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Key or Else: Critical Success Factors of Digital Ecosystems in the Road Transport Industry

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Abstract

Purpose: This research paper aims to analyze, identify, and rank critical success factors (CSFs) of digital ecosystems within the road transport industry. The purpose of this study is to identify and evaluate CSFs from a literature review and then to validate these through a structured questionnaire survey to find out which of these are the most critical ones.

Methodology: The methodology encompasses an international quantitative survey among customers of Europe's freight exchange market leader TIMOCOM. The study measures both the active influence and passive influence-ability of the success factors and presents them in a clear model, a four-quadrant active-passive grid to rank and display the factors into the most and less critical ones.

Findings: The findings based on more than 400 responses selected the following 11 as the most important CSFs: Usability, Trust, Security, Customer orientation, and Value added services, Partnerships, Network, Internationality, Quality, Innovations, and Technology. The remaining 10 factors were rated low: Customer service, pricing and payment, staff members, cost reduction, owner, marketing and sales, transparency, culture, neutrality, and last but not least sustainability.

Unique Contributor to Theory, Policy, and Practice: The unique contribution of this quantitative, Europe-wide study to theory, policy, and practice lies thus not only in the identification and the visualization of the most and less important CSFs of a digital ecosystem but also in gaining important valuable insights into their further development in the road freight industry. Finally, this paper offers several strategic and operational implications and recommended actions for the future of digital ecosystems. Theoretical insights underline usability as the most critical success factor, while practical recommendations include creating all-in-one solutions, enhancing value-added services, and addressing user concerns about data security and platform control.

Keywords: *Digital Ecosystems, Road Transport Industry, Critical Success Factors, Active-Passive Grid, TIMOCOM*

1 Introduction

The European Road transport market is undergoing a significant change (Nowakowska-Grunt & Strzelczyk, 2019). The reasons for this change in one of Europe's most important industrial sectors are manifold. On the one hand, the market is still dominated by inefficiencies and a high proportion of manual processes. On the other hand, the last few years with the Corona pandemic and the war in Ukraine have shown how important stable supply chains are to ensure the population's supply. It is becoming increasingly difficult and important to satisfy the needs of customers (Chan & Choi, 2023). As in other industries, technological change in the form of digital transformation has also found its way into road freight transport (Saarikko, Westergren, & Blomquist, 2020). Digital solutions have the potential to significantly change value chains and business models (Subramaniam, Iyer, & Venkatraman, 2019). Especially digital platforms such as freight exchanges, marketplaces, or even digital freight forwarders are trying to generate added value for their customers in Europe. These innovative platforms are playing an increasingly important role in logistics. But what are the CSFs of such platforms? Which of these are key and which are else? The current literature on CSFs in digital ecosystems and logistics service providers is still very limited and there is a need for further research. This paper aims to address this research gap.

This research contributes a verification of identified CSFs from a literature review on a quantitative basis with many platform customers. This new study closes the literature gap and provides a ranking of the most and less critical CSFs. It also provides valuable insights into the operational and strategic further development of digital ecosystems.

The paper is structured as follows. The literature review starts with a short classification of key terms, and it continues with a review of the existing literature based on which appropriate CSFs were derived. In the following section the research question and the research methodology with the conceptual framework model were explained. The next section discusses the research results. Afterwards the strategic and operational implications were pointed out and recommended actions were proposed. The last section ends with a summary of findings, the limitations and provides an outlook for future research.

2 Literature Review

This chapter first defines the basic terminology of critical success factors and explains the concept of digital ecosystems in the road transport industry. Subsequently, the CSFs from the literature research are identified from two areas: logistics service providers and digital ecosystems. The identified CSFs are then clustered in a meaningful way.

2.1 Critical success factors

As early as the 1970s, Rockart introduced the "critical success factors" (CSF) method in the Harvard Business Review (Rockart, 1979). Rockart describes them as follows: "Critical success factors are the few key areas of activity in which favorable results are absolutely necessary for a particular manager to reach his goals." (Rockart, 1980). Bullen and Rockart add the following

definition "CSFs are the limited number of areas in which satisfactory results will ensure successful competitive performance for the individual, department or organization. CSFs are the few key areas where "things must go right" for the business to flourish and for the manager´s goals to be attained." (Bullen & Rockart, 1981). Like Freund, they suggest that the CSF method can be used both as a Management Information System (MIS) and for requirements analysis (Freund, 1988).

In the academic discussion, the terms key success factors (KSF) and critical success factors (CSF) are used as synonyms. The terms "key" and "critical" have their origins in the well-known Pareto rule - also called the 80-20 rule, developed by the Italian economist Vilfredo Pareto - which is a statistical tool and states that 80 percent of consequences come from 20 percent of the causes (Karuppusami & Gandhinathan, 2006). The identification of CSFs can be done by different methods: via case studies, literature review, interviews, or a combination of these methods (Rebelo, Santos, & Silva, 2015). For this research, the most important CSFs will be identified from the literature review.

