsed to identify the themes of the policies and the vocabulary used, *etc.*)

- Once I had a good grasp of the website, I turned to coding, browsing the website in order to answer the questions one by one.

An EM sometimes constitutes a company on its own with its own business model. Au contraire, an EM is sometimes part of the offer of a company. Therefore, it happened that some pieces of information were available on different parent websites. Several websites were considered for one e-marketplace if the link was obvious and available to all (e.g., CH Robinson site and CHRWTrucks).

Some of the coding consists in finding pieces of information on the website(s) (e.g., year the company was founded). Some consists in answering yes or no to a question based on the website(s) content (e.g., whether the EM handles Truckload offers). Sometimes the EM provider offers a complementary software to go with the EM for some features. It is then coded as "add-on."

If the EM tool is not accessible directly, then coding is realized based on other resources available such as videos, terms and conditions, privacy policies, *etc.*; anything available describing the usage of the tool. If nothing is directly available to describe the tool, then I tried to register as a fake user to access the tool. If nothing worked, then the coding shows "ND" for items that cannot be determined.

NOTES:

Brokers' or carriers' quoting tool was not considered as a marketplace. (e.g., ANPAK logistics)

COMPANY STATISTICS

1. List description

The list of marketplaces has been elaborated out of several lists found on the Internet or in academic papers. When the lists provided a description of the marketplaces, it was pasted in that cell.

2. URL

Link to the marketplace or website of the company offering the marketplace

3. About Us / Company

Description of the company providing the marketplace found under the "about us" link. If that link was not available, I looked for a "company" link. If nothing looked like the "about us" type of information, information provided on the homepage was pasted (if relevant).

This cell is also where I wrote if the transportation website listed did not provide an EM ("no purchasing online tool"), was not a transportation services website ("not for transportation services"), was not found on Google ("not found"), was not available and returned an error message ("not available), or was found but not used or put for sale by the owner of the domain name ("not exploited domain").

4. EM launch date

This is the year the marketplace was put in service and available to the public (often the following year of incorporation). This information is often found in the “about us”, “company” or “history” links of the websites.

5. Company’s foundation or incorporation date

This is the year the company was created/ incorporated. This information is often found in the “about us”, “company” or “history” links of the websites.

If the date was found on Facebook, it was filled as a negative date (e.g., -2007)

6. Public or private

Most EMs are privately held. I therefore went with filling “private” by default. If the website mentions that it is a publicly owned company (*i.e.,* quoted on a stock market), I coded “public”. This information is often found in the “about us”, “company” or “history” links of the websites. The sometimes also sometimes offer a specific stakeholders’ resources link were the information can be found (e.g., “investors” or “corporate”).

7. Headquarters

Headquarters' location. This information is often found in the "about us", "company" or "contact us" links of the websites.

8. Number of employees

The number of employees of the company is entered here. This information is often found in the "about us", "company" or "history" (or "time line") links of the websites.

9. Number of countries served

It is the number of countries covered by the EM. This information is sometimes straightforwardly displayed found in the "about us" or "company" links of the websites. If the information is not bluntly displayed and the EM is accessible, it can be found through the load or truck search tools (sometimes a map). If the information and the EM are not accessible, the number of languages offered can give an idea of a lower estimation of countries served, especially for European websites.) Finally, if none of this is available and the information is given for the company and the EM seems to be offered in the countries served by the company, then the number of countries served by the company is entered here.

10. Registered transporters

Number of carriers who are members of the marketplace investigated. This information is rarely displayed. If it is, it is likely to be on the homepage or next to the links leading to registration forms.

For an EM owned by a carrier or a logistics company, all registered carriers of the company can access the EM. In that case all registered carriers of the company are considered as members of the EM.

11. Registered shipping customers

Number of shippers who are members of the marketplace investigated. This information is rarely displayed. If it is, it is likely to be on the homepage or next to the links leading to registration forms.

Contrary to the number of carriers, the shippers served by a logistics company do not necessarily end up having loads on the EM of the logistics company. Therefore, the number of shippers served by a logistics company cannot be used to fill this cell.

12. Number of users

Sometimes the website provides a number of users without distinguishing between shipper, carriers and brokers. If this information is displayed, it is likely to be on the homepage or next to the links leading to registration forms. The information can also be available as a milestone on a timeline. If the “registered transporters” and “registered shipping customers” are filled, then I used the sum of those numbers to fill this cell.

13. Activity levels

a. Number of transactions or loads, *etc.* per period (month or year). This are volumes of activity, not amounts in dollars. This information is likely to be on the homepage or next to the links leading to registration forms. It can also be displayed on a time line, as a milestone.

b. Number of loads for the coming week. For EMs where the loads being offered can be accessed, a search on all loads available has been performed for the week to come. (to be coded at the end of the coding exercise).

14. Total business transaction

Dollar amount of business conveyed thanks to the website (not by the company as a whole if the company goes beyond the websites activity, e.g., 3PL). This information is rarely displayed. If it is, it is likely to be on the homepage.

15. Visibility on Google - "load board"

Rank of the website in the search results when “load board” is searched on Google. (Commercial links are counted in the ranks. If a company/ website appears more than once, the lowest rank is showed. Only the first 3 pages of results were analyzed. If the company/ website did not belong to the search results, a rank of 50 was assigned (50 was exceeding any rank found before choosing that ceiling value).

16. Visibility on Google - "freight exchange"

Rank of the website in the search results when “freight exchange” is searched on Google. (Commercial links are counted in the ranks. If a company/ website appears more than once, the lowest rank is showed. Only the first 3 pages of results were analyzed. If the company/ website did not belong to the search results, a rank of 50 was assigned (50 was exceeding any rank found before choosing that ceiling value).

17. Industry Codes

a. SIC. This information is rarely displayed. It might be in the “about us” or “contact us” pages. Sometimes it is displayed in the pages dedicated to stakeholders (for public companies).

b. NAICS. This information is rarely displayed. It might be in the “about us” or “contact us” pages. Sometimes it is displayed in the pages dedicated to stakeholders (for public companies).

18. Primary activity

Terminology used on the website to define the company's main business:

a. EM/Software provider (also companies that provide an EM whereas their activity differs from any of the other categories below. E.g., financial services providing an EM).
b. Transportation/Carrier
c. Broker
d. 3PL/Consulting
e. Logistics
f. Others/ shippers/ manufacturers (e.g., farming)

This information is often found on the homepage, the "about us" and/or "history" pages.

19. Possess own fleet

Does the company who owns the website possess its own fleet of vehicles?

20. Access to the actual online tool

Sometimes info regarding the tool is filled out of website description, *etc.* Not an actual tool scrutiny. I wanted to record that fact for a better interpretation of the data collection.

ANALYSIS OF THE EM MECHANISM AND TARGET

21. Fee

The purpose here is to identify how the EM is generating an income on its own. Websites offered by carriers showing their "available loads" are often totally free. Websites offered by software or EM providers are generally trying to generate their own income by charging a fee to some or all of their users. Websites offered by brokers are more difficult to analyze because the website fee can be hidden in the brokers' fees. In that case the website will be considered as free (only when charges for the website's usage are specified did I consider it as a paying website.)

The information regarding how the website generates revenue is often found on the homepage or in the registration links. It is also sometimes better explained in the terms and conditions.

a. Type of fee

    a. One-time fee: there is a fixed charge at registration (license, SaaS, *etc.*)

    b. Fixed cost per period (month or year): if one of the packages involves a fixed payment per month or year (even if the basic package is free).

    c. Transaction based: when the cost of using the website is proportional to the transactions.

    d. Consumption based: when the fees are based on credits that allow different actions (not transactions but seeing the phone numbers for example.)

e. Combination: when the user pays several times for different reasons: fixed + transaction (or other combination). Fixed per package is not a combination because the user pays only in one manner.

f. Free: if entirely free (or a website offered by a broker who did not specify what part of the brokerage fee is a website fee.)

b. Who pays

Who is being charged for using the website?

22. Names Used

Terminology identified for naming the marketplace on the website investigated. The extensive browsing of the website (clicking on each page, reading the FAQs, watching videos, reading the terms and conditions, the privacy policy, *etc.*) provide with an idea of the vocabulary used to describe the website. The name of the site is to be considered in the list of terms used (e.g., freightquote.com => quoting).

23. Price determination mechanism

This information is often found in "how it works" pages or in the terms and conditions of the EM/website. It is not unlikely to find contradictory information on that matter. Some quotes for transportation services can be mentioned as "bids" (as in an auction system) but are actually catalog prices. Careful reading and understanding of the website is therefore needed to clearly identify the mechanism used.

I coded each category as being “yes” or “no” and sometimes filled specific terms when a variation of a mechanism was offered.

a. Catalog

I consider the mechanism to be a catalog mechanism when the price(s) for a service has (have) been calculated in advance and is (are) provided immediately based on generic characteristics of a mission. The price(s) announced is (are) supposed to be non-negotiable (online fixed price). Websites run by brokers who work with a pool of carriers at pre-defined tariffs based on origin-destination characteristics are using catalog mechanisms. However, if the carriers answer to a request live and based on the contextual load information, then I considered it was a “RFQ (sealed bid auction)” mechanism. If the website offers a “get a quote” tool that returns the price of a single carrier, it is then item 38b, not a catalog.

Some sites offer hybrid mechanisms. For example, auction EM can offer fixed price options.

- Rate desired: when the desired price can be expressed but does not necessarily constitute the price at which the service will be paid. (a variation is range of price desired.)
- Book it now: when a price is announced that can replace the negotiation or auction processed if agreed upon.

- Starting price: This is generally used to reduce uncertainty in the market mechanisms. It is used as a complement to "post and search" or auction-like mechanisms.

b. Post and Search

When the price is determined through negotiation once parties found that their offer and demand match.

c. Post only (no pricing, no negotiation)

This type of mechanism has been created while coding as some of the websites have been created to feed other EMs and do not constitute the places where trade actually occurs. (e.g., postonce.net)

d. Auction (open/dynamic)

System in which the price is known through dynamic bids of one party (generally the carriers). In general, it corresponds to an open/dynamic reverse auction (*i.e.,* shippers post loads and carriers bid as low as possible to get the business. Bidders react live to other bidders bids.)

e. RFQ (sealed bid auction)

In the general case, this mechanism correspond to shippers/brokers posting a RFQ for a load and receiving quotes/bids from several carriers. Once several quotes/bids are received, a choice between carriers can be made based on price and other criteria (e.g., star rating). There is no live reaction across bidders (bids are only visible to the party requesting the quote). If the quotes/bids received are only pre-calculated tariffs based on generic pieces of information and returned automatically by electronic systems, it is then considered a catalog mechanism.

The use of terms such as “bids” or “tendering” generally involves the sealed bid auction. (even though theoretically, bids could also correspond to open auctions.)

f. Exchange

Mechanism based on stock market principles. Shippers post their loads and express at what price they are ready to transact and carriers post their services at some rates. The system matches the offer and demand and determines the prices of the transactions.

24. Based on live loads or forecast

Live loads means that the loads are supposed to correspond to actual customer orders.

Forecast means that the loads are either an extrapolation of the past or some kind of prediction. The posting mechanism identification should help identify if loads are live or forecasted. The EM can offer to work with both. Therefore, the coding goes as “live”, “forecast” or “both”.

25. Loads “ownership”

Are the loads exclusively posted by the owner of the website? (e.g., trucking company that posts its available loads.)

If the EM is a SaaS, then the loads are not posted by the technology owner (code "no") but by users.

26. Population targeted

The population targeted by the website/EM. The target can be found on the main page, in the mission statement, in the plans offered to the customers of the EM, and the terms and conditions. The target can be determined thanks to the special functions offered, special menus in the website, logging in as shippers, carrier, brokers, *etc.*, or the website explicitly mentions which type of users can use the website.) (To be noted, a carrier's website is often targeted at shippers but offers a tool for carriers to browse available loads. Although the tool is only intended to carriers, the website is targeted at shippers and carriers.)

a. Commercial Shippers

   Is the website targeting the shippers as its customers?

   When a website mentions "shippers", it was understood as commercial shippers. I assumed that transportation websites apply to professionals unless mentioned otherwise.

b. Non-commercial shippers

   Non-commercial shippers are generally identified as such or as consumers or customers. The use of the term customer (rather than shipper) and the possibility to post any load (any size, even very small ones, and any type of items such as household items) leads to inferring that non-commercial shippers are targeted.

c. Carriers

Is the website targeting carriers as its customers? (and truckers/ owner-operators)

d. Private Carriers

Is the website targeting private carriers as its customers? A website targeting private carriers generally mentions it explicitly by suggesting that the EM can help private carriers increase their capacity usage.

e. Brokers

Is the website targeting brokers as its customers? Or is there a "become an agent" link?

f. Owner operators

Yes, if the site specifically mentions owner operators. If this is checked and 26c "carrier" is not then the company only targets owner operators. "Truckers", "independent drivers", "independent contractors" will be considered as synonymous for "owner-operators".

27. Emphasis on direct shipper

Does the EM Emphasize the difference between dealing with a shipper directly and dealing with brokers, carriers, 3PLs, *etc.*?

