Organizing integrated services in mobility-as-a-service systems

Principles of alliance formation applied to a MaaS-pilot in the Netherlands

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Organizing integrated services in mobility-as-a-service systems:

Principles of alliance formation applied to a MaaS-pilot in The Netherlands

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Abstract:

Mobility as a Service (MaaS) involves integration of various forms of public and private transport services into a single mobility service, accessible on demand. For MaaS to become successful, different suppliers of transport services have to cooperate in alliances in order to bring new benefits in the short and long term. Past experience demonstrates that this is a challenge, and existing transport providers are struggling with this cooperation. Various factors, including divergent interests of stakeholders, may limit the formation of such alliances. In this paper, we resort to the theories of alliance formation to extend our understanding of the formation of alliances within MaaS. Based on the economic, sociological and business literature we propose a conceptual model and formulate ten fundamental propositions for alliance formation to offer MaaS systems. The model takes the perspective of business firms for whom the institutional environment is an exogenous influence. We next apply this conceptual alliance-formation-model for a MaaS-pilot in Nijmegen, The Netherlands. Stakeholders within this pilot were interviewed on their conditions for forming an alliance. It appears that shared goals, limited risks for the partners involved, trust, and stimulating public actions are crucial for a successful alliance. For the pilot, however, learning appears to be the main motive for the firms to involve. For future transition from the exploration to the exploitation phase of MaaS alliance, these results should be taken into account. The framework and the propositions developed in this paper could be adopted as the necessary preconditions for designing a proper governance structure for providing MaaS services.

Key words:

Mobility as a Service, MaaS, alliance, alliance formation, exploration, exploitation, cooperation, transport provider, platform provider

1. Introduction

Mobility as a Service (MaaS) is defined as a "user-centric, intelligent mobility distribution model in which all mobility services are aggregated by an operator and supplied to users through a single digital platform" (Kamargianni et al., 2016). This concept offers an integrated perspective on how mobility services could be organized in the future. While many individual components of MaaS are available, full integration of these services are still in experimental or pilot stages (Jittrapirom et al, 2018 Kamargianni, 2016). In these schemes, bike and car sharing services are included in addition to scheduled public transport. Also demand-responsive forms of transport could be offered, including collective demand-responsive transport (DRT) services offering door-to-door or stop-to-stop services and individual demand-responsive transport (ride hailing or ride-sourcing) offered by Transportation Network Companies (TNCs).

The variety of included modes and services indicates that MaaS services can only be successfully offered in case of a robust, transparently organized, and well managed cooperation between the involved stakeholders. Establishing such a cooperation in practice appears a challenging task (Jittrapirom et al, 2018). While the current literature lists many specific barriers for cooperation among transport providers, a comprehensive framework for specifying and assessing the conditions for willingness to cooperate among these providers and the enabling (or limiting) role of public policies is lacking. This article therefore aims to fill that gap by developing and testing a framework for establishing such a cooperation.

The basic and shared motive for stakeholders to jointly implement is the general expectation that it will bring significant social, economic and environmental benefits to urban societies (Jittrapirom et al., 2017). This includes improved opportunities to access destinations, an improved social inclusion, enhanced access to jobs and skills as well as services and markets, and a better coping with main urban mobility challenges (such as traffic congestion, air and noise pollution, and lack of space). Indications for such benefits have been reported in the first real-world, small-scale pilot of MaaS systems (Karlsson et al., 2016).

However, the for implementation of MaaS required cooperation includes the participation of various private mobility service providers with issues on data sharing, marketing, scheduling of services, booking and payment formats. Presently, these stakeholders might be competitors in the mobility market. Further, MaaS assumes the involvement of public agencies and partners offering Information and Communication technology (ICT) services. The cooperation between these partners aims to make transport services interoperable, allowing for seamless journeys between origins and destinations. Full interoperability is achieved when transport systems have a technical, organizational, legal, and cultural interoperability across all transport service providers (Micheni et al, 2014).

Cooperation in the land-transport markets is not evident for a number of reasons:

- Firstly, land transport providers are reluctant to cooperate with each other, with regard to sharing the available data (on e.g. their travelers' behavior) and making payment systems interoperable[1]. Puhe (2014) analyses the interests of different actors, who each have a different role to play and for each of whom drivers or restraints apply in the decision to participate in integrated ticketing. For public transport providers the perceived risk of losing market share (and related loss of revenues) is of crucial importance, because of increased competition with other suppliers affiliated with the MaaS platform. In addition, the adjustments required to achieve interoperability may be costly for firms involved if considerable investments in interfaces and new standards are required.
- Secondly, the legislation for supplying transport in many countries obstructs cooperation. For instance, the current practice of Public Transport (PT) licensing by governments often creates (temporary) monopolies by PT-operators (Hensher, 2017). In addition, transport-taxation policies are historically mode-specific and do not stimulate users to change their travel behavior (Gärling et al, 2009).
- Thirdly, national and local governments are, often, not actively supporting MaaS pioneers or require strategies that cannot be met by private firms. Their role is mostly limited to the financing of various smart mobility initiatives, for example, Beamrz[2], Go About[3], Turnn[4], Breng Flex[5], while playing a limited role in the overarching management and governance of such system transitions. In the Netherlands this changed recently and the national government is actively collaborating with private partners on formulation of standards en open access to information, reservation and payment systems. Goodall et al (2017) argue that it is important to find the right level of regulations, where the public interest is served, but where the private sector still finds it easy to participate and innovate.

Recognizing that governance of smart mobility transitions in general is an emerging issue in transportation studies (Docherty et al., 2017; Pangbourne et al. 2018), the aforementioned problems have particularly put the challenges regarding MaaS at the forefront. The consequences of the pursued new services and the barriers and challenges related to the required level of integration span across micro (consumer), meso (business) and macro (governance) levels (Kostiainen and Tuominen, 2019; Lund and Kerttu, 2017). Further to that, the barriers to inter-organizational cooperation between the public

[1] In airline industries, interoperability and agreements on code-sharing are much more common practice, facilitated by the dominant market led structure with limited government interference - a fundamental different situation compared to the public transit sector. According to Bennett (1997), in the nineties massive financial losses, deregulation and privatization were the leading factors in the formation of robust airline industry alliances. This practice has been strengthened since then with the development of three major alliances, Oneworld, SkyTeam, and Star Alliance.
[2] https://www.beamrz.com/
[3] https://goabout.com/
[4] https://turnn.io/
[5] https://www.breng.nl/breng-flex/1411

and private actors is particularly challenging due to the inherent differences, notably in terms of legal frame, bureaucracy and political control (Smith et al., 2019).

In reaction to the aforementioned challenges, we develop a conceptual framework for establishing stakeholder cooperation in MaaS and apply it to a case study in The Netherlands. We conceptualize the nature of cooperation in MaaS as an **alliance** of partnering firms offering mobility services, creating value for each partner that cannot be attained or only at high costs in other ways (e.g. mergers and acquisitions). We start by asking fundamental questions like why (or why not) would a key stakeholder be joining a MaaS alliance? What necessary pre-conditions have to be met for a MaaS-alliance to take shape in a certain geo-political context? What would be the goal of such an alliance and how could the governance be arranged? Findings from other domains in which alliances play an important role in firm strategies are used, because they provide the access to critical resources that allow for gaining and maintaining competitive advantages in a turbulent environment (Cobeña et al., 2017; Kandemir et al., 2006).

We take the perspective of an **individual firm** facing challenges in a dynamic environment requiring strategic decision-making. We specify determinants of decision-making of these firms with respect to participation in MaaS alliances. In order to identify these determinants, we use the literature on characteristics of successful alliances. In addition, we take the power distribution of the possible MaaS-actors involved into account, recognizing the differences in terms of resource portfolio and market position of the transport actors, since large public transport firms offer other services (e.g. regular bus services) than startups (e.g. carpooling and the MaaS platform services). Such imbalances yield specific challenges for the implementation of MaaS.

We take the **institutional environment** as exogenous to this model. Traditional sectoral policies with respect to public transport (including service contracts and subsidies), and to car ownership and car usage (including taxation and parking policies) have considerable effects on the businesses of the firms providing transport services and their willingness to cooperate. In this paper, we will however not extensively discuss alternative business models, but focus mainly on alliances, the most common form of MaaS-provision.