2.2 Digital ecosystems in road transport industry

Moore suggested in 1993 that a company should be viewed as a part of business ecosystems across industries: "In a business ecosystem, companies co-evolve capabilities around a new innovation: the work cooperatively and competitively to support new products, satisfy customer needs, and eventually incorporate the next round of innovations." (Moore, 1993). From his point of view, business ecosystems develop from "...a random collection of elements to a more structured community." (Moore, 1993). This will make the value of the digital ecosystem more than just the sum of its parts. But what does digital ecosystems look like in the road transport industry? There are many existing platform definitions and concepts, which again indicates the complexity of the road transport market. As Heinbach et al. emphasizes, "...the rise of Digital Platforms (DPs) in the forwarding business is primarily linked to technological platforms as markets that promote competition separately from cloud architectures to innovate products and design platforms." (Heinbach, Beinke, Kammler, & Thomas, 2022). They identified three different DPs. Möller et al. analyzed archetypes of digital business models of start-ups in the logistics industry with a focus on platform-driven business (Möller et al., 2019). Based on the concept of a transaction platform from Evans and Gawer (Evans & Gawer, 2016) they differentiated into a digital marketplace and booking platform. Hofmann and Osterwalder differentiated into two platform businesses in the logistics industry, logistics marketplace platforms and vehicle manufacturer platforms (Hofmann & Osterwalder, 2017). Hagiu and Wright also stress the growing interest in the economics of multi-sided platforms (MSPs) like Amazon and discussed the economic trade-offs of MSPs in relation to the three traditional alternatives (Hagiu & Wright, 2015). They found two aspects particularly important for MSPs: "They enable direct interactions between two or more distinct sides and each side is affiliated with the platform." (Hagiu & Wright, 2015). Lin et al. analyzed electronic marketplaces for transportation services and reported on the classification of transportation marketplaces into two categories, a vertical and a horizontal marketplace (Lin, Mahmassani, Jaillet, & Michael Walton, 2002). They also found out, that the use of these marketplaces will "...lower

transaction costs, provide greater visibility of freight movement, and reduce inefficiencies." (Lin et al., 2002).

This literature review shows that there is no uniform differentiation between platforms, marketplaces, and ecosystems in the logistics industry. The digital ecosystems go much further than digital platforms and marketplaces. That is why we consider the digital ecosystem as an all-encompassing approach, interacting with customers, partners, and even the competition (Hunter, Chesini, & LeHong, 2020). The marketplace is one part of an ecosystem, matching demand, and supply - often with the support of 3rd party supplier. A platform in turn is part of marketplaces by simplifying the creation of value chains by providing digital tools.

2.3 Critical success factors of digital ecosystems in road transport industry

There are many studies in the field of success factor research, as the literature review and Pareto Analysis of CSFs of Supply Chain Management by Tailib et al. indicate (Ab Talib, Abdul Hamid, & Thoo, 2015). For this reason, narrowing it down to the relevant studies makes sense. Therefore, we have analyzed studies from two areas in the following: CSFs of digital ecosystems and logistics service providers.

2.3.1 Critical success factors of digital ecosystems

As the second part of the literature review of CSFs in the road transport industry, this section focuses on studies that have analyzed CSFs of digital ecosystems. We start with the study of Hope et al. from the year 2001, with a focus on Internet-mediated B-to-B e-commerce (Hope, Hermanek, Schlemmer, & Huff, 2001). CSFs were generated from academia and practice, followed by a case study of companies in the transport and logistics industry that are engaged in supply-chain B-to-B e-commerce relationships. Stockdale and Standing investigate the detection and use of CSFs in e-market places (Stockdale et al., 2003). Through the analysis of more than 150 business articles and reports, they identify seven factors and explored them in the context of 12 selected electronic marketplaces (Stockdale et al., 2023). Clasen and Mueller (2006) analyzed success factors of digital agribusiness marketplaces from an empirical study of 233 organizations (Clasen & Mueller, 2006). Sung investigated CSFs for electronic commerce in three countries of east and west: Korea, Japan, and USA (Sung, 2006). Through an extensive literature review and interviews with managers, a list of 16 CSFs was identified. The next study by Beige and Abdi investigated CSFs on successful implementation and execution of B2B e-marketplaces (Beige & Abdi, 2015). They generated factors through a literature review and interviews with IT experts. Afterwards, they determined the importance and the rank of factors through a case study and by using an analytical network process (ANP). In 2018 Prihastomo et al. analyzed CSFs in e-marketplaces via a systematic literature review (Prihastomo, Hidayanto, Prabowo, et al., 2018). A total of 231 articles were analyzed. The study finds 11 key success factors of e-marketplace implementation (Prihastomo et al., 2018). Berens et al. explored in 2019 CSFs of B2C and B2B digital platforms in an explicative multiple case study approach (Berens, Kolb, & Haase, 2019). This qualitative approach analyzed six globally leading digital platforms with a focus on the establishment of such platforms. Just recently in 2021, Rohn et al. analyzed digital platforms in the metal and steel

industry (Rohn, Bican, Brem, Kraus, & Clauss, 2021). Based on a qualitative analysis, they identified six CSFs of platform-based business models.

2.3.2 Critical success factors of logistics service providers

Power et al. conducted 2001 critical success factors in agile supply chain management via an empirical survey of 962 Australian manufacturing companies (Power, Sohal, & Rahman, 2001). In total 43 variables were identified as relevant and then divided into independent and dependent categories (Power et al., 2001). In the next study, Gunasekaran and Ngain (Gunasekaran & Ngain, 2003) conducted a case study on a small third-party logistics (3PL) company in Hong Kong. The case study focuses on the critical success factors of strategy and technology and developed therefore a conceptual model consisting of the following areas. In the third study by Gupta et al. conducted in 2011, the Indian 3PL Supply Chain Management was examined about the key success factors and growth strategies (Gupta, Ali, & Dubey, 2011). In the same direction goes the study by Mothilal et al. with the title "Key success factors and their performance implications in the Indian third-party logistics (3PL) industry" (Mothilal, Gunasekaran, Nachiappan, & Jayaram, 2012). The next research of Pfoser et al. with a focus on synchro modality (Pfoser, Treiblmaier, & Schauer, 2016) used an extensive literature review and an expert panel to identify the relevant CSFs. Kurpjuweit et al. analyze in a qualitative case study data from Swiss manufacturing firms the important barriers and success factors (Kurpjuweit, Reinerth, Schmidt, & Wagner, 2019). The seventh examination of Chau et al. aimed to identify and prioritize critical success factors for improving supply chain quality management (SCQM) under the context of Industry 4.0 (Chau, Tang, Liu, Ip, & Tao, 2021). They identified five factors from the literature and through semi-structured interviews. Finally, in the current study conducted in the post-COVID-19 era of 2021, Paul et al. have identified key strategies for a more robust and resilient supply chain (Paul, Moktadir, & Ahsan, 2021). The results revealed that supply chain resilience and sustainability practices could play a dominant role in this period. However, after an in-depth literature review of critical success factors in logistics and ecosystems, the question remains, which CSFs are relevant about digital ecosystems in road freight transport?