This information is sometimes Emphasized in the "how it works" sections of the website or in videos. If the EM tool is accessible, it can be also coded based on the presence of tags that identify direct shippers.

28. Entry mechanism

The entry mechanism is the set of links offered to the website's visitors upon arrival (homepage) to access the EM. The entry design sometimes changes once the user is identified as being a carrier, broker or shipper. I considered the entry mechanism before the visitor ever become a member or user.

a. Shippers

   Can the user log in as a shipper? (Either because there is directly a "shipper" link or the registration process asks the user to identify itself as shipper, carrier or broker, or else.) Can be called a customer or manufacturer, *etc.*

b. Carriers

   Can the user log in as a carrier?

c. Brokers

   Can the user log in as a broker?

d. Load search

Is there a quick access to load search? Is the website offering to look for loads on the front page? Or is there a link/tab to access the load search engine in an unlimited manner? A link in the website map is not considered as a quick access.

e. Truck search

Is there a quick access to truck search? Is the website offering to look for trucks on the front page? Or is there a link/tab to access the truck search engine? A link in the website map is not considered as a quick access.

f. Load post/ get quotes

Is there a quick access to load post? Can the user post loads without logging in? A link in the website map is not considered as a quick access. Sometimes a load is posted by asking for quotes (in quoting sites). We'll code both get quotes and posting loads as "yes". Beware "get a quote" (38b) generally from the website owner is not part of this field.

g. Truck post

Is there a quick access to truck post? Can the user post trucks without logging in? A link in the website map is not considered as a quick access.

h. Single sign-up entry

Does the user get to use or sign up for the website as just a user (without being assigned the role of carrier, shipper or broker)? E.g., the entry can be per module/package and not per user's role.

ANALYSIS OF THE TYPE OF CORE TRANSPORTATION SERVICES OFFERED AND SOUGHT FOR ON THE EM

On the homepage or In the "about us" and "company" pages, the company often describes what type of core transportation services are being offered on the EM. It can also sometimes be found in a specific (roll-down) menu such as "services offered". An examination of the EM tools (e.g., load board, or load creation tool) also helps determining what is being offered.

29. Local

Yes if the website advertises local services (within the same city, county, *etc.*)

30. Long-Distance

Yes, if the website advertises long-distance services or if the EM displays interstate loads.

31. General Freight

By default yes, unless the website content specifies that the EM is only answering specialized needs.

32. Specialized

Lists the special needs answered as termed by the website. It can be constituted of special merchandises (e.g., furniture, heavy equipment, hops, *etc.*), services (e.g., hotshots, expedited, *etc.*) or equipment (e.g., tankers, refrigerated, military, *etc.*)

This information is found on the website and in the EM as posted loads generally display the type of equipment needed (a quick look at it shows that the board is made for all types of equipment or not.)

33. Truckload

Yes if the website advertises as serving the TL segment. Can also be identified in the EM tools if roll-down menus to create loads offer the "TL" or "FTL" option.

34. Less Than Truckload

Yes if the website advertises as serving the LTL segment. Can also be identified in the EM tools if roll-down menus to create loads offer the "LTL" or "Partial" option.

35. Small Package

Yes if the website advertises as serving the small package or parcel segment (less than 150lbs).

36. Courier

Yes if the website advertises as serving the courier segment. It is often mention as a specialized service.

ANALYSIS OF ADDITIONAL SERVICES PROVIDED BY THE EM OR AS A COMPLEMENT TO THE EM

"How it works" menus (often containing videos and/or screenshots) and charts comparing different packages offered (sometimes under an "offerings" link) are the best sources for this part of the coding scheme. If the tools were accessible, they were browsed to know what was offered. The terms and conditions are also a great source of information since it often stipulates that the users need to use the options offered to them to be able to exercise their rights in case of conflict – e.g., having printed the bill of lading provided by the EM, *etc.*)

37. Weather and road conditions

If weather and/or road conditions tools are part of the website or advertised as such. If only a link to a weather forecast site is provided, code "no".

38. Rate estimator

a. Is there a tool suggesting at what price the service should be offered (e.g., average of prices listed on the site for a departure-destination pair)? Or do they advertise it (e.g., rate index for DAT)?

b. Is there a "get a quote" tool? This not a RFQ mechanism (21e) but a tool that returns a ***unique*** rate (pre-calculated or not). (Generally a tool offered by carriers with their own fleet.)

c. Is there a "provide a quote" tool? A place where carriers can inform the other party at what price they would be ready to work on some lane. This is not to be confused with RFQ processes where shippers request quotes and carriers answer. In this case, the carrier voluntarily posts quotes in hope of future hiring (without any load corresponding to that quote yet).

39. Instant/ automated matching

Yes if the system matches what is posted by the users. It often goes with text messages systems or e-mail alerts that automatically send information when a match is found between a truck or a load previously posted and a new matching counterpart. It can also be a "lane alert"; users sometimes can request alerts on specific loads without posting equipment available. However, just a "new load alert" is not a matching system (coded "no"). When there was a truck posting system on top of the load fining one, I considered that there was automatic matching.

40. Complementary load tools/ backhaul

Yes, if the website offers a service that helps find a next trip after the current trip bought. A load radius search is not considered as a backhaul searching tool. (Examples of tools: “reverse the trip”, automatic suggestions for return trip, *etc.*) Also, the website emphasizing about backhaul is not enough. Websites often consider their own EMs as a *per se* backhaul-finding tool but it is not. If the EM is not accessible, then the website needs to describe that there is a specific tool to find backhaul/return trips, in order for the code to be a “yes”.

41. Interaction between the carrier and shipper before the deal

Can the different parties discuss the job (orally or in writing) in more details before closing a deal? How? I coded “yes” when they could and added how when it was not just a phone conversation. The “Post and Search” mechanism implies that this field is coded as “yes”. Other mechanism generally implies a “No” but it happens that auction mechanisms offer a way for parties to interact in writing. “How it works” links and videos are a great source to code that field.

42. Mileage calculation tool

I entered “yes” if the mileage involved by a trip is displayed or I named the tool employed if the website helps calculating the number of miles involved in a trip. (e.g., PC*Miler)

43. Credit report

Does the website offer to obtain the credit history or financial profile of the other parties? "yes" if the user can consult the credit score or financial profile of the other parties. Credit scores are often provided by Ansonia. "No" if only a link to another site is provided.

44. Incorporated TMS

a. Planner/ fleet management: Does the website offer tools to help manage the fleet and the jobs?

b. Routing software: does the website offer routing capability when there are multiple loads to organize? (Finding the route to a single point is not considered as a routing solution).

c. Does the EM offer some kind of "intelligence" capability? (e.g., Analysis of performance, summary of activity, density analysis, *etc.*)

d. Integration with TMS

   Does the EM advertise the possibility to integrate the use of the EM with some user TMS (not provided by the same company, otherwise code add-on in 40a)?

e. Integration with other EMs

   Does the EM mentions that it is fed by or feeds other EMs (or able to do so)?

45. Operating documents/ paperwork tools

a. Can the users print documents necessary for the job on the website? (e.g., Bill of lading, carrier package, *etc.*)

b. Can the users post documents electronically for storage or for others to see?

46. Tracking/ locator tools

Does the website display location information obtained through GPS or Cell phone? When provided the technology used is recorded (e.g., GPS, cell phones).

47. Status updates

Does the website provide status updates on the service stages? (Shipped, at that warehouse, delivered, *etc.*)

Payment or booking statuses are not to be considered here (e.g., check pending, paid, *etc.*)

48. Automated confirmation of delivery

a. Is there an automated mechanism to inform the user of the delivery of the goods?

b. Is the possibility of Proof Of Delivery (POD) imaging offered? (e.g., see Caltop Logistics)

49. Mobile app/ compatibility

Is the marketplace adapted to mobile applications (by having a mobile display or an app)? Some sites advertise that the website is accessible via smartphones because it is on the internet, it is not sufficient to qualify as "mobile friendly".

TRUST BUILDING MECHANISMS

In blue is the scheme borrowed from Son *et al.* 2006 (the numbers in parentheses are the item references of Son *et al.* 2006).

50. Escrow Services (1a)

Escrow services let buyers send payments to a third-party to be held until goods are delivered or they are satisfied with the goods; it simultaneously benefits sellers by providing protection against fraudulent credit cards. Escrow can be held by the e-marketplace or by a third-party.

Does the EM provide escrow services? (to be used between carrier and shipper/broker)

51. Payment

This information is often found in the terms and conditions and in the "how it works" pages.

a. Secure payment (and secure handling of private information): Is there a secure payment procedure mentioned between the members and the website company? If mentioned it is often found in the terms and conditions or privacy policy. (e.g., mention of the use of "Secure Sockets Layer" or "encrypted protocols") I browsed the policies for that information and also used the search tool of my browser to look-up for "SSL" or "encrypt". I coded "yes" when I found that private information was encrypted, even if it is not just payment information.

b. Payment facilitation: is there a system offered for the participants to receive their payment more easily or protect their payment? (e.g., quick pay, factoring). This is probably the equivalent of the escrow service in Son et al.'s 1a. Or, is does the system provide information on who is eligible for easier payment?

c. Payment speed: Does the website announces at what speed the carriers are being paid or does it provide at what speed the shipper-partners pay their carriers? Commonly phrased as "day pay" or "days to pay")

52. Monitoring of Products / Services (2)

The service consider for this part of the coding exercise is a transportation operation by a specific carrier.

a. Product appraisal (2a)

Original item: Product price or value are assessed by experts according to the measurement of specified characteristics.

My item: This question is answered by the rate estimator question in 38a.

b. Product guarantees and warranties (2b)

Original item: A guarantee given to the purchaser by sellers or the e-marketplaces stating that a product is reliable and free from known defects and that the seller/e-marketplace will, without charge, repair or replace defective parts within a given time limit and under certain conditions.

My item: Does the EM offer to cover an operation for a certain amount of money in case of problems?

c. Product inspection (2c)

Original item: Products are inspected by a trusted third-party or by the purchaser at particular points, from initial evaluations and inspection of raw materials to final inspections of delivered goods.

My item: I did not find any equivalent in my study for this item as a third party is never involved in the inspection of the service. Status update (47) and automated confirmation of delivery (48a) might be the closest equivalents.

d. Product reviews (2d)

Original item: Product performance or quality is reviewed by a trusted third-party in order to provide valuable information to prospective buyers.

My item: Does the EM provide the FMCSA/SAFER score of the partner or any other score provided by another instance of the transportation industry and representing some level of performance? (A link to sites providing those evaluations is not enough)

Also updated insurance history provided by a third party is considered as a product review (but the insurance check at registration is not). Signals by factoring companies regarding the possibility to factor some loads is considered a review as well.

53. Insurance (3a)

Original item: Insurance is offered for an uncompleted transaction or an unexpected return when there is no fault by either party involved in the exchange.

Does the marketplace provide insurance? (to carriers or shippers)

A link to insurance websites is not enough.

54. Cooperative Norms (4)

Perceived cooperative norms can be defined as organizations' expectations of the values, standards, and principles to which their trading partners adhere.

Dispute resolution (4.1a and b)

Original item: Facilitators and mediators are enlisted to resolve disputes arising from online transactions. Note that the disputes addressed by this mechanism are the conflicts between buyers and sellers (carriers and shippers/brokers) using an e-marketplace to do business. The resolution process rectifies problems involving three participants in a transaction: buyers, sellers, and e-marketplaces. The resolution of bilateral arguments, between only buyers and an e-marketplace or between only sellers and an e-marketplace, should not be considered. The terms and conditions were explored to code this item. The words "dispute" and "arbitration" were thought for.

a. Is arbitration binding in accordance with the rules of the National Arbitration Forum?

b. Is arbitration binding in accordance with the rules of the American Arbitration Association?

c. My item: Dispute resolution between carriers and shippers is mentioned (beyond "we don't take care of it")

d. Codes of conduct (4.2a)

   Original item: Codes of conduct describe general transaction regulations for participants from an ethical perspective. For example, participants should provide accurate information for user identification and product description, keep their accounts and passwords confidential, obey applicable laws (e.g., national export/import laws), and avoid disallowed acts, such as interfering with network security and transmission or trading illegal items. Moreover, some e-marketplaces will list detailed codes of conduct for buyers and sellers respectively. Please note that codes of conducts are often described in a page titled "Codes of Conduct", or incorporated into a "Terms and Conditions" page.

e. Expected transaction patterns (4.3a)

Expected transaction patterns are identified when an e-marketplace provides detailed information to prospective participants about how transactions are made on an e-marketplace. For example, on the page of "Terms and Conditions", an e-marketplace may specify acceptable methods of payment: for example bank transfers or letters of credit. It may also state how shipping is arranged and whether taxes will be charged. In particular, if an e-marketplace has an exchange or auction function, the content of rules may contain price offers, bidding times, requirements for winning a bid, or bid closing processes.

I considered websites explaining how the EM works (e.g., with videos or diagrams or step by step explanations) as having transaction patterns explained.

55. Safe shipping guide/ help to fight or identify fraud

Is there something (a guide, a paragraph in the terms and conditions, *etc.*) that explains how to protect oneself against fraudulent users? Or does the EM explains that it helps fight fraud?