Based on the conceptual framework, we put forward a number of key propositions with respect to the required pre-conditions for MaaS alliances. The resulting framework is applied and tested for an ongoing MaaS-pilot in Nijmegen called SLiM Nijmegen, The Netherlands. The test is based on interviews and focus group meetings with the stakeholders involved. Note that testing the propositions derived from the conceptual model do not take the form of traditional hypothesis testing; that would require analyzing a large number of cases for which information is not available. Rather, the study follows an approach, inspired by e.g. Eisenhardt (1989) of developing conceptual and theoretical understanding from general

literature and using case study analysis to sharpen the theoretical framing for new cases in the field of MaaS. Although the pilot is small scale and in a developing stage, it nevertheless demonstrates the main conditions for achieving an alliance needed for the successful implementation of MaaS systems.

The paper is organized as follows. Section two summarizes the theoretical and conceptual discussion around alliance formation in the context of MaaS and puts forward ten propositions fundamentally important to MaaS alliances. Section three elaborates on the case study. Section four presents the findings of the analysis in line with the earlier formulated propositions. In section five the concluding remarks, limitations and scopes of future research are discussed.

2. Theoretical Understanding

2.1 Strategic alliances offering integrated services

Different business models can be identified for realizing integrated MaaS-services (König et al., 2016). These differ in terms of integration and formalization of the supply of multi-modal service or its governance. Governance refers to the combination of legal and social control mechanisms for coordinating and safeguarding the resource contributions, administrative responsibilities and division of rewards from their joint activities (Todeva and Knoke, 2005). On the continuum of different governance approaches, applied business models are either based on (a) the concept of fully integrated firms or (b) based on intermediate or hybrid structures, classified as alliances, governed by a mix of social and market mechanisms, or (c) market-led collaboration (Williamson, 1975).

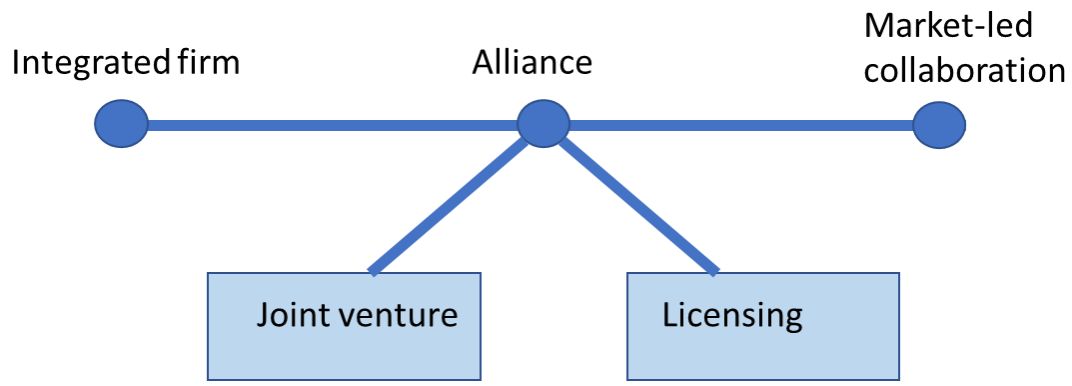

Fig 1: Business structures for the provision of integrated mobility services

The fully integrated firm constitutes an option in which services are combined by mergers and acquisitions under common ownership. Market-led collaborations are based on contract-based transactions between partners and are realized when each of the involved partners expect direct economic benefits.

Strategic alliances are special arrangements between two or more independent firms to cooperate on certain business activities (Isoraite, 2009). Alliances are designed to share resources and knowledge as well as risks between the partnering firms, and to increase the mutual ability to access common markets (Das and Teng, 2000). Often alliances aim at maintaining a long-term cooperative relationship. Alliances may provide different benefits to the partners but also obligate them to make continuing contributions to their partnership (Todeva and Knoke, 2005). In contrast to the other business models, alliances consist of individual firms that decide voluntarily to cooperate and share knowledge, assets and risks, accepting relatively more uncertainty regarding context and added value (Culpan, 2009)

Strategic alliances can take on different forms (Borys and Jemison, 1989). One is, in the context of MaaS, to realize joint ventures of participating transport and MaaS platform providers in which the participants form a single entity to undertake the MaaS activities. Each of the actors has a stake in that entity and share revenues, expenses and profits. Another form is the so-called licensing agreement, where the partners design contracts to use each other's services in return for a fee. For example, a platform provider might do the selling of MaaS tickets in return for a (limited) share of the overall revenues. Ultimately, alliances may develop into complex ecosystems of private firms and public organizations (Köning et al, 2016).

The choice between the integrated firm, a market model or the alliance as a business model for MaaS involves a trade-off between commitment and flexibility. Mudambi et al, 2010; Claussen et al, 2014). Commitment brings great benefits to the integrated firm, but it does so at a cost, in terms of the investment itself and a potential loss of flexibility. Alliances allow firms to take advantage of changing circumstances, but at the cost of less capability to intensively exploit the opportunities since revenues have to be shared. Hence, alliances might be preferred over integrated firms when large investments are not required and interfirm cooperation can be achieved without the costs of merging and acquisition and/or when unpredictable developments are present so that investments are very risky. With large uncertainties and high investments, integration risks premature obsolescence of this investment. Examples of integrated firms within the public transport sector are a number of major companies such as Transdev, DB in Germany and Keolis (part of SNCF) and First Transit. Alternatively, a focal firm being a platform or a key service provider such as a public transport company may consider to offer services from other firms and add it to their services based on contracting, hence choose for a market solution. In relative efficient markets this may work, but market imperfections may raise the costs for travelers and hence reduce demand. This may be the case if two (spatial) monopolies providing transport services in an area have to team up since each optimizes their own objectives without taking the overall optimum into account. To reduce these vulnerabilities, firms engage in alliances or long-term contracts. Hence, alliances may be preferred over market-solutions in case individual firms tend to be vulnerable to their business

partners for obtaining resources and services, placing them at risk of renegotiation or holdup by partners, who thus gain power**.**

Summarizing, the choice for the appropriate business model is complex and involves various trade-off decisions and assessments of the general and unique contextual factors. A more thorough analysis of trade-offs between these architectures is left for future work. In the remainder of this paper we will limit ourselves to alliances based on licensing agreements as the means to offer integrated services, not the alliance as a separate entity, as it seems to be the mutually agreeable first step.

2.2. Determinants of alliance formation: the conceptual Framework

A substantial amount of studies has been published on the formation of alliances. Theories used include economic transaction costs theory, resource dependence theory, strategic choice theory, stakeholder theory, learning theory, social network theory and institutional theory (Russo and Cesarani, 2017). First, we will briefly discuss the phases (Figure 2) in the process of alliance formation before exploring the determinants (Figure 3) that play a role in decision-making related to these steps of alliance formation.

Choices with respect to alliances are made within a strategic decision-making framework. Dietrich (1994) suggests that the level of cooperation between firms seems much less influenced by historic decisions and much more on strategic intentions with respect to an emerging joint purpose and should be put in the light of a strategic intent and expectations of future outcomes (Bronder et al., 1992). Figure 2 pictures a number of (strategic decision-making) phases which, in practice, are not taken sequentially but in iterative rounds. These phases represent the so-called alliance formation process in which firms show an interest in forming a strategic alliance, they analyze reasons and potential alliance benefits, select partners and choose the most appropriate form of cooperation (after Isoraite, 2009).