2.3.3 Critical success factors clustered

The CSFs identified by the literature review above are numerous, with 103 factors in total. This is too numerous for a quantitative study, so the following is an attempt to aggregate these factors. Factors that can be clearly distinguished are heterogeneous. Homogeneous factors - where the differences are very small - can be grouped into subgroups. "Similar" objects are called clusters, and the group assignment is called clustering. By logically grouping them into suitable clusters, the number of success factors can be standardized and reduced. These clusters later cumulatively form the pool of success factors, which then need to be verified with a suitable method. In the end, we were able to extract 21 homogeneous CSFs from the more than 100 originally identified CSFs. Table 1 summarizes the literature review with the most important CSFs and their corresponding clusters.

Authors	Year	Most Critical Success Factors - Logistics	Cluster
Paul, S. K., Moktadir, M. A., & Ahsan, K.	2021	a) Resilience and Sustainability practices	a) Sustainability
Ka-Yin Chau, Yuk Ming Tang, Xiaoyun Liu, Yun-Kit Ip & Yiran Tao	2021	a) Customer focus, b) Supplier quality management, c) Quality of IT system, d) Process integration, e) Leadership	a) Customer orientation, b) Quality, c) Staff members, d) Owner
Stefan Kurpjuweit, Dagmar Reinerth, Christoph G. Schmidt & Stephan M. Wagner	2019	a) Pilot projects, b) External consulting, c) Standardisation and control, d) Stepwise approach, e) Training and coaching, f) Knowledge transfer, g) Management involvement, h) Employee involvement	a) Staff members, b) Innovations
S. Pfoser, H. Treiblmaier, O. Schauer	2016	a) Network, collaboration, and trust, b) Sophisticated planning, c) ICT/ITS technologies, d) Physical infrastructure, e) Legal and political framework, f) Awareness and mental shift, g) Pricing/cost/service	a) Network, b) Technology, c) Pricing , d) Customer service, e) Value added services, f) Cost reduction
Mothilal, S., Gunasekaran, A., Nachiappan, S. P., & Jayaram, J.	2012	a) Relationship with customers, b) Skilled logistics professionals	a) Customer orientation, b) Staff members
Gupta, O. K., Ali, S. S., & Dubey, R.	2011	a) Realized Cost Reduction, b) Geographical Coverage, c) Continuous Improvement, d) Knowledge Based Skills, e) Project Management Skills, f) Global Capabilities, g) Realtime information and route optimization	a) Cost reduction, b) Innovations, c) Internationality, d) Transparency
Gunasekaran, A., & Ngai, E. W.	2003	a) Strategic planning, b) Inventory management, c) Transportation planning, d) Capacity planning, e) Information management	a) Transparency, b) Technology
Power, D. J., Sohal, A. S., & Rahman, S. U.	2001	a) Participative management (human resource management), b) Computer-based technology, c) Resource management (inventory management), d) Continuous improvement, e) Supplier relationship, f) Just-in-time methodology , g) Technology utilization	a) Staff members, b) Innovations, c) Partnerships, d) Network, e) Transparency, f) Technology

Authors	Year	Most Critical Success Factors - Ecosystems	Cluster
Rohn, D., Bican, P. M., Brem, A., Kraus, S., & Clauss, T.	2021	a) Value creation, b) Value delivery, c) Value capture d) Promotion and sensitization of digital transformation, e) A suitable platform architecture and strategic judgement of platform providers, f) Promotion of a start-up culture	a) Technology, b) Innovations, c) Customer orientation d) Value added services
Berens, A., Kolb, S., & Haase, H.	2019	a) First-mover strategies, b) Technology and design, c) Frictionless entering, d) Transparent information, e) Ease of use	a) Innovations, b) Technology, c) Usability, d) Transparency
Prihastomo, Y., Hidayanto, A. N., & Prabowo, H.	2018	a) Trust, b) Technical Platform, c) Platform owner, d) Product, e) Service operation, f) Seller, g) Marketing and sales, h) Payment channel, i) Buyer, j) Environmental	a) Trust, b) Technology, c) Owner, d) Service, e) Customer orientation, f) Network g) Marketing & Sales, h) Pricing & Payment
Beige, S., & Abdi, F.	2015	a) Culture, b) Commitment and support of senior management, c) Government support, d) Purposes, e) Organizational strategies, f) Trust, g) Partial advantage, h) Technical infrastructure	a) Culture, b) Staff members, c) Owner, d) Trust e) Innovations, f) Technology
Sung, T. K.	2006	a) Customer orientation, b) Ease of use, c) Variety of goods & services, d) Delivery of goods & services, e) Speed of systems, f) Security of systems	a) Customer orientation, b) Useability, c) Value added services, d) Customer service, e) Security
Clasen, M., & Mueller, R. A.	2006	a) Market liquidity, b) International orientation, c) No frills - concentration on providing exchange services as core business	a) Internationality, b)Technology
Stockdale, R., & Standing, C.	2003	a) Critical mass, b) Income streams, c) Security, d) Level of indepence, e) Technology infrastructure, f) Relationship management, g) Fulfilling participants' needs (value-add)	a) Network, b) Security, c) Technology, d) Value added services
Hope, B. G., Hermanek, M., Schlemmer, C., & Huff, S. L.	2001	a) Reaching a critical mass, b) Sufficient liquidity, c) Appearance as a neutral intermediary, d) Security and trust, e) Ease of use and reliability, f) Offering additional services, g) Building relationships and strategic partnerships	a) Network, b) Neutrality, c) Security, d) Trust, e) Usability, f) Quality, g) Value added services, h) Partnerships