56. Member Screening (5a)

a. Original item: Member screening is a membership qualification assessment both for first-time visitors and for members who hope to maintain their qualifications. Screening methods include credit checking, letters of reference from existing or current trading partners, telephone verification of member information, and participant performance reviews. Note that completing a registration form which only contains simple contact information for an applicant should not be considered as a screening method.

My Item: Screening is about not letting anybody post or bid on a job. The board can be accessible to all but are people who get in contact screened by the EM owner (it can be the carrier itself if the EM is a carrier tool). Carriers and 3PL generally request other carriers to fill a package (to become a partner). If so the carriers are being screened and Emphasis is placed on screening. Even if we can assume that all carriers or 3PL do that, if it is not mentioned then code "no" (no screening).

If the registration form involves a MC number (or other types of authority ID) that is being checked, then the registration process is a screening form.

b. My item: Is a screening process that goes beyond "MC number" requirements Emphasized (*i.e.,* advertised) (somewhere else than on the registration form)? A carrier requesting other carriers to fill a package is an Emphasis on screening.

c. My item: Does that screening process (56b) seem to be for real? (e.g., Comfreight.com mentioning that business is safe because…)

   When the screening process looked uncertain, I tried to register to test if the tool was accessible.

d. My item: What is the technique (supposedly) employed (if available)? E.g., Mentions of exclusions for bad behaviors, confirmation via phone, *etc.*

e. My item: Who is described as being screened? Carriers, shippers, brokers, all?

f. My item: Is the marketplace offering the possibility to work upon invitations only (*i.e.,* private marketplace with only known participants.)

57. Reputation Systems (6)

A reputation rating system publishes ratings of the performance of particular participants based on opinions stated by their trading partners or the e-marketplace.

a. (6a) Does the EM provide peer rating?

b. (6b) Does the EM evaluate the performance of its participants? (Other than through peer rating).

   My item: During the screening process, the EM may attribute some kind of score to the participants and then maintain that score (e.g., credibility ratio). Also, the EM may accredit or award preferred statuses to some participants. Does the investigated EM display such evaluation system? Participants' exclusion procedures are also considered an evaluation system.

58. Third-party Assurance Seals (7)

Original item: Assurance seals are types of certificates offered by trusted-third parties. Usually, they are issued for solving participants' concerns about privacy and the reliability of the sites they are using to do business. The most commonly-used approval seals include TRUSTe, WebTrust, Verisign, and BBBonline. Please note that the seals issued by the sponsors or owners of an e-marketplace should not be considered.

My Item: what seals are being displayed?

59. Privacy Policy (8a)

Original item: An e-marketplace may state a privacy policy on its web site. Some e-marketplaces state their privacy in specific pages (e.g., "Privacy Policy"), while some may incorporate these policies into general "Terms and Conditions" pages.

Does the EM state its privacy policy?

60. Disclosing E-Marketplace Longevity (9a)

Original item: Site longevity refers to the statements about the business history of an e-marketplace.

Does the EM provide its business history? Complementary with columns in statistics (item 4 and 5). Sometimes longevity is given through other time marks than exact dates (e.g., since the end of WW2, or for half a century.)

61. Disclosing Management Team Profile (10a)

Original item: An e-marketplace's management team may be introduced, often with contact information listed.

Does the EM provide a management team profile?

This information is often found in "about us" or in "Contact us" (it is considered displayed when it is upon request as well).

62. Disclosing E-Marketplace Size (11a)

Original item: An e-marketplace may publish the size of its membership, its revenue, or the volume of trade generated. Redundant with columns in statistics (10 to 14)

63. Affiliation with Respected Organizations (12a and b)

Original item: To establish affiliation with respected organizations, an e-marketplace may enter partnerships with respected organizations or become qualified members of an industry association, or organization.

a. Original item: Has the EM established partnerships with respected organizations?
b. Original Item: Has the EM registered as a qualified member of an industry association, or organization?

There sometimes is a specific link "partners" on the website. Otherwise, this information is often displayed in the "about us" paragraphs.

64. Testimonials from Current Participants (13a)

An e-marketplace may disclose comments or success stories from its current participants.

Often on the homepage. Sometimes in a specific "testimonials" link.

65. Advertising Awards Earned (14a)

Original item: An e-marketplace may advertise that it has won an award from an industry association, organization, or a news media outlet, such as a magazine, newspaper, authoritative website, or email newsletters.

This piece of information can be found in a specific "award" section or in the "press" section. Otherwise it is often within the "about us" or company description.

66. Excerpts from News Media Outlets (15a)

Original item: An e-marketplace may provide excerpts articles or reports from a news media outlet. The content of reports usually includes: revenue growth, strategic affiliations, or an acquisition of investment.

There often is a very specific link (e.g., "press") for it.

67. Advertising the Well-known Participants (16a)

Original item: An e-marketplace may list its well-known customers. For example, an e-marketplace in Finance industry may list its customers which are industry leaders, such as Morgan Stanley, Merrill Lynch, and Citigroup.

This piece of information is sometimes tied to testimonials as the testimonials are often attributed to customers and well-known customers are more often cited than unknown ones.

68. Terms and conditions

Are there terms and conditions? If yes, the link is pasted. It is sometimes called "terms of service" or "disclaimer". The link is often at the very bottom of the homepage. It can also be found after clicking on "subscribe" as a link before agreement.

69. Culture statement/ Vision/ Mission

Does the website give a statement of the company's mission? Either the link to that statement or the text is pasted in the cell.

This piece of information can be found under the "about us" or "company link". Sometimes under a "culture" or "mission" link.

70. Neutrality

Does the website company emphasize its neutrality somewhere? Neutrality must be understood as expressing the fact that the EM is neither serving the interest of the carrier nor the shipper. It is not about the EM expressing that the EM is not responsible for what is being contracted (responsibility disclaimer often found in terms and conditions).

It is most often found in the company description or on the homepage.

71. Photo display of merchandise/ people

On the marketplaces are there photos relative to the job to be performed (either people involved or merchandise to be carried.)

a. Of the merchandise to carry

b. Of users or their equipment or logo (when there is one piece of equipment for a carrier for example.) Sometimes the website mentions branding management, it often means that pictures can be uploaded.

This type of information can be evaluated by accessing the tool or through the "how it works" links and videos. Sometimes it is also displayed on the registration form as there is a tool to upload a picture.

72. Delivery date claim

Does the EM state at what date the merchandise is going to be delivered and vouch for it? (Is there something mentioning some kind of guaranteed performance?)

If there is, it is often advertised in the "how it works" sections or videos. If it is not, it is often stipulated in the terms and conditions that suggested delivery date are not guaranteed, not contractual, *etc.* By default, this piece of information is coded as a no.

73. Quality of merchandise claim

Does the EM claims that the mission will be fulfilled without any problem and vouch for it.

If there is, it is often advertised in the "how it works" sections or videos. If it is not, it is often stipulated in the terms and conditions that the EM is not liable for damages to the merchandise. By default, this piece of information is coded as a no.

74. Transportation specialized content

Does the website provide extra content, besides the marketplace content, regarding the industry? Some sites might display news about the industry. Provide a glossary of the transportation industry, a blog, job search, links to other transportation websites, white papers, *etc.*

The "news" or "press" sections often are about the industry rather than the company (which would be coded in item 61).

CUSTOMER ACCOMPANIEMENT

75. Interactivity

a. Contact info on website

   What are the forms of contact available to people who are managing the website?

   a. E-mail form(s)

   b. E-mail address(es)

   c. Phone

   This type of information is often under a "contact us" link. It is also often at the top-right-hand corner of the homepage.

b. Live chat

   Is there a way to chat live with representative of the website company?

This information is usually available through the appearance of a live chat box while browsing the site (often as the homepage opens). It is also sometimes available under the "contact us" link.

c. Desktop sharing

Does the company offer to share the desktops to help with problems and interact?

This information is generally to be found under a customer support section.

76. Customer support

Does the EM mentions the availability of customer support in case of website issues or usage issues? Or is there a "support" link somewhere?

The presence of a "support" link means a "yes" in the coding. Otherwise, the information is often under "contact us". The presence of a "contact us" section is not sufficient to be considered as customer support.

77. Search

Does the website offer a way to find other users/ companies, *etc.* to facilitate information gathering and decision making? A Directory is often provided, blacklisted companies are sometimes displayed, *etc.*

This piece of information is often found under "how it works" links

78. Help

Is there a help menu? it might be called "help" or just "?" or something else. Any search engine allowing to search for information that is not displayed in the regular structure of the website will be considered help. (Searchable FAQs are considered as help.)

79. FAQ

Is there a list of FAQ? (written by the website owners). A searchable FAQ will be considered both as FAQ and Help.

80. Videos

Are there videos or screenshots to help the customers with problems or how the system works? (Commercial videos advertising the system do not qualify).

81. Training/webinars

Does the EM offer training support for the customers?

FUNCTIONALITY (PRESENTATION)

82. Incompleteness

Are there "Obsolete content or links, non-loading pictures or "coming soon" pages" (Everard and Galetta 2006, p.62)

83. Poor style

Background interfering with the text, font sizes being inconsistent (difficult to see headings, *etc.*), crooked columns or inconsistent word spacing. (Everard and Galetta 2006)

a. Visual appeal (Kincl and Strach 2012)

   Yes means there are issues with columns sizes, font, *etc.*

b. Colors (Kincl and Strach 2012)

   Yes means the flaw is present. Yes was assigned if the color of the background interfered with the color of the text.

84. Errors

Are there "Typographical, grammatical and factual errors" (includes spelling) (Everard and Galetta 2006)

85. Bad Layout/ Organization (Kincl and Strach 2012)

Yes, means that the layout is not very clear.

For example, some content may be difficult to find. Some tools may be separated (on different sites) whereas they work in pair, *etc*.

86. Bad navigation (Kincl and Strach 2012)

Yes means it is difficult to find go from one place to another or use the website in an efficient manner. Sometimes it is difficult to go back to a previous screen or sort information that is on the screen (for example the load board cannot be sorted or filtered.) Navigation between websites is also sometimes difficult.

87. Commercial banners

Are there commercial banners on the pages visited?

FACEBOOK

88. Page?

Does the company of the EM have a Facebook page?

Often, if it does, there is a link to Facebook on the website (through the Facebook icon). Otherwise, the name of the company was typed in Facebook to locate the page.

When FB returns a description page (and not a FB page maintain by the company), it was coded as "no". (even if some of those description pages gather "likes".)

89. # likes

How many "likes" did the page get? (N/A if there is no page)

90. Reviews/ testimonials

Is there a review section? Yes, no or N/A if there is no page

91. User rating

a. What is the user rating if there is a review section? (N/A if there is not)

b. Out of how many reviews?

92. FB description

What is the FB description of the company in the company's profile? Pasted text. There are two areas for description on Facebook (short and long). If both are present, both are pasted in that cell.

93. Mission

What is the mission displayed by the company on Facebook in its profile? Pasted text from Facebook's specific "mission" section.

APPENDIX C: Coding reliability, test re-test procedure (single coder fatigue)

When no variation was observed in a variable in the test-retest procedure, Scott's pi is not calculable.

This is shown as "not calculable" in the reliability column.