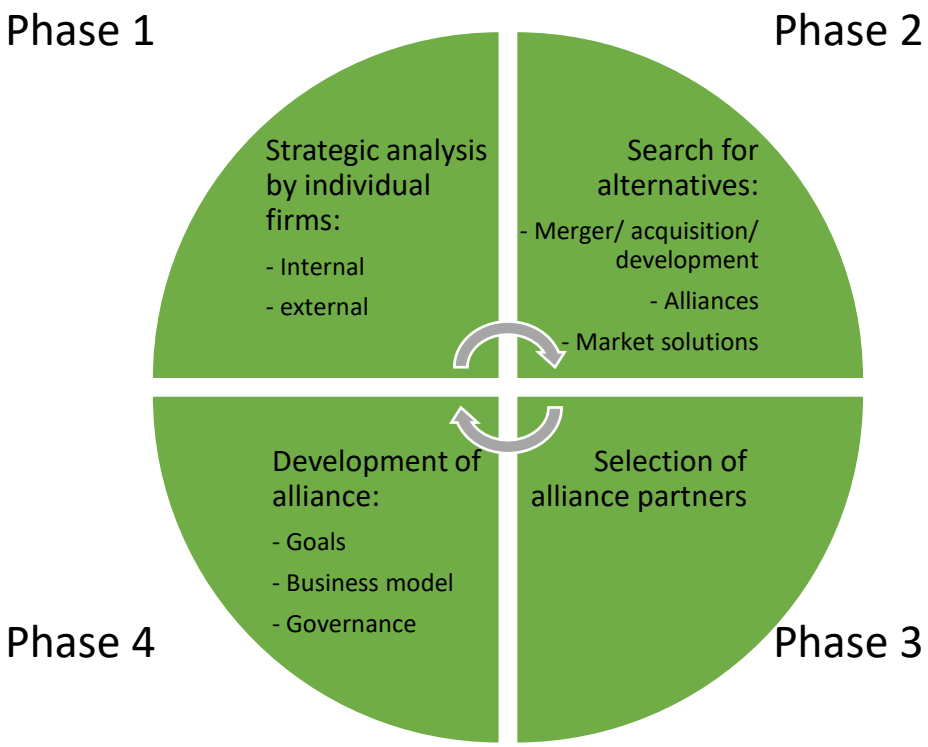

Figure 2: Phases in decision-making with respect to alliance formation

Applying these phases to MaaS gives the following. In phase 1, individual transport firms evaluate their strategic position in the mobility market. They take into account that many future outlooks show that the boundaries between mobility modes appear to break down and the traditional distinction between modes (i.e. bus, train, tram, taxi) will become more blurred as hybrid services develop that cross their traditional distinctions (Atkins, 2015). The public transport operator association expects that combining various flexible transport modes will complement the classic fixed lined public transport systems(Van Audenhove et al., 2014). In addition, they expect that new players (i.e. mobility brokers) will enter the market which may have considerable effects on the business of public transport operators.

For phase 2, transport providers may look at alliances as a possibility to deal with their challenges and evaluate alternatives. We will not discuss the related processes in this paper because we are focusing on alliance formation, hence assume a positive decision on this in this step.

In phase 3, transport providers assess potential partners. Partner assessment involves analyzing a partner's strengths, weaknesses and complementarities (Chung et al, 2000). It requires aligning alliance objectives with the overall strategy of the individual firms, taking differences among the partners into account. Social network theory provides a valuable lens to analyze the selection of partners. While some studies argue that network positions matter, i.e. alliances are explored with partners with a high status quo defined through network centrality, others refer to the basics of sociological traits that actors seek

partnerships with those more similar to them (i.e. homophilous alliances) (McPherson et al., 2001; Stuart, 2000).

In the subsequent alliance-development phase (phase 4), the partners jointly formulate the objectives of the alliance, define the tasks and allocate the resources needed as well as specify the legal and social control mechanisms for coordinating and safeguarding the contribution of each of the partners (Toveda and Knoke, 2005).

Note that it is important to realize that alliances are formed taking into account the interests of all actors. This requires a process of 'co-creation' (Kristensson et al., 2008; Payne et al., 2008; Sanders and Stappers, 2008). Crucial in the co-creation process is the alignment of the needs and desires of all actors as well as the sharing of knowledge, resources and risks.

For each of the phases above, the decision-making of firms is affected by a number of factors. In the remainder of this section, we will lay out the determinants that are crucial for a MaaS alliance to play out successfully, by means of a conceptual framework (Figure 3). For each of the determinants we will summarize the literature in (short) propositions, which will serve as the input for the validation in the empirical section.

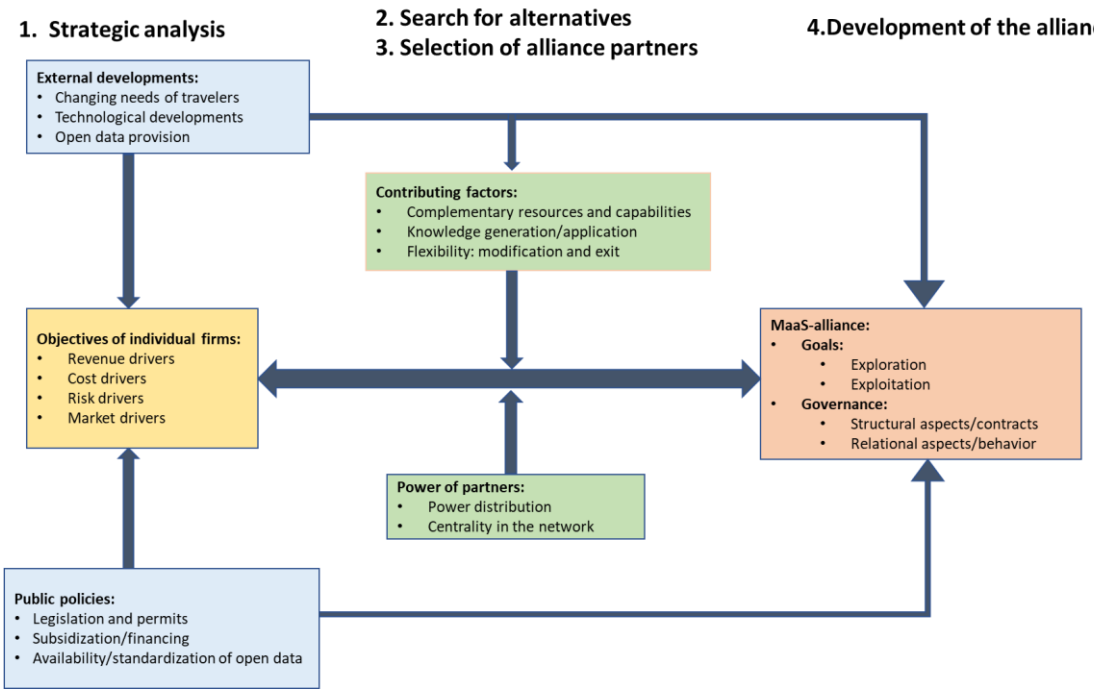

Figure 3: Conceptualizing key determinants of MaaS Alliance

Linking to the decision-making phases (Figure 2), the conceptual model in Figure 3 starts with the objectives of individual firms that consider forming an alliance aimed at offering transport services. In their decision-making they take external developments into account as well as public policies in order to

achieve their objectives including short-term profits, long-term continuity and, to some extent, societal goals such as sustainability. Alliances are characterized by the goals and the way they are managed, including the formal rules (i.e. contracts) as well as the relational (informal/soft) aspects determining the nature of the interaction among the participants in the alliance. The formation and performance of alliances is however also affected by public policies and external drivers providing relevant resources such as legal opportunities and subsidies respectively enabling technologies and economic developments.

In the next subsections, we will elaborate upon each of the elements in the conceptual model (starting from phase 1 to 4).