Table 1: Summary of CSFs literature review (Source: Own work)

2.4 Research contribution

The existing literature provides many specific CSFs in the logistics industry. The question is, which CSFs of digital ecosystems in the road transport industry are key, and which are else? Therefore, this research identifies relevant CSFs from the literature review within digital ecosystems and logistics service providers, clusters these, and validates their relevance and importance directly with the participants of an existing digital platform within the road transport industry. In detail, this allows for assessing the most important as well as the less important CSFs of digital ecosystems in the road freight industry. Furthermore, the study measures both the active influence and passive influenceability of the success factors and presents them in an active-passive grid. This enables a visual ranking of all identified CSFs in a clear model. In addition, the respondents were asked to make additions to the success factors as well as to make further comments and suggestions.

Thus, the contribution of this research is the verification of identified CSFs through a direct, written survey of many customers within the logistics industry, by the example of a well-known, European-acting digital freight exchange platform. As a result, the overall research results form a unique database to drive appropriate operational and strategic implications for digital ecosystems and generate new insights on how to further develop these ecosystems using the TIMOCOM platform as an example. Finally, the findings provide several recommended actions for the future development of digital ecosystems. This study of CSFs will contribute to both the theoretical literature and the practical improvement of digital ecosystems in the road freight transport industry.

3 Research question and methodology

3.1 Research question

The core research question for this paper is: Which success factors of digital ecosystems in the road transport industry are more critical than others? To answer this central research question, the quantitative questionnaire method is chosen. Quantitative approaches are more appropriate than qualitative research designs for the validation of CSFs. Quantitative research aims to collect data that can be expressed through numbers, so the quantitative research approach should provide statistically representative results through a sufficiently large sample (Cöster, Engdahl, & Svensson, 2014). The questionnaire contains various closed and open questions that aim to rank the CSFs as well as to make additional remarks from the customer's point of view. As a result of these questions, there will be a ranking of all examined CSFs, which is then discussed accordingly.

3.2 Methodology

With the questions indicated above, two questionnaires were created, one in German for addressing German-speaking customers and one in English for addressing international, English-speaking customers in Europe. The web-based tool Survio was chosen as the survey tool because it can have the respondent rank a question with more than 20 attributes by clicking on them easily (www.survio.com). A preliminary version of the questionnaires was pilot tested for accuracy and reliability. The completion of the questionnaires by the interviewees took between 5 to 10 minutes each. Finally, the complete data sets with the results were saved and can thus be retrieved at any time.

3.2.1 Active-passive grid

A total of 21 CSFs were identified through clustering on the results of the literature review. To rank these factors in terms of importance, an active-passive grid analysis was carried out in accordance with the influence matrix. The influence matrix methodology is applied in different areas (Cole, 2006). The impact matrix goes back to Vester and von Hesler, who modified the original cross-impact matrix with more sensitive graduation in terms of influence (Vester & von Hesler, 1980). They combined two factors, on the one hand, the influence **on** other factors, and on the other hand the influence **of** other factors. In this study, a simplified version without weighting and mathematical calculation is used. The objective is to obtain four fundamental classes of influencing factors: a) critical, b) active, c) buffer, and d) passive factors. Based on the two

questions about active and passive influence explained above, it is easy to rank all factors by their average sums. Then the sums for the active contribution of each factor are transferred to the ordinate axis (y-axis), i.e., the vertical (perpendicular) coordinate axis. The same procedure is then followed for the passive contribution of each factor; the sums are also transferred to the abscissa axis (x-axis), i.e., the horizontal coordinate axis. If a factor achieves a high score in both the active and passive areas, this factor is in the critical part of the quadrant. In contrast to this is the area with the buffer factors, where factors with a low rating are found again. If factors, in particular, are responsible for the active development of a platform, they are found in the quadrant with the active factors. In contrast to this is the passive factors, whose influence has little or no significance. Figure 1 shows the underlying active-passive grid.

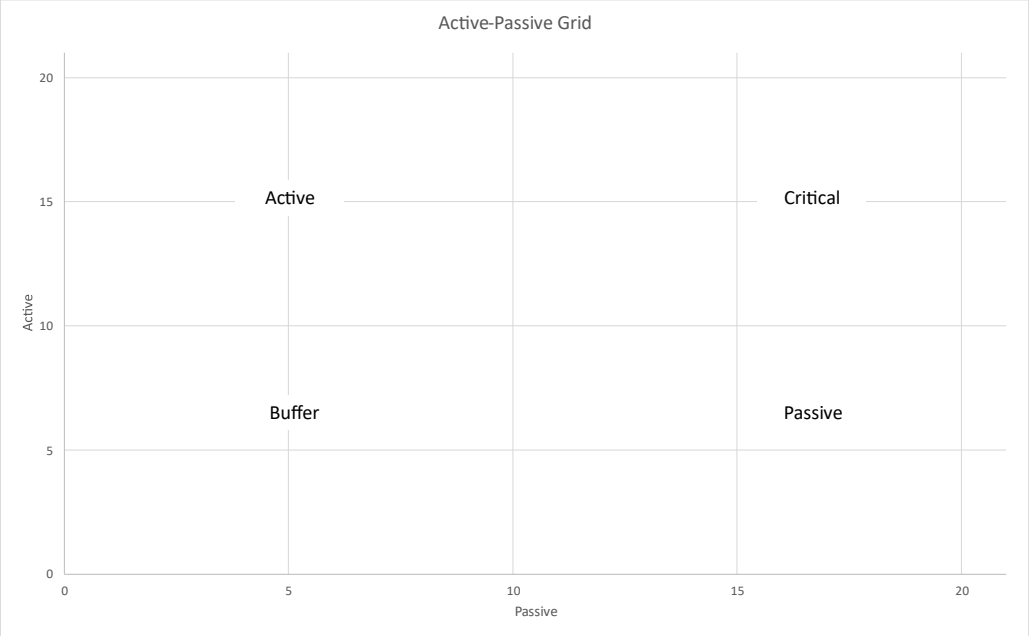

Figure 1: Active-Passive Grid (Source: Own work)

3.2.2 Digital Platform TIMOCOM

TIMOCOM is one of the market leaders in Europe with its freight and vehicle exchange. TIMOCOM has 50.000+ customers and 90 million euros in revenues in 2021. The company's products and services are offered in 44 European countries and 24 languages (available at www.timocom.com). TIMOCOM matchmake freight and truckload capacities between road carriers, freight forwarders, and shippers. In fact, the 150.000+ users of the platform generate in some days more than 1 million international freight and capacities bids.