Coding scheme's variable number	Son et al.'s (2006) code	Variable name	Reliability (Scott's pi)
4	9a	EM Launch date	**0.786**
5	9a	Company's foundation or incorporation date	**0.892**
6		Public or Private	**0.916**
7		Headquarters location	**0.685**
8		Number of Employees	**0.860**
9		Number of Countries Served	**0.722**
10	11a	Registered Transporters	**0.717**
11	11a	Registered Shipping Customers/ brokers	**0.571**
12	11a	Number of users	**0.769**
13a	11a	Activity level	**0.612**
14	11a	Total Business Transactions	**1.000**
18a		Primary activity - EM/software	**1.000**
18b		Primary activity - transportation/carrier	**0.874**
18c		Primary activity - broker	**0.893**
18d		Primary activity - 3PL/consulting	**0.749**
18e		Primary activity - logistics	0.357
18f		Primary activity - others	**1.000**
19		Possess own fleet?	**0.602**
20		Accessed actual tool?	**0.794**
21aa		Fee - one-time	**0.637**
21ab		Fee - periodic	**1.000**
21ac		Fee - transaction	**0.653**
21ad		Fee - consumption	**1.000**
21ae		Fee - combination	-0.014
21af		Fee - free	**0.888**
23a		Mechanism - Catalog	**0.526**
23b		Mechanism - Post and Search	**0.907**
23c		Mechanism - Post only, no pricing, no nego	Not calculable
23d		Mechanism - Auction (open)	**0.637**

23e		Mechanism - RFQ (sealed bid auction)	**0.720**
23f		Mechanism - Exchange	Not calculable
24		Based on live loads or forecast?	**0.720**
25		Loads ownership	**0.942**
26a		Population targeted - commercial shippers	0.295
26b		Population targeted - non-commercial shippers	**0.720**
26c		Population targeted - carriers	**0.637**
26d		Population targeted - private carriers	**0.571**
26e		Population targeted - brokers	**0.552**
26f		Population targeted - owner operators	**0.667**
27		Emphasis on direct shippers	**0.653**
28a		Entry logic - Shippers	**0.413**
28b		Entry logic - Carriers	**0.459**
28c		Entry logic - Brokers	**0.452**
28d		Entry logic - load search	**0.741**
28e		Entry logic - truck search	**0.618**
28f		Entry logic - load post/ get quotes	**0.726**
28g		Entry logic - truck post	**0.618**
28h		Entry logic - Single Sign-up entry	**0.425**
29		Service - Local	0.253
30		Service - Long-Distance	0.204
31		Service - General Freight	**0.621**
32		Service - Specialized	**0.562**
33		Service - Truckload	0.159
34		Service - Less than Truckload/ partial	**0.452**
35		Service - Small Package Delivery	**0.602**
36		Service - Courier	**0.471**
37		Weather and road conditions	**0.842**
38a	2a	Rate estimation	**0.720**
38b		Get a quote	**0.841**
38c		Provide a quote	**1.000**
39		Instant/ automated matching	**0.655**
40		Complementary load tools/ backhaul …	**0.842**
41		Carrier - shipper interaction before deal	**0.573**
42		Mileage calculation	**0.560**
43		Credit reports	**1.000**
44a		Planner/ fleet management	**0.819**
44b		Routing	-0.088
44c		Analytics	**0.601**

44d		Integration with TMSs	**0.749**
44e		Integration with other Transportation EMPs, powered by	**0.788**
45a		Operating documents/ paperwork tools	**0.612**
45b		Posting documents capacity	0.306
46		Tracking/ locator	**0.706**
47		Status Updates	**0.706**
48a		Automated confirmation of delivery	0.211
48b		POD imaging	-0.057
49		Mobile app/ mobile compatible	**0.853**
50	1a	Escrow	**0.786**
51a		Secure payment	**0.717**
51b		Payment facilitation (quick pay or factoring)	**0.881**
51c		Payment speed (in days)	**0.413**
52b	2b	Product Warranties and Guarantees	**1.000**
52d	2d	Product Review and Rating FMCSA and SAFER scores	**0.769**
53	3a	Insurance	**0.471**
54a	4.1a	Cooperation Norms - dispute resolution NAF	Not calculable
54b	4.1b	Cooperation Norms - dispute resolution AAA	Not calculable
54c		Cooperation Norms - dispute resolution	**0.842**
54d	4.2a	Codes of Conduct	**0.507**
54e	4.3a	Expected Transaction Patterns	**0.589**
55		Safe Shipping Guide/ help to fight or identify fraud	**1.000**
56a	5a	Member Screening (MC#, VAT#, etc.)	**0.670**
56b		Emphasis on screening	**0.675**
56c		Screening real?	**0.675**
56d		Technique for screening	**0.619**
56f		Upon Invitation marketplace option	**0.916**
57a	6a	Reputation Systems - peer ratings	**0.681**
57b	6b	Reputation Systems - evaluate performance	**0.720**
58	7	Third-party Assurance Seals	**0.907**
59	8a	Privacy Policy	**0.730**
60	9a	Disclosing E-marketplace Longevity	**0.560**
61	10a	Disclosing Management Team Profile	**0.646**
63a	12a	Affiliation with Respected Organizations - partnerships	**0.824**
63b	12b	Affiliation with Respected Organizations - association	**0.685**
64	13a	Testimonials from Current Participants	**0.681**
65	14a	Displaying Awards Earned	**0.621**
66	15a	Excerpts from New Media Outlets	**0.698**
67	16a	Disclosing Well-Known Participants	**0.680**
68		Terms and Conditions	**0.833**

69		Culture statement/ vision/ mission	**0.771**
70		Emphasize neutrality	0.211
71a		Photo display of merchandise	**1.000**
71b		Photo display of users	**1.000**
72		Delivery date claim	**1.000**
73		Quality of merchandise claim	Not calculable
74		Transportation additional specialized content/ resources	**0.514**
75aa		Interactivity - contact info of website - e-mail form	**0.863**
75ab		Interactivity - contact info of website - e-mail address	**0.674**
75ac		Interactivity - contact info of website - phone	**0.771**
75b		Interactivity - live chat with website people	**0.824**
75c		Interactivity - desktop sharing	**0.842**
76		Customer support	0.315
77		Search	**0.825**
78		Help	**0.720**
79		FAQ	**0.836**
80		Videos/ screenshots	**0.668**
81		Training/ webinars	0.357
82		Incompleteness	0.039
83a		Poor style - visual appeal	-0.104
83b		Poor style - colors	**0.653**
84		Errors	0.357
85		Bad Layout/ organization	0.357
86		Bad navigation	**0.858**
87		Commercial banners	**0.657**
88		Is there a Facebook page?	**1.000**
89		# likes	**1.000**
90		Testimonials/ reviews	**0.853**
91a		User rating	**1.000**
91b		Rating out of	**1.000**
92		FB Description	**1.000**
93		Mission	**0.815**

APPENDIX D: Coding reliability, inter-coder reliability with two coders

Item	Reference #	Scott's Pi
Cooperation Norms - dispute resolution AAA	54b	-0.04
Mechanism - Catalog	23a	0.12
Rate estimation	38a	0.18
Status Updates	47	0.20
Complementary load tools/ backhaul …	40	0.34
Escrow	50	0.34
Analytics	44c	0.47
Operating documents/ paperwork tools	45a	0.48
Reputation Systems - evaluate performance	57b	0.51
Mechanism - Post and Search	23b	0.51
Carriers	28b	0.55
Payment facilitation (quick pay or factoring)	51b	0.57
Are the loads exclusively posted by website owner?	25	0.59
Shippers	28a	0.59
Credit reports	43	0.63
Product Warranties and Guarantees	52b	0.65
Primary activity - 3PL/consulting	18d	0.66
Mechanism - RFQ (sealed bid auction)	23e	0.66
Technique for screening	56d	0.68
Tracking/ locator	46	0.70
Forecast?	24	0.71
Product Review and Rating FMCSA and SAFER scores	52d	0.71
Insurance	53	0.71
Mileage calculation	42	0.72
Load post/ get quotes	28f	0.76
Primary activity - EM/software	18a	0.77
Truck search	28e	0.78
Weather and road conditions	37	0.78
Cooperation Norms - dispute resolution	54c	0.78
Reputation Systems - peer ratings	57a	0.78
Fee structure	21a	0.78
Possess own fleet?	19	0.87
Population targeted - non-commercial shippers	26b	0.87
Truck post	28g	0.87
Accessed actual tool?	20	0.92
Load search	28d	0.92

Mechanism - Auction (open)	23d	1.00
Photo display of merchandise	71a	1.00
Primary activity - Shippers	18f	Not calculable
Mechanism - Exchange	23f	Not calculable
Cooperation Norms - dispute resolution NAF	54a	Not calculable

APPENDIX E: Contingency tables and tests of independence

The tests of independence have been performed with JMP Pro 11.

B1 vs. A Observed Expected	B2B and or B2C	B2B only	Sum
One-to-many	1	80	48
	8.3	72.7	
Many-to-many	12	65	77
	7.8	69.15	
Many-to-few	8	40	81
	4.9	43.1	
Sum	21	185	206

INDEPENDENCE TESTS			
N	DF	-loglike	R2
206	2	7.507	0.1107
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	15.015	0.0005	
Pearson	11.743	0.0028	

B2 vs. A Observed Expected	B2B and or B2C	B2B only	Sum
Seller-oriented	2	64	7
	6.7	59.3	
Buyer-oriented	4	3	133
	0.7	6.3	
Neutral-oriented	15	118	66
	13.6	119.4	
Sum	21	185	206

INDEPENDENCE TESTS			
N	DF	-loglike	R2
206	2	7.244	0.1068
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	14.488	0.0007	
Pearson	20.724	<.0001	

B3 vs. A Observed Expected	B2B and or B2C	B2B only	Sum
Carrier-owned	2	46	48
	4.9	43.4	
Broker-owned	2	43	45
	4.6	40.4	
Third-party-owned	17	96	113
	11.5	101.5	
Sum	21	185	206

INDEPENDENCE TESTS			
N	DF	-loglike	R2
206	2	3.493	0.0515
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	6.986	0.0304	
Pearson	6.433	0.0401	

B4 vs. A Observed Expected	B2B and or B2C	B2B only	Sum
Open (public)	15	145	160
	16.3	143.7	
Closed (private)	6	40	46
	4.7	41.3	
Sum	21	185	

INDEPENDENCE TESTS			
N	DF	-loglike	R2
206	2	0.249	0.0037
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	0.499	0.4802	
Pearson	0.525	0.4686	

C vs. A Observed Expected	B2B and or B2C	B2B only	Sum
Free	9	109	118
	12	106	
Periodic fee	3	66	69
	7	62	
Transaction fee	9	10	19
	1.9	17.1	
Sum	21	185	206

INDEPENDENCE TESTS			
N	DF	-loglike	R2
206	2	10.549	0.1555
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	21.098	<.0001	
Pearson	32.106	<.0001	

D vs. A Observed Expected	B2B and or B2C	B2B only	Sum
Post & Search	7	137	144
	14.1	129.9	
Open auction	5	14	19
	1.9	17.1	
Sealed auction	8	33	41
	4	37	
Sum	20	184	204

INDEPENDENCE TESTS			
N	DF	-loglike	R2
204	2	6.253	0.0956
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	12.506	0.0019	
Pearson	14.207	0.0008	

E vs. A Observed Expected	B2B and or B2C	B2B only	Sum
Spot	19	160	179
	18.2	160.7	
Systematic	2	25	27
	2.8	24.2	
Sum	21	185	206

INDEPENDENCE TESTS			
N	DF	-loglike	R2
206	2	0.142	0.0021
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	0.285	0.5936	
Pearson	0.264	0.6077	

F vs. A Observed Expected	B2B and or B2C	B2B only	Sum
Consulting	0	27	27
	2.75	24.2	
Tool only	21	158	179
	18.2	160.8	
Sum	21	185	206

INDEPENDENCE TESTS			
N	DF	-loglike	R2
206	2	3.125	0.0461
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	6.249	0.0124	
Pearson	3.527	0.0604	

G1 vs. A Observed Expected	B2B and or B2C	B2B only	Sum
Info only	3	51	54
	5.3	48.7	
Info+Settlt	0	17	17
	1.7	15.3	
Info+AS	3	36	39
	3.8	35.2	
Info+Settlt+AS	1	33	34
	3.3	30.7	
Nego only	3	7	10
	1	9	
Nego+Settlt	2	8	10
	1	9	
Nego+AS	4	6	10
	1	9	
All phases	4	26	30
	2.9	27.1	
Sum	20	184	204

INDEPENDENCE TESTS

N	DF	-loglike	R2
204	2	9.137	0.1396
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	18.273	0.0108	
Pearson	21.48	0.0031	

G2 vs. A Observed Expected	B2B and or B2C	B2B only	Sum
No Decision supp.	11	76	87
	8.9	78.1	
With Decision sup.	10	109	119
	12.1	106.9	
Sum	21	185	206

INDEPENDENCE TESTS

N	DF	-loglike	R2
206	2	0.487	0.0072
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	0.975	0.3235	
Pearson	0.987	0.3205	

B2 vs. B1 Observed Expected	One-to-many	Many-to-many	Many-to-few	Sum
Seller-oriented	54	4	8	66
	26	24.7	15.3	
Buyer-oriented	0	3	4	7
	2.8	2.6	1.6	
Neutral-oriented	27	70	36	133
	52.3	49.7	31	
Sum	48	77	81	206

INDEPENDENCE TESTS			
N	DF	-loglike	R2
206	2	42.56	0.19
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	85.124	<.0001	
Pearson	78.747	<.0001	

B3 vs. B1 Observed Expected	One-to-many	Many-to-many	Many-to-few	Sum
Carrier-owned	44	2	2	48
	18.9	17.9	11.2	
Broker-owned	36	0	9	45
	17.7	16.8	10.5	
Third-party-owned	1	75	37	113
	44.4	42.2	26.3	
Sum	81	77	48	206

INDEPENDENCE TESTS			
N	DF	-loglike	R2
206	2	105.463	0.4766
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	210.927	<.0001	
Pearson	163.317	<.0001	

B4 vs. B1 Observed Expected	One-to-many	Many-to-many	Many-to-few	Sum
Open (public)	72	77	11	160
	62.9	59.8	37.3	
Closed (private)	9	0	37	46
	18.1	17.2	10.7	
Sum	81	77	48	206

INDEPENDENCE TESTS			
N	DF	-loglike	R2
206	2	55.305	0.2499
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	110.61	<.0001	
Pearson	110.985	<.0001	

C vs. B1 Observed Expected	One-to-many	Many-to-many	Many-to-few	Sum
Free	81	22	15	118
	46.4	44.1	27.5	
Periodic fee	0	43	26	69
	27.1	25.8	16.1	
Transaction fee	0	12	7	19
	7.5	7.1	4.4	
Sum	81	77	48	206