2.2.1 Objectives of individual firms

According to prior research, the willingness to cooperate by individual firms may be attributed to one or more of the following four drivers related to economic value creation (Contractor and Lorange, 1988; Robson et al, 2008):

a) *Revenue drivers* - *s*trategic alliances can provide entry into new markets and attract new customers. In the case of MaaS one of the aims is to attract car drivers towards these transport services by offering potential customer benefits (Kamargianni et al., 2016), including personalized services, ease of transaction and payment, dynamic journey management and improved journey planning. Integration of these elements were found to have a positive effect on ridership in public transport systems in e.g. London and Paris (Kamargianni et al. 2016). The integration of different travel options into one service was also appreciated by customers in the Ubigo field trial (Sochor et al. 2015).

b) *Cost drivers* - strategic alliances can reduce the costs of individual firms (Hoffmann et al, 2000). In case of MaaS alliances, production costs for transport services may be reduced. For example, conventional fixed bus lines may be replaced by DRTs in low-demand areas (Ambrosino et al., 2016; Sharmeen and Meurs, 2019; Wong et al., 2017). Public transport networks may be shortened to the major lines while other modes serve as access and egress modes on less intensive origin-destination combinations. Combining different means of transportation may also yield economies of scale and scope. Finally, the costs of distribution (ticket sales, information provision to travelers and marketing) may be reduced, especially for new consumer segments by using specialized distribution platforms.

c) *Risk drivers* - strategic alliances can reduce and diversify risks (Reuer et al., 2006). In case of MaaS, travelers might want to replace individual ownership of cars by shared cars. Offering such services would require major investments in car sharing facilities in order to get sufficient scale to be attractive for potential users. Consequently, the revenues for public transport operators are uncertain since these services may compete with the regular bus services. Moreover, the risk of losing brand exposure and a direct relationship with the customer base is perceived as a threat to many service

providers (Holmberg et al., 2016; Sochor et al., 2015). However, an alliance between different providers joining resources and services, with explicit options for exit, helps to limit such risks if the performance of the alliance is carefully monitored.

d) *Long-term continuity drivers*- strategic alliances stimulates to maintain long term continuity and relevance in response to market evolution and socio-political transitions (Douma et al, 2000). Transport providers pursue such continuity and relevance and, in that context, have to cope with increasing passenger requirements concerning quality of public transport services, whereas financial considerations put firm constraints on the cost-effectiveness of these services. The emergence of new mobility solutions in the context of MaaS can potentially address some of the limitations inherent to conventional public transport, especially during the off-peak hours and outside the central city areas (Holmberg et al. 2016). In addition, MaaS-alliances may strengthen the joined ability to respond to new competition, due to e.g. major information-technological firms that enter the market for mobility services.

Having mentioned all these drivers, large uncertainties regarding the effects on ridership/revenues, costs of implementing the system, and realizing the critical mass in the face of substantial investment requirements, persist as continuous threats to transport and platform providers. In addition, changing institutional mandates and constraints, for instance in data privacy and equity, may impact opportunities for a real business case.

Based on this we postulate **P1: Transport providers are increasingly forced to assess the pros and cons of a MaaS-alliance in terms of the crucial drivers for value creation.**

2.2.2 Contributing factors in alliance formation

a) Complementary resources

Formation of strategic alliances may be viewed as a means to acquire additional resources and capabilities that are difficult or even impossible to develop internally (Das and Teng, 2000). Alliances allow access to well-defined resources of the partners saving valuable time and costs of the development phases (Mudambi et al, 2010). In transportation, these resources do not only concern vehicles, employees and buildings, but especially the transport networks provided by the different partners, including the links and nodes as well as the data on users. This includes the necessary infrastructure for bike-, ride- and car sharing and the public transport hubs. These complementary network resources may be shared by transport providers to improve the door-to-door services. The challenge in linking these networks is to integrate information, ticketing and scheduling of services to create multimodal networks for travelers (Feng, 2014; Franckx and Mayeres, 2015). In addition, not all transport service providers have capabilities

to develop software offering personalized services with proper look and feel properties. Specific intermediaries may add their experiences.

Following this, we hypothesize **P2: Systematic linking of complementary resources of potential alliance partners speeds up the formation of a MaaS alliance.**

b) Knowledge generation and learning

Knowledge is a key resource in terms of innovative value creation in a MaaS alliance requiring separate attention, and for that reason actors (each having limited and specialized knowledge on mobility services) may for that reason enter the alliance (Dong et al, 2006). The degree to which skills and knowledge are different are regarded as one of the key competencies in new service design (Tax and Stuart, 1997). Access to knowledge may be more important than the acquisition of knowledge from the partners (Buckley et al, 2009). For instance, not many public transport firms aim at learning about car sharing operations but aim to create value through combining their PT knowledge to that of car sharing companies (Grant, 1996). Alliances in a context of MaaS may be useful as learning vehicle in case:

- The services require specific expertise or infrastructural (e.g. data) setup in the production and/or maintenance phases (Cravens et al, 1994).
- Partners are uncertain about the knowledge required to maintain their services in the future. Acquiring and integrating new knowledge takes time and investing in knowledge updates might be risky (Grant and Baden-Fuller, 2004).
- Rapid market and technological developments require early-movements in order not to lose the market. The advantage of early-movement rests upon the ability to quickly identify, access, and integrate new services. Strategic alliances can greatly increase the speed with which a company can access new combinations of knowledge needed to bring new products or services to the market (Hamel, 1991).

This leads to the following proposition **P3: The need for alliance formation is larger when early movers are active, more uncertainties on the future are experienced and the services require specialized knowledge.**

This proposition is in line with transaction cost approach in which uncertainty, specific assets and frequency of transactions are key elements in assessing integration strategies of firms (Williamson, 1975).

c) Flexibility

Another factor in forming alliances is that they offer flexibility (Tafti et al, 2013)**.** In a dynamic environment with great uncertainties, firms want to avoid long-term entanglements. Porter and Fuller

(1986) argue that collaborations are more rapid means of competitive repositioning than internal (re)development, and less costly and more flexible than mergers. Flexibility is defined as the ability to rapidly adapt to dynamic changes and has two dimensions (Young-Ybarra and Wiersema, 1999) :

- Adaptability, referring to the ability of partners to adapt their strategies in response to external developments (e.g. demographics, economics, technological developments), changes in performance of the alliance, or to the dynamic needs of partners in the alliance. Due to several uncertainties of the future transport system developments (possible new stakeholders, possible new technology, changes in transport demand, etc.), it is impossible to foresee all future circumstances when forming an alliance. The success of a MaaS alliance is related to the ability to modify strategies of the alliance for continued value creation of transport services.

- The relative ease to exit the alliance. Harrigan and Newman (1990) argue that the needs and strengths of partners in an alliance are subject to constant change and can enhance or diminish the partners' interest in the activities of the alliance. Hence, the ability to terminate the participation becomes an important strategic concern for each of the participants.

This leads to the following proposition **P4: Exogenous and endogenous uncertainties about multimodal services, stimulates MaaS alliance formation, as alliances offer more flexibility to handle these uncertainties.**

2.2.3 Power of partners

In alliances it is vital that all partners in the alliance need to attain benefits from the partnership (Ohmae, 1989). Unbalanced power between the partners might endanger the attainment of these benefits for the party with less influence in the partnership (Das & Teng, 2002). Social network analysis of entrepreneurial alliances suggest that 'heterogeneity in social capital endowments give rise to performance differences' and thereby positionality in the strategic networks (Stuart and Sorenson, 2007). The firm that contributes more critical resources in an alliance will have more power in the partnership and can use this power to gain the upper hand in negotiations (Pfeffer, 1981). Smaller firms in an alliance may in this respect be subordinate to the larger partners, hence reducing the chances for these smaller organizations to achieve their strategic goals. This is analyzed using social network theories, among others by Granovetter (1977) and Burt(1992) . These approaches suggest that network positionalities and structure are important in explaining power relationships (see, Cook and Emerson, 1978). Borgatti and Foster (2011) argue that 'whereas a basic principle in centrality phenomena is that being connected to well-connected others implies greater centrality, in power phenomena it can be the other way around: being connected to weak others makes one powerful, and being connected to powerful others makes one weak. Moreover, smaller

firms may, due to unique and specialized expertise, contribute more to the innovations than larger firms can, and in that way gain more power. On the other hand, the bargaining power is also related to the position in the network. Das and Teng (2002) argue that the central firm has a power advantage over less central firms in the network, i.e. the notion of network centrality. Smaller organizations may have advantages as well from collaborating with larger partners such as the provision of cash resources, new investments or access to distribution channels (Burgers et al., 1993). This power imbalance might be less favorable for success, although some studies indicate that successful alliances are often controlled by a central firm (Lorenzoni and Baden-Fuller, 1995). A lead partner (often the larger firm) in a successful alliance contributes to this success by sharing its superior information, asset(s) and status and not by abusing its power advantage (Gnyawali and Madhavan, 2001).