3.2.3 Data collection

TIMOCOMs customers in the form of shippers, freight forwarders, and carriers serve as the base of respondents covering 53 countries including Germany. TIMOCOM has a potential of 147.000 user e-Mail addresses. A total of 46.120 e-mail addresses were selected as users of the TIMOCOM Platform with the option of addressing them in both German and English. The

customers of the countries have indicated that the preferred language for contacting them via TIMOCOM is German or English. Other languages were sorted out as well as contact persons with the same e-mail address. All of them received an e-mail with an introduction and a link to the survey in Survio. The title of the survey was "Critical success factors of digital ecosystems in the road freight industry". 20.860 of the e-mail addresses came from the database for the German language and therefore received a German questionnaire, another 25.260 came from an international database and received therefore an English questionnaire. The start of the survey was September 7th, 2022, and it ended on November 11th, 2022.

The quantitative survey comprises eight questions. The first three questions serve to record and identify the respective respondent. They should provide information on the company description, how many employees they have, and since when they have been a customer of the TIMOCOM platform. Subsequently, two questions are designed to capture the order in which respondents would rank the 21 success factors identified and clustered above in terms of importance. A distinction is made between their active and passive contribution. Finally, the last 3 open questions serve both to make additions in case someone misses a success factor and to make supplementary comments and suggestions.

403 surveyed completed the questionnaires with 207 German answers and 196 English answers. 1.751 and thus 3.8 per cent of companies' respondents sent an automatic "out of office" reply, 4.047 and hence 8.8 per cent were undeliverable. Thus, with an address pool of 46.120, a confidence level of 95 per cent, and a margin of error of 5 per cent the ideal sample size is therefore n=384. This means that 384 or more completed surveys are required, which was achieved with 406 successful responses. Table 2 in the appendix illustrates the eight research questions and answers we developed for the survey.

4 Results

After analyzing the German and International questionnaires, we found that the results are very similar, therefore we focus on the international results in the following interpretation of the results.

4.1 International market questionnaire results

4.1.1 Key features

Internationally, it is evident that freight forwarders form the clear majority: half of the respondents are self-entering freight forwarders with their own vehicles (91 responses, 46.9 per cent). Together with the group of freight forwarders as a pure intermediary without their own vehicles (38 responses, 19.6 per cent), they form more than 66 per cent of the respondents. Carriers form a larger group with almost a quarter of the respondents or self-drivers (46 responses, 23.7 per cent). The smallest group is clearly the shippers from trade and industry (19 responses, 9.8 per cent). Smaller enterprises with employees from 1 to 10 form the clear majority (104 responses, 53.9 per cent). The second largest group is that of 11 to 25 employees (38 responses, 19.6 per cent). The groups thereafter each form only small sizes: 26 to 50 employees (13 responses, 6.7 per cent), medium-sized companies with 51 to 100 employees (17 responses, 8.8 per cent), 101 to 250

employees (8 responses, 4.1 per cent), and the group of over 250 employees (14 responses, 7.2 per cent). The belonging to the TIMOCOM platform is as follows: almost three-quarters have been part of it for less than 5 years. The majority, with 90 answers (46.4 per cent), stated that they had been there for between 1 and 5 years. A good quarter (50 responses, 25.8 per cent) have stated that they have been members for less than 1 year. 1 and 5 years have been indicated by 80 answers (38.8 per cent) and 66 answers (32 per cent) have been with the platform for more than 10 years. In between 5 and 10 years, there are 33 responses (16 per cent). Only 27 customers (13.1 per cent) have been with TIMOCOM for less than 1 year. Long membership is less common, with 27 responses (13.9 per cent) indicating either belonging for between 5 and 10 years or being a member for more than 10 years.

A summary of the key results shows that freight forwarders make up most respondents, with small companies and few employees predominant, and loyalty to the TIMOCOM platform on a lower level.

4.2.2 CSFs in active-passive grid

The international questionnaire assessed the 21 CSFs identified by 194 interviewees. These values were placed in the active-passive grid, which is shown in figure 2.