INDEPENDENCE TESTS			
N	DF	-loglike	R2
206	2	64.719	0.2924
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	129.439	<.0001	
Pearson	99.644	<.0001	

D vs. B1 Observed Expected	One-to-many	Many-to-many	Many-to-few	Sum
Post & Search	72	49	23	144
	57.2	53.6	33.2	
Open auction	1	10	8	19
	7.5	7.1	4.4	
Sealed auction	8	17	16	41
	16.3	15.3	9.4	
Sum	81	76	47	204

INDEPENDENCE TESTS

N	DF	-loglike	R2
204	2	14.558	0.0665

Tests	Chi Sq	P> ChiSq
Likelihood ratio	29.116	<.0001
Pearson	26.2	<.0001

E vs. B1 Observed Expected	One-to-many	Many-to-many	Many-to-few	Sum
Spot	78	63	38	179
	70.4	66.9	41.7	
Systematic	3	14	10	27
	10.6	10.1	6.3	
Sum	81	77	48	206

INDEPENDENCE TESTS

N	DF	-loglike	R2
206	2	6.11	0.0276

Tests	Chi Sq	P> ChiSq
Likelihood ratio	12.219	0.0022
Pearson	10.546	0.0051

F vs. B1 Observed Expected	One-to-many	Many-to-many	Many-to-few	Sum
Consulting	22	1	4	27
	10.6	10.1	6.3	
Tool only	59	76	44	179
	70.4	66.9	41.7	
Sum	81	77	48	206

INDEPENDENCE TESTS

N	DF	-loglike	R2
206	2	13.535	0.0612

Tests	Chi Sq	P> ChiSq
Likelihood ratio	27.069	<.0001
Pearson	24.434	<.0001

G2 vs. B1 Observed Expected	One-to-many	Many-to-many	Many-to-few	Sum
No Decision supp.	49	27	11	87
	34.2	32.5	20.3	
With Decision sup.	32	50	37	119
	46.8	44.5	27.7	
Sum	81	77	48	206

INDEPENDENCE TESTS

N	DF	-loglike	R2
206	2	10.2	0.0462

Tests	Chi Sq	P> ChiSq
Likelihood ratio	20.448	<.0001
Pearson	20.034	<.0001

G1 vs. B1 Observed Expected	One-to-many	Many-to-many	Many-to-few	Sum
Info only	18	33	3	54
	21.4	20.1	12.4	
Info+Settlt	13	3	1	17
	6.7	6.3	3.9	
Info+AS	21	8	10	39
	15.5	14.5	9	
Info+Settlt+AS	20	5	9	34
	13.5	12.7	7.8	
Nego only	3	5	2	10
	4	3.7	2.3	
Nego+Settlt	2	3	5	10
	4	3.7	2.3	
Nego+AS	0	6	4	10
	4	3.7	2.3	
All phases	4	13	13	30
	12	11.2	6.9	
Sum	81	76	47	204

INDEPENDENCE TESTS

N	DF	-loglike	R2
204	2	34.064	0.1556

Tests	Chi Sq	P> ChiSq
Likelihood ratio	68.128	<.0001
Pearson	61.147	<.0001

B3 vs. B2 Observed / Expected	Seller-oriented	Buyer-oriented	Neutral-oriented	Sum
Carrier-owned	31	2	15	48
	15.4	1.6	31	
Broker-owned	23	1	21	45
	14.4	1.5	29.1	
Third-party-owned	12	4	97	113
	36.2	3.8	73	
Sum	66	7	133	206

INDEPENDENCE TESTS			
N	DF	-loglike	R2
206	2	29.298	0.1866
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	58.596	<.0001	
Pearson	55.838	<.0001	

B4 vs. B2 Observed / Expected	Seller-oriented	Buyer-oriented	Neutral-oriented	Sum
Open (public)	56	4	100	160
	51.3	5.4	103.3	
Closed (private)	10	3	33	46
	14.7	1.6	29.7	
Sum	66	7	133	206

INDEPENDENCE TESTS			
N	DF	-loglike	R2
206	2	2.03	0.0129
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	4.061	0.1313	
Pearson	4.134	0.1266	

C vs. B2 Observed / Expected	Seller-oriented	Buyer-oriented	Neutral-oriented	Sum
Free	56	5	57	118
	37.8	4	76.2	
Periodic fee	9	1	59	69
	22.1	2.3	44.5	
Transaction fee	1	1	17	19
	6.1	0.6	12.7	
Sum	66	7	133	206

INDEPENDENCE TESTS			
N	DF	-loglike	R2
206	2	18.384	0.1171
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	36.768	<.0001	
Pearson	33.334	<.0001	

D vs. B2 Observed / Expected	Seller-oriented	Buyer-oriented	Neutral-oriented	Sum
Post & Search	57	0	87	144
	45.9	4.9	93.2	
Open auction	3	1	15	19
	6.1	0.7	12.3	
Sealed auction	5	6	30	41
	13.1	1.4	26.5	
Sum	65	7	132	204

INDEPENDENCE TESTS			
N	DF	-loglike	R2
204	2	15.294	0.0984
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	30.589	<.0001	
Pearson	30.794	<.0001	

E vs. B2 Observed Expected	Seller-oriented	Buyer-oriented	Neutral-oriented	Sum
Spot	63	6	110	179
	57.3	6.1	115.6	
Systematic	3	1	23	27
	8.7	0.9	17.4	
Sum	66	7	133	206

INDEPENDENCE TESTS			
N	DF	-loglike	R2
206	2	3.691	0.0235
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	7.382	0.0249	
Pearson	6.303	0.0428	

F vs. B2 Observed Expected	Seller-oriented	Buyer-oriented	Neutral-oriented	Sum
Consulting	16	0	11	27
	8.7	0.9	17.4	
Tool only	50	7	122	179
	57.3	6.1	115.6	
Sum	66	7	133	206

INDEPENDENCE TESTS			
N	DF	-loglike	R2
206	2	5.509	0.0351
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	11.018	0.004	
Pearson	10.973	0.0041	

G1 vs. B2 Observed Expected	Seller-oriented	Buyer-oriented	Neutral-oriented	Sum
Info only	14	0	40	54
	17.2	1.8	34.9	
Info+Settlt	9	0	8	17
	5.4	0.6	11	
Info+AS	17	0	22	39
	12.4	1.3	25.2	
Info+Settlt+AS	17	0	17	34
	10.8	1.2	22	
Nego only	1	1	8	10
	3.2	0.3	6.5	
Nego+Settlt	3	2	5	10
	3.2	0.3	6.5	
Nego+AS	0	0	10	10
	3.2	0.3	6.5	
All phases	4	4	22	30
	9.6	1	19.4	
Sum	65	7	132	204

INDEPENDENCE TESTS			
N	DF	-loglike	R2
204	2	22.845	0.147
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	45.69	<.0001	
Pearson	45.273	<.0001	

G2 vs. B2 Observed Expected	Seller-oriented	Buyer-oriented	Neutral-oriented	Sum
No Decision supp.	34	6	47	87
	27.9	3	56.2	
With Decision sup.	32	1	86	119
	38.1	4	76.8	
Sum	66	7	133	206

INDEPENDENCE TESTS			
N	DF	-loglike	R2
206	2	5.319	0.0339
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	10.638	0.0049	
Pearson	10.347	0.0057	

B4 vs. B3 Observed Expected	Carrier-owned	Broker-owned	Third-party-owned	Sum
Open (public)	40	33	87	160
	37.3	35	87.8	
Closed (private)	8	12	26	46
	10.7	10	25.2	
Sum	48	45	113	206

INDEPENDENCE TESTS

N	DF	-loglike	R2
206	2	0.724	0.0035

Tests	Chi Sq	P> ChiSq
Likelihood ratio	1.447	0.4849
Pearson	1.406	0.4952

C vs. B3 Observed Expected	Carrier-owned	Broker-owned	Third-party-owned	Sum
Free	48	43	27	118
	27.5	25.8	64.7	
Periodic fee	0	2	67	69
	16.1	15.1	37.8	
Transaction fee	0	0	19	19
	4.4	4.2	10.4	
Sum	48	45	113	206

INDEPENDENCE TESTS

N	DF	-loglike	R2
206	2	70.774	0.3432

Tests	Chi Sq	P> ChiSq
Likelihood ratio	141.547	<.0001
Pearson	114.294	<.0001

D vs. B3 Observed Expected	Carrier-owned	Broker-owned	Third-party-owned	Sum
Post & Search	39	36	69	144
	33.9	31.8	78.4	
Open auction	1	0	18	19
	4.5	4.2	10.3	
Sealed auction	8	9	24	41
	9.6	9	22.3	
Sum	48	45	111	204

INDEPENDENCE TESTS

N	DF	-loglike	R2
204	2	9.917	0.0484

Tests	Chi Sq	P> ChiSq
Likelihood ratio	19.833	0.0005
Pearson	15.427	0.0039

E vs. B3 Observed Expected	Carrier-owned	Broker-owned	Third-party-owned	Sum
Spot	45	43	90	179
	41.7	39.1	98.2	
Systematic	3	1	23	27
	6.3	5.9	14.8	
Sum	48	45	113	206

INDEPENDENCE TESTS

N	DF	-loglike	R2
206	2	6.9	0.0335

Tests	Chi Sq	P> ChiSq
Likelihood ratio	13.8	0.001
Pearson	11.874	0.0026

F vs. B3 Observed Expected	Carrier-owned	Broker-owned	Third-party-owned	Sum
Consulting	11	15	1	27
	6.3	5.9	14.8	
Tool only	37	30	112	179
	41.7	39.1	98.2	
Sum	48	45	113	206

INDEPENDENCE TESTS

N	DF	-loglike	R2
206	2	19.81	0.0961

Tests	Chi Sq	P> ChiSq
Likelihood ratio	39.62	<.0001
Pearson	35.042	<.0001

G2 vs. B3 Observed Expected	Carrier-owned	Broker-owned	Third-party-owned	Sum
No Decision supp.	31	23	33	87
	20.3	19	47.7	
With Decision sup.	17	22	80	119
	27.7	26	65.3	
Sum	48	45	113	206

INDEPENDENCE TESTS

N	DF	-loglike	R2
206	2	9.665	0.0469

Tests	Chi Sq	P> ChiSq
Likelihood ratio	19.33	<.0001
Pearson	19.145	<.0001

G1 vs. B3 Observed Expected	Carrier-owned	Broker-owned	Third-party-owned	Sum
Info only	9	10	35	54
	12.7	11.9	29.4	
Info+Settlt	7	7	3	17
	4	3.8	9.3	
Info+AS	12	9	18	39
	9.2	8.6	21.2	
Info+Settlt+AS	11	10	13	34
	8	7.5	18.5	
Nego only	2	1	7	10
	2.4	2.2	5.4	
Nego+Settlt	2	2	6	10
	2.4	2.2	5.4	
Nego+AS	0	1	9	10
	2.4	2.2	5.4	
All phases	5	5	20	30
	7.1	6.6	16.3	
Sum	48	45	111	204

INDEPENDENCE TESTS

N	DF	-loglike	R2
204	2	14.022	0.0684

Tests	Chi Sq	P> ChiSq
Likelihood ratio	28.044	0.014
Pearson	25.173	0.0329

C vs. B4 Observed Expected	Open (Public)	Closed (Private)	Sum
Free	97	21	118
	91.7	26.3	
Periodic fee	50	19	69
	53.7	15.4	
Transaction fee	13	6	19
	14.8	4.2	
Sum	160	46	206

INDEPENDENCE TESTS			
N	DF	-loglike	R2
206	2	1.681	0.0154
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	3.362	0.1862	
Pearson	3.414	0.1814	

D vs. B4 Observed Expected	Open (Public)	Closed (Private)	Sum
Post & Search	124	20	144
	112.2	31.8	
Open auction	11	8	19
	14.8	4.2	
Sealed auction	24	17	41
	32	9	
Sum	159	45	204

INDEPENDENCE TESTS			
N	DF	-loglike	R2
204	2	8.867	0.0824
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	17.734	0.0001	
Pearson	19.011	<.0001	

E vs. B4 Observed Expected	Open (public)	Closed (private)	Sum
Spot	142	37	179
	139	40	
Systematic	18	9	27
	6	21	
Sum	160	46	206

INDEPENDENCE TESTS			
N	DF	-loglike	R2
206	2	1	0.0091
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	2.001	0.1572	
Pearson	2.169	0.1408	

F vs. B4 Observed Expected	Open (public)	Closed (private)	Sum
Consulting	20	7	27
	21	6	
Tool only	140	39	179
	139	40	
Sum	160	46	206

INDEPENDENCE TESTS			
N	DF	-loglike	R2
206	2	0.112	0.001
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	0.225	0.6354	
Pearson	0.232	0.6303	

G1 vs. B4 Observed Expected	Open (public)	Closed (private)	Sum
Info only	52	2	54
	42.1	11.9	
Info+Settlt	15	2	17
	13.3	3.8	
Info+AS	33	6	39
	30.4	8.6	
Info+Settlt+AS	24	10	34
	26.5	7.5	
Nego only	8	2	10
	7.8	2.2	
Nego+Settlt	5	5	10
	7.8	2.2	
Nego+AS	7	3	10
	7.8	2.2	
All phases	15	15	30
	23.4	6.6	
Sum	159	45	204