In MaaS, public transport operators often take the role as coordinator of the mobility services. According to Holmberg et al (2016) this would guarantee a longitudinal stability to the service, and a regional coverage (Holmberg et al. 2016). On the other hand, leaving the lead partner role to the public transport operator may lead to maximizing interests of public transport firms, rather than supporting the objectives of other participants or leaving choices to travelers. It is, therefore, imperative to the success of a MaaS alliance that resource sharing commitments are made and duly executed, e.g. larger firm commits to share users, data on travelers, payment system and website/marketing facilities and smaller startups reciprocates that commitment by bringing in fast innovation in ICT and integrated service offers.

Therefore, we formulate **P5: In case of unequal distribution of power among MaaS partners, it is imperative for the success of the alliance that the larger partners recognize the value of smaller partners and that resource sharing commitments are established accordingly.**

2.2.4 External factors

External developments (socio-political, environmental, economic, technological) that are beyond control of individual (or all) stakeholders may motivate alliance formation (Robertson et al, 1998). Changing socio-political contexts, increased environmental awareness, and/or popularity of circular economy can motivate firms to revise their products and services (Sharmeen and Meurs, 2019). Also, individuals' changes towards a more flexible lifestyle can change demand from fixed transport service provisions towards flexible service provisions. All of these are beyond the control of the firms and create substantial external pressure and increase uncertainty of the life-cycle of the firms.

In addition, the growing availability of ICT technologies enables the construction of a platform that supports the flexible travel planning, booking, and ticketing within MaaS. Open data market places and harmonized deployment of data standards are crucial for MaaS platforms to become successful (Baron et

al. 2013). The use of wireless networks as infrastructural requirements for MaaS allows for seamless accessibility, including new telecommunication technologies (4G,5G). The open data provisions also pave the way for transport providers to efficiently address service gaps and demands. On the other hand, ensuring data storage and security requires new infrastructures and regulatory guidelines. Melis et al. (2017) look into a number of threats involving among others data leakage, data manipulation, fake data injections and denial of service, due to sabotage, espionage, misuse or fraud. Strategies to reduce and manage these risks have to be developed.

However, it is important to balance the external factors in the development of a strategic alliance with the internal one's (Robertson et al, 1998). Social and environmental interests in addition to those of the MaaS actors has to be strategized and duly administered during the formation of MaaS alliances. Such broader socio-environmental factors provide a creative and stimulating context to launch certain initiatives, such as MaaS. Beyond that it is important to maintain that the initiatives complement each other and alligns with initiatives with similar aims in order to yield success. Therefore, we mark proposition **P6: MaaS alliances become more efficient when alligned with societal developments regarding sustainability and the sharing economy.**

2.2.5 Public policies

Public agencies play an important role in shaping and promoting MaaS-alliances, affecting both the demand and supply of multi-modal services (Koglin, 2017). Market structures are shaped and market performance is influenced through the legal and institutional infrastructures (Nee, 1992), including:

a) *Legislation and permits:* In many countries today, legal institutions do have a unimodal orientation which may limit the formation of multimodal alliances. This includes the practice of unimodal public transport contracting resulting in fixed and coherent public transport networks. This limits the development of flexible and demand-oriented multimodal networks enabling e.g. MaaS alliances to optimize revenues and costs (Holmberg et al., 2016).

b) *Subsidization:* Subsidies related to modes (supply) rather than to mobility needs is prevailing in most nations. In addition, absence of a level playing field among the transport providers poses further challenges.

c) *Financing:* Financial resources to accommodate innovative changes and pilots are an important stimulus for promoting MaaS. Karlsson et al. (2016) conclude that for the Ubigo trial in Gothenburg, one of the barriers for continuation was the lack of financial support.

d) *Availability and standardization of open data:* Implementing and operating a MaaS services requires open data for trip planning and accessible payment options for third parties. If a transport operator is not willing to allow a third party to sell its tickets to create level playing field conditions, these

services cannot be included in MaaS and integrated ticketing of various modes is not possible. In addition, working ICT infrastructure and open application programming interfaces (APIs) are vital elements in making MaaS a reality (König et al., 2016).

All of the above were also identified as major barriers external to private organizations in the formation of MaaS alliances (Smith et al., 2019). Hence, we pose **P7: Policymakers should actively create favorable conditions to enable the formation of a Maas alliance and the provision of seamless service delivery.**

2.3 Goals and governance of the MaaS alliances

2.3.1 Goals

The formulation of shared goals of the alliance is an important element for success of the alliances (Spekman et al,., 1996). A number of studies analyzed alliance formation for innovative services and products. Koza and Lewin (1998) argue that the decision to enter an alliance can be seen in terms of the motivation to exploit an existing capability or to explore for new opportunities. In the early stages of a development project the search for something new is frequently structured through *exploration alliances*. After successful exploration, the alliance or its partners turn to exploiting these new services often through *exploitation alliances* (Rothaermel, 2001). Hence, explorative alliances are used in innovation and gaining new expertise, the "R" in R&D. The exploitative alliances are used for bringing the services to the market (the "D") (Cohen and Levinthal, 1989).

Firms form explorative alliances when they do not possess the resources to develop the innovation in-house (Xia et al, 2016). Even though large public transport firms have the resources to develop the innovative services, smaller firms and start-ups could make an innovative contribution at faster speeds than the major firms could (Christensen, 1997). The role of the large firms and the smaller ones could be synthesized by looking at an innovation as a process: initially, incumbents may collaborate with startups for exploration purposes. After success, these start-ups may merge with these partners for exploitation of the innovation or re-orient the alliance from an exploration into an exploitation alliance. This leads to the following proposition:

P8: Initially, exploration goals are important for partners in forming alliances. In later stages exploitation goals become important, such as generating revenues and profits.

2.3.2 Governance

Formal aspects

In deciding upon the participation, firms want to safeguard their resources and interests. For this a proper governance of the alliance is essential (Williamson, 1975). Note that it is important to make a distinction between alliance management and alliance governance. Management is more or less the day-to-day

operational handling of the alliances' practices. Governance has more to do with the whole system of management, institutional framing, partner network evaluation, rules of conduct and accountability. In this paper on alliance formation, the governance is a key issue; management is more important with respect to the operational practices.

In alliances, control can be achieved through formal governance structures and contractual specifications, which at its turn is strongly influenced by the use of organizational capital and mechanisms of social control of strategic partnerships (Granovetter, 1985). An important issue here is that when independent firms collaborate together, there is a risk of certain partners cooperating with a hidden agenda. This is referred to as opportunistic behavior (Williamson, 1975). In order to deal with this, alliance partners can negotiate safeguarding clauses, inflicting penalties for the omission of cooperative behaviors or commission of contravening behaviors (Parkhe, 1993). Such contracts may also be helpful to improve the specification of responsibilities and coordination tasks regarding the activities of the platform.

This leads to **P9: Well-specified agreements, safeguarding key interests of the partners, are important for the formation of MaaS-alliances.**

Relational aspects

While formal aspects of governance are important elements explaining the success of alliances, the literature on alliances shows that informal, relational issues such as trust, commitment and nature of cooperation, are also important determinants of the success of alliances (Meier et al., 2016; Smith et al., 2019; Spekman et al., 1998).

- The issue of trust includes a set of expectations between partners about the behavior of each other concerning the anticipation that each will fulfil its agreed obligations (Moorman, et al, 1993). Nooteboom (1996) notes that trust concerns a partner's *ability* to perform according to agreements (competence trust) or his *intentions* to do so (goodwill trust). Mutual trust creates the basis for an enduring and effective relationship.
- The issue of commitment is described as the willingness of alliance partners to act with maximum effort in regard to the partnerships' maintenance and performance (Moorman et al., 1993). It points at a long-term orientation of partners such that they will forgo short-term incentives for the sake of the longer-term benefits they believe the relationship will provide. This provides an environment conducive to the achievement of mutually beneficial outcomes and reducing opportunism.
- The issue of cooperation refers to the organization and mutually tuning of actions to achieve overall beneficial outcomes. Anderson and Narus (1990) argue that once a relationship is established and a degree of trust has developed, partner firms learn that coordinated, joint efforts will lead to outcomes that exceed what the partner firm could achieve if it acted solely following its own opportunistic interests. Thus, cooperation is a key antecedent to developing a successful partnership.