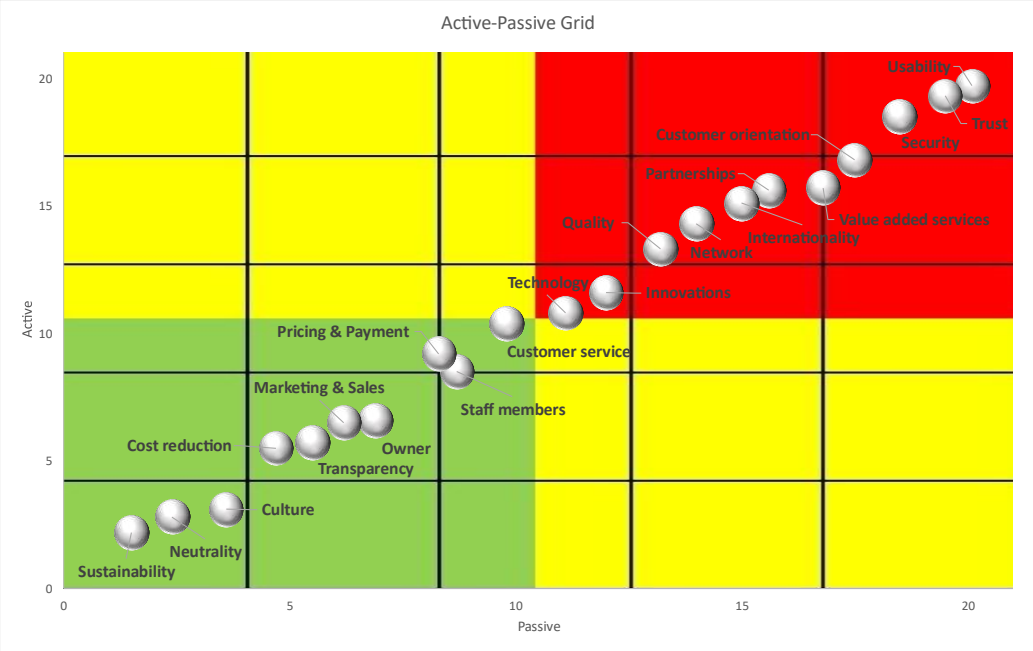

Figure 2: International Active-Passive Grid (Source: Own work)

Two quadrants remain empty, there are no CSFs with the combination of active influence high and passive influence low and vice versa. It turns out that the interviewees rate the two perspectives nearly similarly. There are 11 CSFs in the “critical” quadrant, which score high for both their active influence and their passive influence-ability. In detail, these are: Usability, Trust, Security, Customer orientation, Value added services, Partnerships, Internationality, Network, Quality, Innovations, and Technology. Therefore, the remaining factors that were rated low by the subjects

in both questions: Customer service, Staff members, Pricing and Payment, Owner, Marketing and Sales, Transparency, Cost reduction, Culture, Neutrality, and Sustainability.

5 Discussion

The present study can draw valuable operational and strategic conclusions and recommends numerous individual action points, which we will discuss in the following section.

5.1 Strategic and operational discussion

The results shown are now classified in the following and discussed against the background of their operational and strategic importance.

5.1.1 Strategic importance

The desire for security and trust in the use of a digital ecosystem is strongest among customers. The creditworthiness of partners in particular seems to be a critical point for customers, as one quote underpins: “I think everyone should rate each other after every shipment, so that companies would care customer service better, few times I worked with some companies and they didn´t pay me on time, but I couldn´t do anything to them, I think a rating system could make each company work better for their customer. ”. What is demanded is the verification and ratings of the actors on the platform about their creditworthiness and financial data. This can certainly be integrated with a new function, for example by checking the partners.

Customers of a digital ecosystem demand a large network with many partners and an international offer. A broader range of value-added services is expected to be able to complete all services related to the transport process in one place. Approaches should be developed along the value chain that can represent a complete package for the transport process, e.g., an all-in-one solution. Customers demand a single source to meet all their transport needs in one place, like a respondent said “TIMOCOM, is an all-in-one system that does the complete networking of my daily business. I no longer want to jump back and forth between the many different systems.”.

A platform approach only for the match of supply and demand is not enough for the respondents, they want more products and services, like in a marketplace. The advantage of a marketplace for customers is that they can take care of all their needs in one place with one trustworthy partner without having to go to another digital provider. Not all services and products have to come from the provider itself, specialized companies such as 3rd party solution providers can help here. As an example, TIMOCOM has already implemented the first partnerships in this direction with JITpay as a factoring provider and with Schunck as an insurance provider. It can be assumed that the development of this platform has already started in one direction of the marketplace.

The point of technology is of crucial strategic importance for digital ecosystems. Digital platforms must not only be up-to-date and secure in terms of information technology (IT). In addition to good user-friendliness, the customer naturally expects adequate speed to be able to find or process his transports quickly. And this is on the cutting edge with all available devices, whether stationary via the desktop personal computer or via mobile devices such as smartphones, tablets,

or laptops. In the transport industry speed and accessibility are decisive criteria for receiving orders and completing them on time. This also includes communication between the network partners. TIMOCOM, with its 25-year-old platform, certainly has a challenge to address here, a respondent criticized both, the technological platform, and the communication with the customers: “Your platform is very slow”.

Now, however, there is a critical aspect of platforms that causes headaches for customers. The question of how digital ecosystems handle the customers’ data. They do not want their data to be passed on to third parties or even sold, as the following feedback underlines: “The payment of services is big enough, you do not need to sell company business data to third parties.”. Interesting is also the justification for not doing this, one earns enough with the flat rate fee anyway. New offers are often based on information and data. However, customers only pass on their data very restrictively and want it to be handled with care. In the long term, care must be taken to ensure that this data is only collected and stored for relevant use and is not carelessly passed on to third parties. Only careful handling of this data will further increase trust and reliability.

The point of sustainability plays still a subordinate role. This is also due to the structure of the respondents, the majority of whom are freight forwarders and carriers who do not yet consider this point to be strategically important. Over time, however, this point will certainly also become more prominent among these target groups. If only shippers from trade and industry were asked, sustainability could receive a significantly higher priority, even today.

5.1.2 Operational importance

The most critical factor and therefore operationally the most important for digital ecosystems is the usability factor. A good user experience is key for users and as soon as they have experienced an acceptable level, they no longer want to do without this entitlement. In the case of TIMOCOM a changeover of the user interface took place in the 4th quarter of the year 2022, but there still seems to be significant potential for improvement here, as many customers are not (yet) comfortable with the changeover and some even reject it. Some of the quotes read like this: “Keep the old concept/layout!”. This shows repeatedly that the success factor usability is rated by far the most important by the customers. Often it simply takes a little time for broader acceptance, as one of the respondents confirmed “The technology should not always be renewed because we, as freight forwarders, use your platform as a tool. A craftsman who gets a new hammer more often is not happy there either.”. This is a remarkable quote, which suggests that you don’t need innovation, new features, and value-added services all the time and that you should keep the old user interface. These customers tend to act according to the motto “Never change a running system.” (Heidt, Sonnenschein, & Loske, 2017).