INDEPENDENCE TESTS			
N	DF	-loglike	R2
204	2	16.75	0.1556
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	33.5	<.0001	
Pearson	32.264	<.0001	

G2 vs. B4 Observed Expected	Open (public)	Closed (private)	Sum
No Decision supp.	74	13	87
	67.6	19.4	
With Decision sup.	86	33	119
	92.4	26.6	
Sum	160	46	206

INDEPENDENCE TESTS			
N	DF	-loglike	R2
206	2	2.451	0.0224
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	4.902	0.0268	
Pearson	4.739	0.0295	

D vs. C Observed Expected	Free	Periodic fee	Transact. Fee	Sum
Post & Search	96	43	5	144
	82.6	48	13.4	
Open auction	1	9	9	19
	10.9	6.3	1.8	
Sealed auction	20	16	5	41
	23.5	13.7	3.8	
Sum	117	68	19	204

INDEPENDENCE TESTS			
N	DF	-loglike	R2
204	2	20.827	0.1127
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	41.654	<.0001	
Pearson	48.918	<.0001	

E vs. C Observed Expected	Free	Periodic fee	Transact. Fee	Sum
Spot	112	50	17	179
	102.5	60	16.5	
Systematic	6	19	2	27
	15.5	9	2.5	
Sum	118	69	19	206

INDEPENDENCE TESTS			
N	DF	-loglike	R2
206	2	9.293	0.0498
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	18.586	<.0001	
Pearson	19.393	<.0001	

F vs. C Observed Expected	Free	Periodic fee	Transact. Fee	Sum
Consulting	24	3	0	27
	15.5	9	2.5	
Tool only	94	66	19	179
	102.5	60	16.5	
Sum	118	69	19	206

INDEPENDENCE TESTS			
N	DF	-loglike	R2
206	2	8.075	0.0433
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	16.15	0.0003	
Pearson	12.933	0.0016	

G1 vs. C Observed Expected	Free	Periodic fee	Transact. Fee	Sum
Info only	32	20	2	54
	31	18	5	
Info+Settlt	15	2	0	17
	9.8	5.7	1.6	
Info+AS	25	12	2	39
	22.4	13	3.6	
Info+Settlt+AS	24	9	1	34
	19.5	11.3	3.2	
Nego only	6	2	2	10
	5.7	3.3	0.9	
Nego+Settlt	3	6	1	10
	5.7	3.3	0.9	
Nego+AS	1	3	6	10
	5.7	3.3	0.9	
All phases	11	14	5	30
	17.2	10	2.8	
Sum	117	68	19	204

INDEPENDENCE TESTS			
N	DF	-loglike	R2
204	2	22.32	0.1207
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	44.633	<.0001	
Pearson	55.307	<.0001	

G2 vs. C Observed Expected	Free	Periodic fee	Transact. Fee	Sum
No Decision supp.	66	18	3	87
	49.8	29.1	8	
With Decision sup.	52	51	16	119
	68.2	39.9	11	
Sum	118	69	19	206

INDEPENDENCE TESTS			
N	DF	-loglike	R2
206	2	11.443	0.0614
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	22.887	<.0001	
Pearson	21.896	<.0001	

E vs. D (Observed / Expected)	Post & Search	Open auction	Sealed Auction	Sum
Spot	138	11	28	179
	124.9	16.5	35.6	
Systematic	6	8	13	27
	19.1	2.5	5.4	
Sum	144	19	41	206

INDEPENDENCE TESTS

N	DF	-loglike	R2
206	2	16.2	0.1009

Tests	Chi Sq	P> ChiSq
Likelihood ratio	32.493	<.0001
Pearson	36.285	<.0001

F vs. D (Observed / Expected)	Post & Search	Open auction	Sealed Auction	Sum
Consulting	22	1	4	27
	19.1	2.5	5.4	
Tool only	122	18	37	177
	125	16.5	35.6	
Sum	144	19	41	206

INDEPENDENCE TESTS

N	DF	-loglike	R2
206	2	1.146	0.0071

Tests	Chi Sq	P> ChiSq
Likelihood ratio	2.292	0.318
Pearson	2.007	0.3666

G1 vs. D (Observed / Expected)	Post & Search	Open auction	Sealed auction	Sum
Info only	54	0	0	54
	38.1	5	10.9	
Info+Settlt	17	0	0	17
	12	1.6	3.4	
Info+AS	39	0	0	39
	27.5	3.6	7.8	
Info+Settlt+AS	34	0	0	34
	24	3.2	6.8	
Nego only	0	2	8	10
	7.1	0.9	2	
Nego+Settlt	0	1	9	10
	7.1	0.9	2	
Nego+AS	0	3	7	10
	7.1	0.9	2	
All phases	0	13	17	30
	21.2	2.8	6	
Sum	144	19	41	204

INDEPENDENCE TESTS

N	DF	-loglike	R2
204	2	126.152	0.7833

Tests	Chi Sq	P> ChiSq
Likelihood ratio	252.304	<.0001
Pearson	219.974	<.0001

G2 vs. D (Observed / Expected)	Post & Search	Open auction	Sealed Auction	Sum
No Decision supp.	69	0	17	87
	60.7	8	17.3	
With Decision sup.	75	19	24	119
	83.3	11	23.7	
Sum	144	19	41	206

INDEPENDENCE TESTS

N	DF	-loglike	R2
206	2	11.375	0.0706

Tests	Chi Sq	P> ChiSq
Likelihood ratio	22.75	<.0001
Pearson	15.815	0.0004

F vs. E Observed Expected	Spot	System.	Sum
Consulting	25	2	27
	23.5	3.5	
Tool only	154	25	179
	155.5	23.5	
Sum	179	27	206

INDEPENDENCE TESTS			
N	DF	-loglike	R2
206	2	0.504	0.0063
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	1.008	0.3154	
Pearson	0.886	0.3465	

G2 vs. E Observed Expected	Spot	System.	Sum
No Decision supp.	78	9	87
	75.6	11.4	
With Decision sup.	101	18	119
	103.4	15.6	
Sum	179	27	206

INDEPENDENCE TESTS			
N	DF	-loglike	R2
206	2	0.515	0.0064
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	1.031	0.31	
Pearson	1.009	0.3152	

G1 vs. E Observed Expected	Spot	System.	Sum
Info only	50	4	54
	46.9	7.1	
Info+Settlt	17	0	17
	14.8	2	
Info+AS	39	0	39
	33.8	5.2	
Info+Settlt+AS	32	2	34
	29.5	4.5	
Nego only	6	4	10
	8.7	1.3	
Nego+Settlt	5	5	10
	8.7	1.3	
Nego+AS	10	0	10
	8.7	1.3	
All phases	18	12	30
	26	4	
Sum	177	27	204

INDEPENDENCE TESTS			
N	DF	-loglike	R2
204	2	24.013	0.3012
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	48.026	<.0001	
Pearson	49.988	<.0001	

G1 vs. F Observed Expected	Consulting	Tool only	Sum
Info only	6	48	54
	7.1	46.9	
Info+Settlt	4	13	17
	2.3	14.8	
Info+AS	4	35	39
	5.2	33.8	
Info+Settlt+AS	8	26	34
	4.5	29.5	
Nego only	0	10	10
	1.3	8.7	
Nego+Settlt	1	9	10
	1.3	8.7	
Nego+AS	1	9	10
	1.3	8.7	
All phases	3	27	30
	4	26	
Sum	27	177	204

INDEPENDENCE TESTS			
N	DF	-loglike	R2
204	2	3.917	0.0491
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	7.835	0.3474	
Pearson	7.201	0.4083	

G2 vs. F Observed Expected	Consulting	Tool only	Sum
No Decision supp.	12	75	87
	11.4	75.6	
With Decision sup.	15	104	119
	15.6	103.4	
Sum	27	179	206

INDEPENDENCE TESTS			
N	DF	-loglike	R2
206	2	0.031	0.0004
Tests	Chi Sq	P> ChiSq	
Likelihood ratio	0.062	0.8033	
Pearson	0.062	0.8029	

G2 vs. G1 Observed Expected	Info only	Info+Settlt	Info+AS	Info+Settlt +AS	Nego only	Nego+ Settlt	Nego+AS	All phases	Sum
No Decision supp.	33	8	15	13	8	5	0	4	87
	22.8	7.2	16.4	14.3	4.2	4.2	4.2	12.6	
With Decision sup.	21	9	24	21	2	5	2	26	119
	31.2	9.8	22.6	19.7	5.8	5.8	5.8	17.4	
Sum	54	17	39	34	10	10	10	30	206

INDEPENDENCE TESTS

N	DF	-loglike	R2
206	2	18.723	0.0483

Tests	Chi Sq	P> ChiSq
Likelihood ratio	37.45	<.0001
Pearson	32.191	<.0001

APPENDIX F: Correlation analyses

Correlation coefficients marked with an asterisk are significant at the 0.05 level.

Coefficients greater than 0.7 are highlighted: lightly highlighted if the correlation involves a variable that is not included in the model (referent variable). Strongly highlighted and written in bold for coefficients that require attention in the analysis.

Table F1: Spearman rank correlation coefficients between variables for study 1 of chapter 5 (EM Categories)

Spearman rank correlation coefficients	(A) B2C	(B1) M-to-M	(B1) O-to-M	(B1) M-to-F	(B2) Buyer-O	(B2) Seller-O	(B2) Neutral-O	(B3) Carrier-Own	(B3) IT provider-Own	(B3) Broker/ shipper-Own	(B4) Open	(C) Periodic Fee	(C) Transact. Fee	(C) Free of Fee
(A) B2C	1													
(B1) M-to-M	0.1551*	1												
(B1) O-to-M	-0.2339*	-0.6253*	1											
(B1) M-to-F	0.0936	-0.4216*	-0.4440*	1										
(B2) Buyer-O	0.3001*	0.0218	-0.1530*	0.1527*	1									
(B2) Seller-O	-0.1901*	-0.4399*	0.6062*	-0.1993*	-0.1289	1								
(B2) Neutral-O	0.071	0.4206*	-0.5327*	0.1361	-0.2552*	-0.9259*	1							
(B3) Carrier-Own	-0.1052	-0.3796*	0.5891*	-0.2486*	0.0224	0.3895*	-0.3883*	1						
(B3) IT provider-Own	0.1694*	0.6646*	-0.8664*	0.2437*	0.0103	-0.5147*	0.4979*	-0.6060*	1					
(B3) Brok/shipper-Own	-0.0959	-0.4099*	0.4381*	-0.0384	-0.0353	0.2198*	-0.2008*	-0.2951*	-0.5812*	1				
(B4) Open	-0.0234	0.4099*	0.2143*	**-0.7196***	-0.0946	0.1354	-0.096	0.0721	-0.0122	-0.0591	1			
(C) Periodic Fee	-0.1282	0.3585*	-0.5738*	0.2552*	-0.0762	-0.2827*	0.3046*	-0.3922*	0.6055*	-0.3260*	-0.1003	1		
(C) Transact. Fee	0.4048*	0.1717*	-0.2601*	0.105	0.0322	-0.1829*	0.1661*	-0.1778*	0.2933*	-0.1705*	-0.0736	-0.2266*	1	
(C) Free of Fee	-0.1157	-0.4426*	0.6998*	-0.3050*	0.0536	0.3770*	-0.3880*	0.4783*	-0.7495*	0.4109*	0.1389*	-0.8200*	-0.3716*	1
(D) Post & Search	-0.2575*	-0.1034	0.3259*	-0.2600*	-0.2920*	0.2567*	-0.1390*	0.1298	-0.2020*	0.1099	0.3052*	-0.1141	-0.3114*	0.2917*
(D) Open auction	0.1779*	0.1019	-0.2256*	0.1451*	0.0322	-0.1106	0.0955	-0.1380*	0.2595*	-0.1705*	-0.1549*	0.0954	0.4196*	-0.3375*
(D) Sealed auction	0.1637*	0.0437	-0.2070*	0.1904*	0.3087*	-0.2117*	0.0888	-0.0475	0.0415	-0.0013	-0.2347*	0.0605	0.0497	-0.0869
(E) Systematic	-0.0315	0.1179	-0.2283*	0.1298	0.0058	-0.1739*	0.1674*	-0.1143	0.2413*	-0.1729*	-0.1062	0.3069*	-0.0256	-0.2774*
(F) Consulting role	-0.1288	-0.2710*	0.3335*	-0.0763	-0.0736	0.2296*	-0.1959*	0.1585*	-0.3976*	0.3155*	-0.0364	-0.1841*	-0.1252	0.2490*
(G1) Info only	-0.0857	0.2961*	-0.0781	-0.2491*	-0.1131	-0.0764	0.1176	-0.0971	0.1253	-0.0512	0.2656*	0.0471	-0.1158	0.0231
(G1) Info + Settl	-0.0994	-0.1223	0.2266*	-0.1228	-0.0568	0.1364	-0.1113	0.1254	-0.2226*	0.1390*	0.0749	-0.1380*	-0.0966	0.1883*
(G1) Info + After sales	-0.0345	-0.1684*	0.1405*	0.03	-0.0916	0.1224	-0.0844	0.083	-0.0806	0.0119	0.0783	-0.0264	-0.07	0.0664
(G1) Info + Settl + After	-0.1032	-0.2086*	0.1747*	0.0364	-0.0843	0.1741*	-0.1376*	0.093	-0.1453*	0.0793	-0.0793	-0.0651	-0.0981	0.1197
(G1) Nego. only	0.1542*	0.0598	-0.045	-0.0164	0.0819	-0.1065	0.0727	-0.0189	0.0711	-0.066	0.0113	-0.0642	0.0835	0.0122
(G1) Nego + Settl	0.0778	-0.0341	-0.0914	0.1454*	0.2066*	-0.0091	-0.0699	-0.0189	0.0255	-0.0113	-0.1530*	0.1284	0.0054	-0.1256
(G1) Nego + After sales	0.2305*	0.1068	-0.1842*	0.0914	-0.0428	-0.1553*	0.1677*	-0.1259	0.1622*	-0.066	-0.0435	-0.0161	0.3960*	-0.2174*
(G1) All phases	0.0493	0.0522	-0.2238*	0.2001*	0.2259*	-0.1651*	0.075	-0.0672	0.1022	-0.054	-0.2798*	0.1174	0.1051	-0.1737*
(G2) With dec. support	-0.0524	0.1035	-0.3013*	0.2314*	-0.1663*	-0.1193	0.1796*	-0.2519*	0.2949*	-0.0965	-0.1669*	0.2246*	0.1711*	-0.3147*
(Ctrl1) Publicly traded	-0.0994	-0.1590*	0.1541*	0.0035	-0.0568	0.2506*	-0.2227*	0.1672*	-0.1157	-0.0321	-0.0107	0.0125	-0.0966	0.0448
(Ctrl2) US EM	-0.3008*	-0.1668*	0.3436*	-0.2077*	0.0916	0.2254*	-0.2547*	0.2403*	-0.3950*	0.2286*	0.0721	-0.1587*	-0.3160*	0.3369*