From this we can derive proposition **P10: Trust, long term commitment, and willingness to share resources are important in the exploration phase. In the exploitation phase formal contracts become more important for the continued success of alliances.**

3. The Nijmegen-Heyendaal pilot case: setting the scene

3.1 Methodology and research approach

In this section, we describe the MaaS-pilot used to qualitatively test the propositions derived from the theoretical exploration in section 2. As mentioned before, this testing aims to sharpen the theoretical framework for collaboration for offering MaaS services. The case study - MaaS pilot SliM Nijmegen[6] was developed for the urban district of Heyendaal in the Dutch city of Nijmegen with involvement of all stakeholders throughout the innovation process. In order to achieve cooperation a number of activities were performed reflecting the alliance formation process presented in Figure 1. The following approach was adopted:

- Assessment of the base situation with respect to the current supply of mobility services, the availability of a MaaS-platform provider and the public policies in the region with respect to MaaS. This step is based on desk research.
- Interviews with all stakeholders and potential partners in order to assess their goals and challenges with respect to the market and the potential contribution of MaaS-services. This step should lead to identifying strengths and weaknesses of alternative MaaS concepts. Furthermore, these insights were used as input for further development of the pilot.
- Partner selection, including the transport providers and the platform providers to be included in the project. The province and the local government financed part of the project.
- Defining the pilot and establishing an alliance among the partners that are affiliated to MaaS. This involved a number of focus group discussions with all partners as well as bilateral meetings with partners for solving technical as well as contractual issues.
- To further validate the developed propositions, a small survey and follow up dialogues with the alliance partners of MaaS Heyendaal were conducted.

The interviews were held with:

- Transport firms, including the regional bus-provider, the regional train provider, the national railways (NS) and two car sharing firms. They were asked about their interests in participating in the pilot and their goals in forming a MaaS-research alliance.
- Four potential platform providers, asking them to demonstrate their tools, capabilities, business models as well as their willingness to cooperate in the pilot.

[6] https://www.slimnijmegen.nl/

- Regional and local authorities (province, municipality as well as some project-groups affiliated with Smart Mobility initiatives concerning their willingness to participate, to subsidize parts of the ICT-development in line with the public transport goals.

We used semi-structured interview protocols and communicated the summaries of the outcomes with them. Below, we discuss the results of these steps.

3.2 The base situation for realizing the MaaS-project

Heyendaal is a neighborhood in the medium-sized city of Nijmegen in the eastern part of the Netherlands. In this area universities and colleges are located, with about 45.000 students and 17.000 employees. Moreover, the university hospital attracts about 5000 visitors per day. In peak hours public transport services (consisting of mainly train and bus services) are very intensively used, whereas car traffic to the area suffers from congestion. Policy programs in this area aim at reducing the traffic peak by spreading lecture schedules, paid parking policies, and stimulating alternative modes, including carpooling, Park & Ride and bicycling.

People with destination Heyendaal can use, alternative to the private car, a number of services, summarized in Table 1. In addition, Table 1 summarizes the profile of the travelers and the enabling facilities.

Table 1: An overview of mobility services in the study area preceding SliM Nijmegen (Heyendaal, Nijmegen)

Items	Type	Key Characteristics
Modes	Train	The central station has national and regional connections, with services offered by the Dutch Railways (NS). From this station people have to travel to Heyendaal by bus or bicycle. The area itself has a local railway station with services provided by Arriva, a subsidiary of DB, the German Railways.
	Busses	Nijmegen has a well-developed bus network. The long-term concession is granted to Hermes, a subsidiary of Connexxion (Transdev is the parent company).
	Flexible bus	Under the name of Breng Flex, Hermes offers innovative flexible bus services. Users can order services by app. The resulting minibuses bring them straight to bus stops in the region.
	Bike sharing	Bike sharing services are offered by NS-bicycle, which is owned by the Dutch Railways. It is made easy to use this service starting from the central station downtown. The universities also offer company bicycles for their employees to travel in the city.
	Car sharing	There are limited offerings of car sharing in Nijmegen. Some P2P-services are in an experimental stage where an app allows sharing private cars. In addition, Greenwheels, a subsidiary of the Volkswagen importer Pon, offers limited car sharing services in some neighborhoods in this city, but not in Heyendaal.
	Carpooling	Carpooling is stimulated in the area by the educational institutes with an app called TwoGo, a private app. Recent analyses suggest that a number of associated institutes registered for usage of this app, but usage is still low.
Enablers	Travel information	Open data for public transport through a national organization who also provides information on schedules and delays. Data on travel times and average traffic speeds are provided for the road network by National Data Warehousing (NDW). Although a market for multimodal journey planners in the Netherlands is developing, operators of other transport modes rarely offer access to their data, for example on car and bicycle sharing.
	Payment system	The OV-chipcard is the electronic payment system for all modalities of public transportation such as trains, buses, metro and trams. Currently it is not possible to use this card for other mobility services than public transport. In addition, mobile payments are still in a developmental stage.
Travelers	General	All passengers can travel at a reduced rate during off peak hours if they buy the yearly subscription or discount cards.
	Students	Free public transport cards on weekdays or during weekends (choice up to students).
	Elderly	For elderly travellers (60+) special train services are available.
	Employees	Most of them get reimbursed for travel expenses for business or commuter travel.

From the characterization of the current supply of mobility services, it is apparent that the (traditional) public transport system is well-developed in this area. However, the other, more innovative, mobility services (car and bike sharing and carpooling) are underdeveloped. Although NS-bicycle is rather successful, it mainly serves as access and egress mode to using national trains and is relatively expensive for daily use. There is a dominant use of public transport, private cars, and bicycles for traveling in this

area. Other (sharing) services are offered by the transport providers, but not used intensively. In particular students make use of the public transport services, as in public transport in The Netherlands is free of fare for students. This creates a lot of pressure on the public transport network, particularly during the peak hours. To reduce this pressure, several soft (scheduling) and hard (infrastructures, e.g. bicycle highways) policies have been implemented over the years. Smart scheduling agreement was reached among the universities of the area to start half an hour apart from each other to relieve the pressure on public transport services during peak hours (MuConsult, 2017). The MaaS pilot was also a response to tackle these growing mobility problems.

3.3 The base situation with respect to MaaS service providers in The Netherlands

In the start-up of the project in the year 2016, we analyzed the characteristics of platform providers by interviewing potential partners in The Netherlands for providing MaaS-services. We found that several partial and isolated initiatives were undertaken, including the development of multimodal trip planning apps (see Section 1). In addition, some third-party activities were undertaken related to reselling transport services, such as MobilityMixx, NS Businesscard and Radiuz Total Mobility (see Kamargianni, 2016). But no platform provider was able to offer all services of an integrated MaaS-platform. This is consistent with more recent findings in a market consultation by the Dutch Ministry of Transport. The Dutch Ministry (I&W, 2018) related this lack of suppliers of MaaS-services to a number of barriers, including:

- While there may be a data platform for travel planners, there is no uniform, national data platform including all transport services and data providers.
- There is no affordable, uniform payment system for all transport services, including car and bicycle sharing, taxi, Flexible Transport systems (FTS), etc.
- Real-time data is limited available.
- As yet, not an easy transfer of travelers is possible between service providers.
- There exists no broad set of agreements between parties in the transport supply chain about data-sharing, open data, data formats, interfaces and clearing-house functions.
- Unequal market power among firms due to (temporary) monopoly situation with exclusive concessions for public transport, tax treatment of business cars and so on.
- The range of services is fragmented and inadequately meets the demand.

The market consultation was discussed in a workshop organized by the Ministry. Participants were private parties showing interest in providing MaaS services. In this workshop these findings were mostly confirmed, although parties disagreed on some of the barriers for MaaS-alliance formation act e.g. data availability and the role of market power.