The quality of partners and their content is of great operational importance for users of a digital ecosystem. The example of TIMOCOM shows, that posting offers multiple times seems to reduce the attractiveness and quality of the platform: “Too many duplicate freights offer from individual companies, many freight offers are unfortunately still without prices.”. Here, it is certainly possible

to create an option that offers can only be posted once. At the same time, a feature could be integrated to highlight offers. This feature would then have to be paid for with an extra fee.

Finally, it shows that the international, English-speaking interviewees are more critical and creative in their proposals. It is likely that international customers also use other platforms parallel such as competitor Trans.eu (www.trans.eu) to fulfil their transport needs and thus have better comparability.

5.2 Implications and recommended actions

This research based on the direct users of a platform could be the starting point for rethinking the operational and strategic aspects of digital ecosystems. The most important action points recommended on this basis are the following six:

First, usability is by far the most critical success factor of a digital ecosystem. Management would do well to take another close look at changeovers and analyze why many customers are still not comfortable with new interfaces.

Second, if one takes the survey at its word, the aspect of sustainability is not as important as thought, at least in the year 2025 and in the assessed target group.

Third, customers want an all-in-one digital solution. With the possibility to get everything from one source in one platform. This would develop the platform in the direction of a marketplace that also allows third-party providers.

Fourth, as already indicated in the previous point, relevant value-added services are needed, which can also be provided in partnerships with other providers.

Fifth, customers are looking for security and want more control of the players on a platform, this could be done centrally by a platform but also through peer-to-peer review.

Sixth, the handling of customer data is critical and requires a very sensitive and transparent approach.

6 Summary

This research manages to rank the CSFs identified through a detailed literature review and to identify further valuable key success factors. However, it also reaches its limits at some points and provides room for subsequent future research.

6.1 Summary of findings

The current literature on CSFs of digital ecosystems in the road freight industry is still very limited. The present research identified 21 CSFs based on a literature review, 11 of which have been evaluated by customers of the TIMOCOM digital platform as most important: Usability, Trust, Security, Customer orientation, Value added services, Partnerships, Network, Internationality, Quality, Innovations, and Technology. In contrast, the remaining 10 factors that were rated low are Customer service, Pricing and Payment, Staff members, Cost reduction, Owner, Marketing and Sales, Transparency, Culture, Neutrality, and Sustainability. Viewed from the top,

the strongest factor is Usability, and the factor with the lowest value is sustainability. The four-quadrant active-passive grid displayed all CSFs and highlighted the most critical ones, and the less critical ones. Furthermore, considering the perspective of customers, the study identified valuable additions for complementary success factors as well as supplementary notes for the future development of the digital ecosystem using the example of TIMOCOM.

The paper´s contribution is the verification of identified CSFs on a quantitative basis with many customers. The present study covers a literature gap regarding the ranking of CSFs with the help of an appropriate model, the active-passive grid based on the model of influence analysis. The results consist of three outcomes: the identification and the visualization of the most important CSFs of a digital ecosystem and the gains of important insights into their future development. The numerous additions and suggestions from TIMOCOM customers provided a multitude of fruitful internal insights that had not been available before. In the end, there are sixth very specific recommended action points as implications for the future development of digital ecosystems.

6.2 Limitations and future research

Some limitations based on the survey need to be mentioned.

First, from the numerous customers and potential e-mail addresses of TIMOCOM, we have only filtered out those who have chosen either German or English as their language. This means that we have only exploited 1/3 of the potential customers. It would be possible to get significantly more responses with additional languages.

Second, the additional comments and feedback on the open questions were very valuable. However, these were only isolated feedback on specific points, a universalization is very difficult and should then again be done by means of quantitative methods.

Third, the research tool Survio was very helpful for conducting the quantitative questionnaires. Nevertheless, moving the CSFs into an arbitrary ranking was very challenging for the clients. We think that many respondents left the order due to lack of time or laziness. Therefore, the results can only be interpreted in a limited way.

This study provides a good starting point for further future research on digital ecosystems in the road transport industry. Future studies should go further and use the basis of ranking CSFs to explore how to successfully undertake business transformation of digital ecosystems.

Disclosure statement

No potential conflict of interest was reported by the author.

Data availability statement

The authors confirm that the data supporting the findings of this study are available within the article and its supplementary materials.

List of References

Ab Talib, M. S., Abdul Hamid, A. B., & Thoo, A. C. (2015). Critical success factors of supply chain management: a literature survey and pareto analysis. *EuroMed Journal of Business*, *10*(2), 234–263.

Beige, S., & Abdi, F. (2015). On the critical success factors for b2b e-marketplace. *Decision Science Letters*, *4*(1), 77–86.

Berens, A., Kolb, S., & Haase, H. (2019). Critical success factors for digital platforms in b2b and b2c environments: an explicative multiple case study approach. *International Journal of Business Forecasting and Marketing Intelligence*, *5*(3), 346–370.

Bullen, C. V., & Rockart, J. F. (1981). A primer on critical success factors. *Center for Information Systems Research, Sloan School of Management*.

Chan, H. L., & Choi, T. M. (2023). Logistics management for the future: the IJLRA framework. *International Journal of Logistics Research and Applications*, 1-19.

Chau, K.-Y., Tang, Y. M., Liu, X., Ip, Y.-K., & Tao, Y. (2021). Investigation of critical success factors for improving supply chain quality management in manufacturing. *Enterprise Information Systems*, *15*(10), 1418–1437.

Clasen, M., & Mueller, R. A. (2006). Success factors of agribusiness digital marketplaces. *Electronic Markets*, *16*(4), 349–360.