To be continued >>

Spearman rank correlation coefficients	(D) Post & Search	(D) Open auction	(D) Sealed auction	(E) Syst.	(F) Consulting role	(G1) Info only	(G1) Info + Settl	(G1) Info + After sales	(G1) Info + Settl + After sales	(G1) Nego. only	(G1) Nego + Settl	(G1) Nego + After sales	(G1) All phases	(G2) With decision support	(Ctrl1) Publicly traded	(Ctrl2) US EM
(A) B2C																
(B1) M-to-M																
(B1) O-to-M																
(B1) M-to-F																
(B2) Buyer-O																
(B2) Seller-O																
(B2) Neutral-O																
(B3) Carrier-Own																
(B3) IT provider-Own																
(B3) Brok/shipper-Own																
(B4) Open																
(C) Periodic Fee																
(C) Transact. Fee																
(C) Free of Fee																
(D) Post & Search	1															
(D) Open auction	-0.4965*	1														
(D) Sealed auction	-0.7770*	-0.1607*	1													
(E) Systematic	-0.4146*	0.2730*	0.2734*	1												
(F) Consulting role	0.0934	-0.0754	-0.0515	-0.0672	1											
(G1) Info only	0.3873*	-0.1923*	-0.3009*	-0.1032	-0.0376	1										
(G1) Info + Settl	0.1946*	-0.0966	-0.1512*	-0.1178	0.0916	-0.1809*	1									
(G1) Info + After sales	0.3138*	-0.1558*	-0.2438*	-0.1899*	-0.0427	-0.2917*	-0.1466*	1								
(G1) Info + Settl + After	0.2887*	-0.1433*	-0.2243*	-0.097	0.1359	-0.2683*	-0.1348	-0.2174*	1							
(G1) Nego. only	-0.3517*	0.0835	0.3394*	0.1793*	-0.0887	-0.1362	-0.0685	-0.1104	-0.1015	1						
(G1) Nego + Settl	-0.3517*	0.0054	0.3960*	0.2463*	-0.0217	-0.1362	-0.0685	-0.1104	-0.1015	-0.0515	1					
(G1) Nego + After sales	-0.3517*	0.1616*	0.2827*	-0.0887	-0.0217	-0.1362	-0.0685	-0.1104	-0.1015	-0.0515	-0.0515	1				
(G1) All phases	-0.6433*	0.4861*	0.3789*	0.3280*	-0.0396	-0.2491*	-0.1252	-0.2019*	-0.1857*	-0.0943	-0.0943	-0.0943	1			
(G2) With dec. support	-0.1807*	0.2736*	0.007	0.0698	-0.0181	-0.2303*	-0.0299	0.0364	0.0355	-0.1740*	-0.0361	0.1938*	0.2424*	1		
(Ctrl1) Publicly traded	0.1168	0.0254	-0.1512*	-0.0654	0.1963*	-0.0201	0.0374	0.0338	0.1031	-0.0685	-0.0685	-0.0685	-0.025	0.0778	1	
(Ctrl2) US EM	0.0966	-0.1445*	-0.005	-0.1044	0.1899*	0.0091	0.1015	0.0462	-0.0167	-0.0628	0.0526	-0.2938*	0.0611	-0.0869	0.1015	1

Table F2: Spearman rank correlation coefficients between variables for study 2.1 of chapter 5 (3 EM types of the new typology)

Spearman rank correlation coefficients	Type 1	Type 2	Type 3	(Ctrl1) Publicly traded	(Ctrl2) US EM
Type 1	1				
Type 2	-0.6587*	1			
Type 3	-0.4323*	-0.3938*	1		
(Ctrl1) Publicly traded	0.3048*	-0.2425*	-0.0817	1	
(Ctrl2) US EM	0.3875*	-0.2454*	-0.1793	0.1592	1

Table F3: Spearman rank correlation coefficients between variables for study 2.2 of chapter 5 (3 EM types inspired by the hierarchical cluster analysis)

Spearman rank correlation coefficients	Type 1	Type 2a	Type 2b + 3	(Ctrl1) Publicly traded	(Ctrl2) US EM
Type 1	1				
Type 2a	-0.4017*	1			
Type 2b + 3	-0.6945*	-0.3799*	1		
(Ctrl1) Publicly traded	0.3035*	-0.1475	-0.1907*	1	
(Ctrl2) US EM	0.3931*	-0.1073	-0.3128*	0.1609	1

Table F4: Spearman rank correlation coefficients between variables for study 2.3 of chapter 5 (5 EM types of the new typology)

Spearman rank correlation coefficients	Type 1	Type 2a	Type 2b	Type 3a	Type 3b	(Ctrl1) Publicly traded	(Ctrl2) US EM
Type 1	1						
Type 2a	-0.4017*	1					
Type 2b	-0.4139*	-0.2265*	1				
Type 3a	-0.2049*	-0.1121	-0.1155	1			
Type 3b	-0.3644*	-0.1994*	-0.2054*	-0.1017	1		
(Ctrl1) Publicly traded	0.3035*	-0.1475	-0.152	-0.0752	-0.0464	1	
(Ctrl2) US EM	0.3931*	-0.1073	-0.2071*	0.0239	-0.2146*	0.1609	1

Table F5: Spearman rank correlation coefficients between variables for study 3.1 of chapter 5 (3 clusters from the K-means analysis)

Spearman rank correlation coefficients	Cluster 1 (T2)	Cluster 2 (T1)	Cluster 3 (T3)	(Ctrl1) Publicly traded	(Ctrl2) US EM
Cluster 1 (T2)	1				
Cluster 2 (T1)	-0.6317*	1			
Cluster 3 (T3)	-0.4158*	-0.4424*	1		
(Ctrl1) Publicly traded	-0.1590*	0.1507*	0.0071	1	
(Ctrl2) US EM	-0.1668*	0.3477*	-0.2149*	0.1015	1

Table F6: Spearman rank correlation coefficients between variables for study 3.2 of chapter 5 (3 clusters from the hierarchical analysis)

Spearman rank correlation coefficients	Cluster 1 (T2b + T3)	Cluster 2 (T2a)	Cluster 3 (T1)	(Ctrl1) Publicly traded	(Ctrl2) US EM
Cluster 1 (T2b + T3)	1				
Cluster 2 (T2a)	-0.4460*	1			
Cluster 3 (T1)	-0.5937*	-0.4554*	1		
(Ctrl1) Publicly traded	-0.0828	-0.095	0.1677*	1	
(Ctrl2) US EM	-0.2239*	-0.1161	0.3271*	0.1015	1

Table F7: Spearman rank correlation coefficients between variables for study 3.3 of chapter 5 (5 clusters from the K-means analysis)

Spearman rank correlation coefficients	Cluster 1 (T3b)	Cluster 2 (T2b)	Cluster 3 (T2a)	Cluster 4 (T3a)	Cluster 5 (T1)	(Ctrl1) Publicly traded	(Ctrl2) US EM
Cluster 1 (T3b)	1						
Cluster 2 (T2b)	-0.1784*	1					
Cluster 3 (T2a)	-0.2548*	-0.2273*	1				
Cluster 4 (T3a)	-0.1118	-0.0997	-0.1425*	1			
Cluster 5 (T1)	-0.3592*	-0.3204*	-0.4577*	-0.2008*	1		
(Ctrl1) Publicly traded	0.0555	-0.1203	-0.0893	-0.0754	0.1574*	1	
(Ctrl2) US EM	-0.3178*	-0.1321	-0.0707	0.1215	0.3394*	0.1015	1

APPENDIX G: Regression analyses

Table G1: Results for study 1 of chapter 5, influence on performance of EM categories

	Logistic Regression		OLS Regression (standard betas)									
	Rank 10%		Log Rank		Visitors		Log Visitors		Pages		Log Pages	
	a	b	a	b	a	b	a	b	a	b	a	b
N	198	192	198	191	198	192	198	192	198	192	198	192
R-square	0.36	0.32	0.34	0.32	0.19	0.21	0.31	0.27	0.16	0.19	0.32	0.31
Adj. R-square	-	-	0.30	0.28	0.14	0.17	0.27	0.23	0.12	0.16	0.29	0.26
Prob>ChiSq	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	<0.0001	<0.0001	<0.0001
Intercept	-8.038 ***	-6.551 ***	0 ***	0 ***	0 **	0	0 ***	0 ***	0 ***	0	0 ***	0 ***
(Ctrl1) Publicly traded	5.383 ***	3.204 ***	-0.319 ***	-0.313 ***	0.113 *	0.251 ***	0.310 ***	0.329 ***	-	0.180 ***	0.314 ***	0.322 ***
(Ctrl2) US EM	-	-	-0.115 *	-	0.215 ***	0.190 **	0.189 ***	0.114	0.240 ***	0.244 ***	0.178 **	0.121
(A) B2C	2.259 ***	2.454 ***	-0.149 **	-0.089	0.284 ***	0.159 **	0.224 ***	0.163 **	0.293 ***	0.133 *	0.189 ***	0.130 *
(B1) O-to-M	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
(B1) M-to-F	-	-	-	-	-	-	-	-	-	-	-	-
(B1) M-to-M	-	-1.516 **	-	-	-	-	-	-	-	-	-	-
(B2) Seller-O	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
(B2) Buyer-O	3.020	-	0.150 **	-	-0.112	-	-0.127 *	-	-0.133 *	-	-0.102	-
(B2) Neutral-O	4.341 ***	1.969 **	-	-	-	-	-	-	-	-	-	-
(B3) Carrier-Own	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
(B3) Broker/ shipper-Own	-	-	-	-	-	-	-	-	-	-	-	-
(B3) Third-party-Own	1.016	-	-0.189 ***	-	0.158 **	0.250 ***	0.276 ***	0.280 ***	0.141 *	0.190 **	0.292 ***	0.209 **
(B4) Open	-1.631 **	-	0.197 ***	0.192 ***	-	-0.221 ***	-0.196 ***	-0.224 ***	-	-0.268 ***	-0.198 ***	-0.200 ***
(C) Free of Fee	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
(C) Periodic Fee	-	1.644 **	-	-0.139 **	-	-	-	-	-	-	-	0.118
(C) Transact. Fee	-	-	-	-	0.118	-	-	-	-	-	-	-
(D) Post & Search	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
(D) Open auction	3.084 ***	3.422 ***	-0.270 ***	-0.238 **	0.209 **	-	0.149 **	-	0.220 ***	-	0.198 ***	0.247 ***
(D) Sealed auction	2.165 *	2.587 ***	-0.270 ***	-0.235 **	0.220 **	0.102	0.195 **	0.111	0.142 *	-	0.232 ***	0.295 ***
(E) Systematic	-	-1.708 *	0.191 ***	0.134 *	-0.144 *	-0.150 **	-0.201 ***	-0.126 *	-0.127	-	-0.226 ***	-0.190 **
(F) Consulting role	-	-	-	-	-	-	-	-	-	-	-	-
(G1) Info only	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
(G1) Info + Settl	2.672 *	2.068	-	-	-	-	-	-	-	-	-	-
(G1) Info + After sales	-	-	0.097	0.120 *	-	-	-0.112 *	-0.121 *	-	-	-	-
(G1) Info + Settl + After	3.146 **	3.163 ***	-0.178 ***	-0.147 **	0.105	0.107	0.166 **	0.146 **	0.149 **	0.195 ***	0.218 ***	0.208 ***
(G1) Nego. only	-	-	0.131 **	0.113	-0.141 *	-	-	-	-0.099	0.166 **	-	-0.101
(G1) Nego + Settl	-	-	-	-	-	0.128 *	-	-	-	-	-	-
(G1) Nego + After sales	-	-	-	-	-0.147 *	-	-	-	-	-	-	-
(G1) All phases	-	-	-	0.122	-	-	-	-	-	-	-	-0.153 *
(G2) With decision support	-	-	-	-0.144 **	-	-	-	-	-	-	-	-