As argued in section 2, cooperation between private and public actors is considered crucial for the success of MaaS. Some private partners of MaaS-services have concerns about cooperation with public transport firms having the public concessions. According to these private firms, regional public transport authorities have an important role to stimulate information provision, data sharing and third-party sales of tickets. However, the current concession regime for public transport is perceived as an impediment. Although the willingness to work together seems to be present from both sides (public transport providers and private MaaS-service providers), the level of mutual trust appears insufficient for initiating a MaaS alliance and the plea for first creating a level playing field (i.e. all stakeholders should play by the same set of rules) is still strong.

With respect to public policies concerning the stimulation of MaaS in The Netherlands a number of initiatives are taken. The Dutch Ministry of Infrastructure and Water Management wants to expand innovative smart mobility, in collaboration with regional and local public agencies. This includes policies to increase the presence and accessibility of data and service platforms. The main motive is that potentially, MaaS enables a more responsive, more efficient and more robust transport system for the traveler. To improve basic empirical knowledge on MaaS, the Ministry initiated a number of larger scale regional MaaS pilots in the Netherlands. These pilots aim to accelerate the development of MaaS-services in the Netherlands and to gain more empirical insight into their effects.

3.3 Partner selection and actor analysis

A successful alliance formation process depends on a high level of fit among partners, including complementary resources, compatible goals and a fit in management and organizational practices (Das and Teng, 2002). While this sounds straightforward, in practice this sometimes turns out to be less obvious. In some areas in The Netherlands, it turned out that the MaaS-pilots were very difficult to realize, probably because potential MaaS-service providers did not have the right match with the suppliers of the transport services.

In interviews with key actors for the case of Heyendaal, much attention was paid to the challenges the actors are facing and the possible roles of MaaS in addressing these issues. A wide variety of challenges for the partners were reported. While the public transport firms seek to safeguard their market share or perhaps even increase their share, especially in off-peak hours, the car sharing and bike sharing partners seek to get a proper market position. The public agencies and the educational institutes have social objectives, including improving accessibility for Heyendaal and promoting sustainable modes of transport. The MaaS platform provider is interested in developing the services and identifying an appropriate business model.

Selection of the platform provider

At the time of the Heyendaal-project, no single transport provider was able to fully realize MaaS-services. Consequently, an alliance offering these services had to be developed. This included the selection of a partner responsible for developing the MaaS-platform that should offer the MaaS-services. The MaaS-platform is developed by a start-up firm called GoAbout. This firm was selected based on three criteria:

- The firm should be able to offer the planning part of MaaS, which was considered to be crucial. The other parts had to be developed together with the suppliers.
- Trust: the public transport operators should have good experiences with this organization, based on demonstrated competence.
- The firm should be interested in research and development with considerable, non-subsidized funding.

Selection of the mobility service providers

The selection of the mobility providers is done pretty straightforward in the pilot. Public transport providers are (temporary) monopolists that were granted contracts for exclusive provision of public transport services (concessions). This concerns the regional bus service provider Connexxion - a subsidiary of Transdev, the regional train-provider Arriva - a subsidiary of DB (German Railways) and the Dutch Railways (NS). The car sharing and bike sharing services are (temporary) provided by GoAbout, the platform provider. This mixing of services of the platform provider and the mobility service provider is not the best outcome for the future development of MaaS, but accepted for the time being since this allowed to start the project fast and provide the MaaS-provider with a workable business model to start their operations. In going from an exploration to an exploitation phase, this structure has to be renegotiated.

3.4 Development of the MaaS-pilot for Heyendaal

Based on the previous steps, a MaaS-pilot (launched in 1 September 2018 and planned to run until 2020) for Nijmegen was developed. Figure 4 provides the key actors and their roles with respect to the MaaS-pilot in this area.

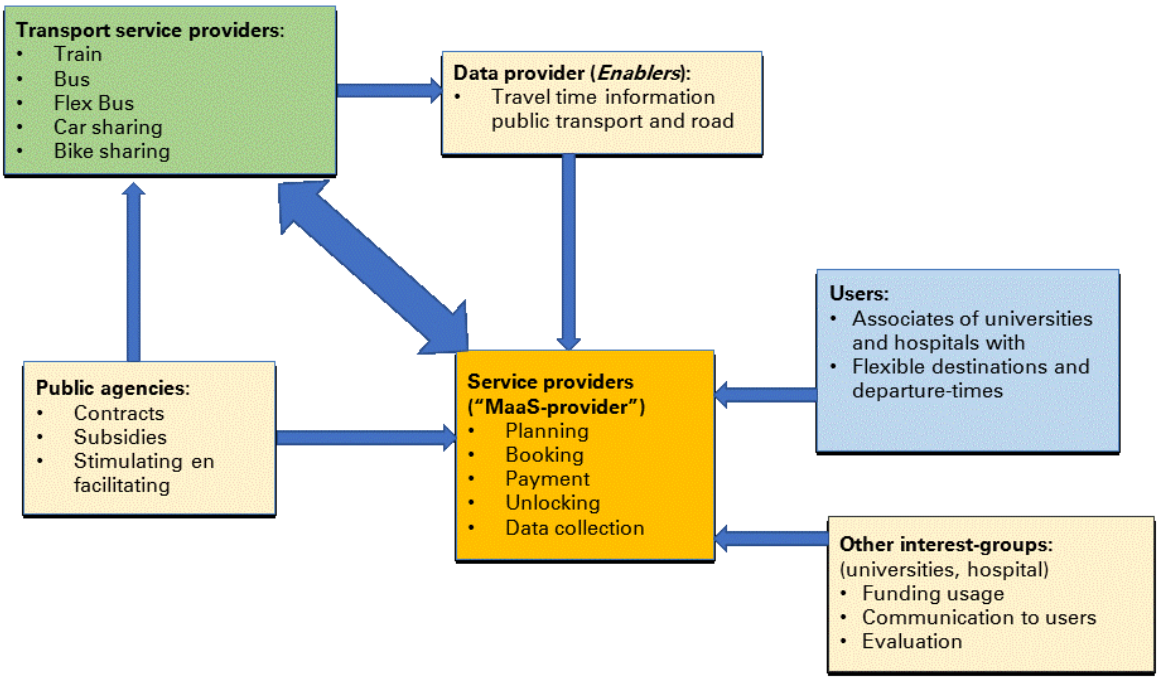

Figure 4: Key Stakeholders and their roles with respect to SliM Nijmegen

Concerning the users, it was decided to start with approaching potential users at the universities and the university hospital. Students were not the first priority, since they receive a student pass for travelling with public transport. It was argued that MaaS could contribute to fulfilling travel needs of people with varying travel habits including flexible destinations (e.g. business trips) and flexible working hours.

While originally it was assumed that the MaaS-service provider would coordinate the activities related to bringing all interests together, this turned out not to work. The technical and ICT requirements were too demanding and the process of establishing collaboration was neglected. Therefore, a process manager was hired to motivate all partners to participate in the project.

Within this framework, partners agreed upon taking responsibilities for a number of tasks required to realize mobility services to the users. Notably the following issues were solved during the setup of the pilot:

- The development of interfaces between the transport service providers and the MaaS-provider appeared to be one of the most difficult steps. Most transport providers have closed systems that are not accessible by external actors. The interfaces had to be newly developed, generating fixed costs of the project. These development costs were subsidized by the regional public agencies for this project.
- Ownership of data on clients. It was agreed that the platform service provider would not get access to data on clients of the public transport provider, and vice versa.

- Privacy issues had to be addressed concerning information about travelers and the trips they make. It was decided to set-up the platform in line with the EU-privacy laws. Participants are informed that their data are used for research purposes.
- Costs of participation. In order to stimulate participation, it was decided that participants in the pilot were offered free usage of the system during the pilot. The variable costs of using the system were partially covered by the mobility providers and accepted as their investment in learning about MaaS. For business trips related to activities of the universities made using MaaS, the platform provider charged the Universities directly; the universities had to pay for these trips anyway. Monitoring systems were set-up to reduce the risks in terms of revenues and costs for the participating partners in terms of the number of users and the usage of the system.
- Communication to potential users. The universities and hospital offered facilities and support to communicate the pilot to associates of the institutes.