Cole, A. (2006). The influence matrix methodology: A technical report. *Landcare Research Contract Report: LC0506/175*.

Cöster, F., Engdahl, M., & Svensson, J. (2014). *Critical success factors: An evaluation to identify strategic capabilities.*

Evans, P. C., & Gawer, A. (2016). The rise of the platform enterprise: A global survey. *Report: 99516671002346, The Center for Global Enterprise*.

Freund, Y. P. (1988). Critical success factors. *Planning Review*.

Gunasekaran, A., & Ngai, E. W. (2003). The successful management of a small logistics company. *International Journal of Physical Distribution & Logistics Management*.

Gupta, O. K., Ali, S. S., & Dubey, R. (2011). Third party logistics: key success factors and growth strategies. *International Journal of Strategic Decision Sciences (IJSDS)*, *2*(4), 29–60.

Hagiu, A., & Wright, J. (2015). Multi-sided platforms. *International Journal of Industrial Organization*, *43*, 162–174.

Heidt, M., Sonnenschein, R., & Loske, A. (2017). Never change a running system? how status quo-thinking can inhibit software as a service adoption in organizations. *ISBN 978-989-20-7655-3 Research Papers, European Conference on Information Systems (ECIS)*.

Heinbach, C., Beinke, J., Kammler, F., & Thomas, O. (2022). Data-driven forwarding: a typology of digital platforms for road freight transport management. *Electronic Markets*, 1–22.

Hofmann, E., & Osterwalder, F. (2017). Third-party logistics providers in the digital age: towards a new competitive arena? *Logistics*, *1*(2), 9.

Hope, B. G., Hermanek, M., Schlemmer, C., & Huff, S. L. (2001). Critical success factors in the development of business-to-business electronic commerce. *Journal of Information Technology Case and Application Research*, *3*(3), 7–34.

Hunter, R., Chesini, F., & LeHong, H. (2020). The gartner digital ecosystem framework: How to describe ecosystems in the digital age. *Gartner Research*.

Jazairy, A., & von Haartman, R. (2020). Analysing the institutional pressures on shippers and logistics service providers to implement green supply chain management practices. *International Journal of Logistics Research and Applications, 23*(1), 44-84.

Karuppusami, G., & Gandhinathan, R. (2006). Pareto analysis of critical success factors of total quality management: A literature review and analysis. *The TQM magazine*.

Kurpjuweit, S., Reinerth, D., Schmidt, C. G., & Wagner, S. M. (2019). Implementing visual management for continuous improvement: barriers, success factors and best practices. *International Journal of Production Research*, *57*(17), 5574–5588.

Lin, I. I., Mahmassani, H. S., Jaillet, P., & Michael Walton, C. (2002). Electronic marketplaces for transportation services: Shipper considerations. *Transportation Research Record*, *1790*(1), 1–9.

Möller, F., Bauhaus, H., Hoffmann, C., Niess, C., Otto, B., & Isst, F. (2019). Archetypes of digital business models in logistics start-ups. In *Ecis.*

Moore, J. F. (1993). Predators and prey: a new ecology of competition. *Harvard business review*, *71*(3), 75–86.

Mothilal, S., Gunasekaran, A., Nachiappan, S., & Jayaram, J. (2012). Key success factors and their performance implications in the indian third-party logistics (3pl) industry. *International Journal of Production Research*, *50*(9), 2407– 2422.

Nowakowska-Grunt, J., & Strzelczyk, M. (2019). The current situation and the directions of changes in road freight transport in the european union. *Transportation Research Procedia*, *39*, 350–359.

Paul, S. K., Moktadir, M. A., & Ahsan, K. (2021). Key supply chain strategies for the post-covid-19 era: implications for resilience and sustainability. *The International Journal of Logistics Management*.

Pfoser, S., Treiblmaier, H., & Schauer, O. (2016). Critical success factors of synchromodality: Results from a case study and literature review. *Transportation Research Procedia*, *14*, 1463–1471.

Power, D. J., Sohal, A. S., & Rahman, S.-U. (2001). Critical success factors in agile supply chain management-an empirical study. *International journal of physical distribution & logistics management*.

Prihastomo, Y., Hidayanto, A. N., Prabowo, H., et al. (2018). The key success factors in e-marketplace implementation: A systematic literature review. In *2018 international conference on information management and technology (icimtech)* (pp. 443–448).

Rebelo, M. F., Santos, G., & Silva, R. (2015). Integrated management systems: critical success factors. *Journal of Global Economics, Management and Business Research*, *5*(2), 109–124.

Rockart, J. F. (1979). Chief executives define their own data needs. *Harvard business review*, *57*(2), 81–93.

Rockart, J. F. (1980). The changing role of the information systems executive: a critical success factors perspective. *Center for Information Systems Research, Alfred P. Sloan School of Management*.

Rohn, D., Bican, P. M., Brem, A., Kraus, S., & Clauss, T. (2021). Digital platformbased business models–an exploration of critical success factors. *Journal of Engineering and Technology Management*, *60*, 101625.

Saarikko, T., Westergren, U. H., & Blomquist, T. (2020). Digital transformation: Five recommendations for the digitally conscious firm. *Business Horizons*, *63* (6), 825–839.

Shankar, A., Tiwari, A. K., & Gupta, M. (2021). Sustainable mobile banking application: a text mining approach to explore critical success factors. *Journal of Enterprise Information Management*.

Subramaniam, M., Iyer, B., & Venkatraman, V. (2019). Competing in digital ecosystems. *Business Horizons*, 62 (1), 83–94.

Sung, T. K. (2006). E-commerce critical success factors: East vs. west. *Technological forecasting and social change*, *73*(9), 1161–1177.

Vester, F., & von Hesler, A. (1980). Sensitivity model. *Technical Report: NP2906270*.