Table G2: Results for study 2.1, influence on performance of the 3 types of EMs suggested in the new typology

	Logistic Regression		OLS Regression (standard betas)									
	Rank 10%		Log Rank		Visitors		Log Visitors		Pages		Log Pages	
	a	b	a	b	a	b	a	b	a	b	a	b
N	108	104	108	104	109	105	109	105	109	105	109	105
R-square	0.09	0.11	0.24	0.23	0.04	0.17	0.24	0.23	0.04	0.14	0.25	0.24
Adj. R-square	-	-	0.21	0.20	0.00	0.14	0.22	0.20	0.00	0.10	0.22	0.21
Prob>ChiSq	0.0695	0.0574	<0.0001	<0.0001	0.3890	0.0007	<0.0001	<0.0001	0.3741	0.0050	<0.0001	<0.0001
Intercept	-2.859 ***	-2.534 **	0 ***	0 ***	0	0	0 ***	0 ***	0	0	0 ***	0 ***
(Ctrl1) Publicly traded	n.i.	n.i.	-0.376 ***	-0.395 ***	0.058	0.184 *	0.375 ***	0.392 ***	0.065	0.163	0.391 ***	0.411 ***
(Ctrl2) US EM	-0.215	-0.486	-0.142	-0.076	0.142	0.169 *	0.166 *	0.103	0.149	0.162	0.150	0.076
Type 1	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Type 2	0.771	0.350	-0.338 ***	-0.288 ***	0.199 *	0.161	0.395 ***	0.352 ***	0.185	0.111	0.401 ***	0.360 ***
Type 3	2.012 **	1.850 **	-0.489 ***	-0.484 ***	0.185	0.478 ***	0.494 ***	0.487 ***	0.196 *	0.408 ***	0.483 ***	0.475 ***

n.i. = variable not included in this model. Ref. = the variable was taken as a reference within its categorization scheme, */**/*** = significant at the 0.1/0.05/0.01 level

Table G3: Results for study 2.2, influence on performance of the 3 types of EMs inspired by the hierarchical clustering analysis

	Logistic Regression		OLS Regression (standard betas)									
	Rank 10%		Log Rank		Visitors		Log Visitors		Pages		Log Pages	
	a	b	a	b	a	b	a	b	a	b	a	b
N	107	103	107	103	108	104	108	104	108	104	108	104
R-square	0.17	0.15	0.29	0.26	0.07	0.13	0.28	0.24	0.06	0.08	0.27	0.24
Adj. R-square	-	-	0.26	0.23	0.03	0.10	0.25	0.21	0.03	0.05	0.24	0.21
Prob>ChiSq	0.0054	0.0129	<0.0001	<0.0001	0.1359	0.01	<0.0001	<0.0001	0.1534	0.07	<0.0001	<0.0001
Intercept	-2.991 ***	-2.733 ***	0 ***	0 ***	0	0	0 ***	0 ***	0	0	0 ***	0 ***
(Ctrl1) Publicly traded	n.i.	n.i.	-0.376 ***	-0.395 ***	0.058	0.184 *	0.376 ***	0.393 ***	0.065	0.163	0.391 ***	0.412 ***
(Ctrl2) US EM	-0.079	-0.288	-0.160 *	-0.102	0.157	0.188 *	0.176 *	0.118	0.163	0.175	0.159 *	0.086
Type 1	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Type 2a	-15.16	-14.26	-0.126	-0.120	0.051	0.081	0.192 *	0.191 *	0.055	0.075	0.221 **	0.228 **
Type 2b + 3	1.876 **	1.634 **	-0.564 ***	-0.519 ***	0.287 **	0.417 ***	0.573 ***	0.529 ***	0.278 **	0.326 ***	0.556 ***	0.506 ***

n.i. = variable not included in this model. Ref. = the variable was taken as a reference within its categorization scheme, */**/*** = significant at the 0.1/0.05/0.01 level

Table G4: Results for study 2.3, influence on performance of the 5 types of EMs suggested in the new typology

	Logistic Regression		OLS Regression (standard betas)									
	Rank 10%		Log Rank		Visitors		Log Visitors		Pages		Log Pages	
	a	b	a	b	a	b	a	b	a	b	a	b
N	107	103	107	103	108	104	108	104	108	104	108	104
R-square	0.18	0.17	0.29	0.27	0.07	0.18	0.28	0.26	0.07	0.14	0.27	0.25
Adj. R-square	-	-	0.25	0.22	0.02	0.13	0.24	0.21	0.01	0.09	0.22	0.20
Prob>ChiSq	0.0221	0.0365	<0.0001	<0.0001	0.2742	0.0029	<0.0001	<0.0001	0.3229	0.0207	<0.0001	<0.0001
Intercept	-2.916 ***	-2.602 **	0 ***	0 ***	0	0	0 ***	0 ***	0	0	0 ***	0 ***
(Ctrl1) Publicly traded	n.i.	n.i.	-0.376 ***	-0.395 ***	0.058	0.184 *	0.376 ***	0.393 ***	0.065	0.163	0.391 ***	0.412 ***
(Ctrl2) US EM	-0.156	-0.419	-0.150	-0.086	0.158	0.175 *	0.166 *	0.103	0.169	0.176 *	0.156 *	0.078
Type 1	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Type 2a	#####	#####	-0.123	-0.116	0.052 *	0.077	0.190 *	0.187 *	0.056	0.076	0.220 **	0.226 **
Type 2b	1.621 *	1.155	-0.416 ***	-0.339 ***	0.280	0.185	0.433 ***	0.362 ***	0.256 **	0.113	0.418 ***	0.341 ***
Type 3a	2.352 **	2.254 **	-0.322 ***	-0.332 ***	0.107	0.302 ***	0.330 ***	0.338 ***	0.087	0.193 *	0.287 ***	0.294 ***
Type 3b	1.904 *	1.728 *	-0.410 ***	-0.400 ***	0.168	0.407 ***	0.408 ***	0.396 ***	0.195 *	0.389 ***	0.422 ***	0.408 ***

n.i. = variable not included in this model. Ref. = the variable was taken as a reference within its categorization scheme, */**/*** = significant at the 0.1/0.05/0.01 level

Table G5: Results for study 3.1, influence on performance of the 3 clusters from the k-means clustering analysis

	Logistic Regression		OLS Regression (standard betas)									
	Rank 10%		Log Rank		Visitors		Log Visitors		Pages		Log Pages	
	a	b	a	b	a	b	a	b	a	b	a	b
N	198	192	198	192	198	192	198	192	198	192	198	192
R-square	0.07	0.10	0.17	0.18	0.04	0.10	0.15	0.16	0.03	0.09	0.17	0.18
Adj. R-square	-	-	0.15	0.16	0.02	0.08	0.14	0.14	0.01	0.07	0.16	0.16
Prob>ChiSq	0.0334	0.0065	<0.0001	<0.0001	0.1151	0.0005	<0.0001	<0.0001	0.2892	0.0016	<0.0001	<0.0001
Intercept	-2.708 ***	-2.300 ***	0 ***	0 ***	0	0	0 ***	0 ***	0	0	0 ***	0 ***
(Ctrl1) Publicly traded	n.i.	n.i.	-0.319 ***	-0.331 **	0.110	0.225 ***	0.301 ***	0.311 ***	0.071	0.168 **	0.312 ***	0.323 ***
(Ctrl2) US EM	-0.216	-0.601	-0.040	0.013	0.110	0.112	0.076	0.026	0.107	0.114	0.077	0.024
Cluster 2 (T1)	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Cluster 1 (T2)	0.417	0.105	-0.148 *	-0.116	0.165 **	0.142 *	0.210 ***	0.184 **	0.127	0.069	0.213 ***	0.187 **
Cluster 3 (T3)	1.591 **	1.577 **	-0.326 ***	-0.326 ***	0.164 **	0.284 ***	0.330 ***	0.329 ***	0.148 *	0.280 ***	0.359 ***	0.355 ***

n.i. = variable not included in this model. Ref. = the variable was taken as a reference within its categorization scheme, */**/*** = significant at the 0.1/0.05/0.01 level

Table G6: Results for study 3.2, influence on performance of the 3 clusters from the hierarchical clustering analysis

	Logistic Regression		OLS Regression (standard betas)									
	Rank 10%		Log Rank		Visitors		Log Visitors		Pages		Log Pages	
	a	b	a	b	a	b	a	b	a	b	a	b
N	198	192	198	192	198	192	198	192	198	192	198	192
R-square	0.07	0.05	0.17	0.16	0.04	0.08	0.16	0.14	0.04	0.06	0.17	0.16
Adj. R-square	-	-	0.15	0.14	0.02	0.06	0.14	0.13	0.02	0.04	0.15	0.14
Prob>ChiSq	0.0363	0.0814	<0.0001	<0.0001	0.0699	0.0039	<0.0001	<0.0001	0.1266	0.0237	<0.0001	<0.0001
Intercept	-2.241 ***	-1.843 **	0 ***	0 ***	0	0	0 ***	0 ***	0	0	0 ***	0 ***
(Ctrl1) Publicly traded	n.i.	n.i.	-0.327 ***	-0.341 ***	0.111	0.234 ***	0.309 ***	0.320 ***	0.073	0.180 **	0.321 ***	0.333 ***
(Ctrl2) US EM	-0.397	-0.767	-0.024	0.025	0.106	0.096	0.060	0.012	0.103	0.100	0.058	0.007
Cluster 3 (T1)	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Cluster 2 (T2a)	-0.703	-0.360	-0.053	-0.057	0.082	0.135 *	0.116	0.125	0.042	0.062	0.122	0.130 *
Cluster 1 (T2b + T3)	0.987 *	0.726	-0.317 ***	-0.276 ***	0.215 **	0.226 ***	0.339 ***	0.301 ***	0.196 **	0.206 **	0.351 ***	0.311 ***

n.i. = variable not included in this model. Ref. = the variable was taken as a reference within its categorization scheme, */**/*** = significant at the 0.1/0.05/0.01 level

Table G7: Results for study 3.3, influence on performance of the 5 clusters from the k-means clustering analysis

	Logistic Regression		OLS Regression (standard betas)									
	Rank 10%		Log Rank		Visitors		Log Visitors		Pages		Log Pages	
	a	b	a	b	a	b	a	b	a	b	a	b
N	198	192	198	192	198	192	198	192	198	192	198	192
R-square	0.09	0.11	0.19	0.20	0.05	0.11	0.17	0.17	0.05	0.10	0.19	0.19
Adj. R-square	-	-	0.17	0.17	0.02	0.08	0.15	0.15	0.02	0.07	0.17	0.17
Prob>ChiSq	0.0428	0.0176	<0.0001	<0.0001	0.0997	0.0015	<0.0001	<0.0001	0.1729	0.0037	<0.0001	<0.0001
Intercept	-2.818 ***	-2.410 ***	0 ***	0 ***	0	0	0 ***	0 ***	0	0	0 ***	0 ***
(Ctrl1) Publicly traded	n.i.	n.i.	-0.323 ***	-0.333 ***	0.111	0.217 ***	0.304 ***	0.311 ***	0.072	0.159 **	0.313 ***	0.322 ***
(Ctrl2) US EM	-0.074	-0.460	-0.061	-0.006	0.132 *	0.132 *	0.098	0.048	0.131 *	0.142 *	0.103	0.047
Cluster 5 (T1)	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Cluster 3 (T2a)	-0.304	-0.389	-0.063	-0.060	0.086	0.141 *	0.128 *	0.128 *	0.046	0.068	0.134 *	0.137 *
Cluster 2 (T2b)	1.118	0.655	-0.214 ***	-0.153 **	0.209 ***	0.084	0.244 ***	0.191 **	0.193 **	0.046	0.241 ***	0.184 **
Cluster 4 (T3a)	1.283	1.260	-0.170 **	-0.173 **	0.051	0.100	0.158 **	0.160 **	0.038	0.084	0.164 **	0.166 **
Cluster 5 (T3b)	1.717 **	1.704 **	-0.322 ***	-0.320 ***	0.181 **	0.299 ***	0.333 ***	0.332 ***	0.168 **	0.303 ***	0.366 ***	0.361 ***

n.i. = variable not included in this model. Ref. = the variable was taken as a reference within its categorization scheme, */**/*** = significant at the 0.1/0.05/0.01 level