In addition, the service provider agreed upon a number of contracts with the partners. Crucial is that the public transport firms did, at this stage, not reward the service provider for additional passengers. It was decided that at this stage not to develop protocols for such rewards, since there is not sufficient and reliable information on effects of MaaS available yet. The business model of the service provider is, for the time being, based upon subsidies, profits, and selling trips to shared cars and bicycles. This approach stimulates the service provider to realize a market for shared cars and bicycles. This did cause some concern by the public transport providers and might not be sustainable on the long run. However, the partners accepted this construction for the purpose of the pilot referring to the present lack of interest of the providers offering shared cars and bicycles.

In the period September-October about 192 people filled in questionnaires required for participation with 138 people actually registering as MaaS-participants. The currently ongoing pilot will be evaluated thoroughly in the near future with respect to effects on travel behavior, governance, business opportunities and so on.

4. Assessment of the setup of the pilot using the conceptual model

In this section, we assess the setup of the pilot in terms of the propositions deduced from the conceptual framework in section 2.

4.1 Goals of the partners and the alliance

The interviews suggested that all partners have an interest in MaaS for various reasons. All feel the pressure of the changing needs of travelers and the public policy interest in developing MaaS to achieve public objectives. This may affect their business in the future. Since this may affect the long-term

continuity of the firms and their results, they are keen on learning about the pros and cons of MaaS. However, the starting point of the firms is different. Public transport firms want to safeguard their market positions and possibly extent the market by improving services to customers. On the other hand, car and bike sharing appear to be niche markets at this time and these firms aim at expanding their markets. MaaS may be a way to realize this potential, although so far, they expect their own unimodal marketing strategies to work better. The public agencies and the universities involved aim at improving accessibility of the business area of Heyendaal and reducing negative effects of car usage. They are willing to consider these as long-term goals and aim in this pilot at developing and testing various innovations in accessibility policy. The public objectives will be important for the future development of MaaS in this area.

Despite these differences, private and public partners share the learning goal of the alliance. This provides them with information useful for strategic decision-making with respect to their future position towards MaaS and the strategies that might be used to obtain acceptable benefits for their business. This implies that the pilot can be labeled as an exploration alliance. The exploration alliance will be a success if learning objectives are achieved such as learning about the market for MaaS-services, the technical barriers that need to be solved, potential contributions to the business model of each of the partners and so on. In order to achieve this learning effect, attention should also be paid to issues like information sharing, the competence to develop new ideas to cope with unexpected challenges, and the speed of decision-making. This may support participating firms to define future strategic options with respect to MaaS. One of them is to develop into an exploitative alliance.

These results are consistent with proposition P1: transport providers are increasingly forced to assess the pros and cons of a MaaS-alliance in terms of the crucial drivers for value creation.

4.2 Contributing factors

Resource complementarity

In the pilot, a number of different providers of transport services joined with the service provider. Participants considered it essential that not only public transport firms, but also firms offering car and bicycle services would participate to test the effects of MaaS. Hence, they wanted to formulate a 'horizontal alliance' allowing for testing substitution between modes. For this reason, it was decided in this stage not to include competitors with similar capabilities within the alliance. This finding is consistent with proposition P2: systematic linking of complementary resources of potential alliance partners speeds up the formation of a MaaS alliance.

Knowledge generation and learning

As argued, the pilot can be considered an exploratory alliance in which learning is an essential element. For example, all the partners affiliated in the alliance argue that specialized knowledge about the management of the different modes is required but not available in the firm: PT-firms do not have the experience in management of car sharing. In addition, not much is known about the real market benefits of MaaS. The alliance offers the opportunity to learn from this. Finally, it is argued that considerable early-mover benefits may be present. Many firms fear that some of the major tech-firms (Google, Apple, Uber) will enter the market triggering them to move fast. The small-scale pilot in Heyendaal may also be helpful in forming consortia for the major pilots initiated by the Dutch Ministry of Infrastructure and Water Management. These findings are consistent with proposition P3: the need for alliance formation is larger when early movers are active, more uncertainties on the future are experienced and the services require specialized knowledge.

Flexibility

All partners entered the alliance with the agreement that the pilot would last for a pre-specified, fixed period. At this stage, no agreements with the partners were made for a longer-term affiliation. Such agreements were not excluded, but should not be decided upon before the outcomes of the pilot evaluation are available. Of course, continuation also depends on further developments of the individual firms with respect to MaaS. During the pilot a number of meetings are planned to discuss the progress of the pilot. Partners agreed that intermediate experiences may lead to modification in the services provided and the characteristics of these services. This finding is consistent with P4: exogenous and endogenous uncertainties about multimodal services, stimulates MaaS alliance formation, as alliances offer more flexibility to handle these uncertainties.

Power of the participants

There are significant asymmetries in the size of the partners: the public transport firms are part of the major public transport firms with large market shares, whereas the car and bicycle sharing firms are small and try to increase their market, and the service provider is a start-up.

In the development of the pilot, the role of the platform provider, a small firm, appears to be rather important for the innovation process. However, we also noted that this firm is limited in its ability to get appropriate rents from their innovation. Hence, it was in their interest from the beginning to seek collaboration with larger partners with the complementary resources they need. This includes knowledge of the transport market, the financial support from public agencies, as well as expertise from the university to organize the process of alliance building. At the same time, the major public transport partners seek partners in these new technological arenas. This allows them to test effects of MaaS in order to be able to develop underpinned strategies with respect to the future. It was noted that the public

transport firms appear open minded with respect to experiments and innovation, unlike the common believe as being conservative. However, it was important for them that, at this stage of knowledge, the size of the experiment remains limited and will be well-evaluated in order to be able to deduce conclusions with respect to future decision-making. These findings are consistent with proposition P5: In case of an unequal distribution of power among MaaS partners, a success of the alliance requires that the larger partners recognize the value of smaller partners and that resource sharing commitments are established accordingly.

External developments

While the developments in society and technology favoring MaaS are well-known and initial market analysis in The Netherlands and elsewhere reveals its potential, it was difficult to make this specific for the unique urban area in which the pilot is carried out lasting only a short period. Hence, this proposition P6 (MaaS alliances become more efficient when aligned with societal developments regarding sustainability and the sharing economy.) could not be tested.

Supportive role of public policies

The pilot would not have been possible without the supportive role of the public agencies. First, because they provided financial means to realize the interfaces between the systems of the different providers. Secondly, they provided the means for appointing a process manager who worked on forming the alliance taking the interests of all partners involved into account. Finally, these authorities are also managing the public transport concessions implying that they can put some pressure on the public transport firms to show flexibility. In addition, the supportive role of the universities and hospital appears important. These findings are consistent with proposition P7: policymakers should actively create favorable conditions to enable the formation of a Maas alliance and the provision of seamless service delivery.

Governance of the alliance

The service provider signed agreements with the transport providers, participating institutes and public agencies. These agreements are in general rather open, reflecting the stage of development and the objective of the alliance. They focus on a few core issues, concerning the development and usage of the interfaces, data ownership, billing and participation in the pilot. The set of agreements included:

- An agreement between the service provider and the public agencies regarding the further development of the platform. This provided the basis for a contribution to the MaaS-innovation by GoAbout. A key success element in this agreement was that merely the process for developing the services was agreed upon, implying that no service or product specifications were included, hence leaving room for flexibility on the content of the platform.

- An agreement between the educational institutes for financing and approaching associates of these institutes, providing funding for usage of the platform services. These means were used to start-up the activities of the platform.
- An agreement between the platform provider and the transport operators. With the Dutch Railways (NS) this formalized in a re-seller contract, licensing the platform firm to sell NS-products. The other firms agreed upon a so-called distribution agreement where the platform was given more freedom in selling and repackaging services from these providers.

This approach is to some extent consistent with hypothesis P8 (initially, exploration goals are important for partners in forming alliances. In later stages exploitation goals become important, such as generating revenues and profits) and P9 (well-specified agreements, safeguarding key interests of the partners, are important for the formation of MaaS-alliances). The contracting activities took place after the initial start of the platform, demonstrating the relevance of trust. Therefore, it is rather premature to fully assess the value of P8, P9 and P10 at this stage of the pilot of Heyendaal. All partners recognized that formal contracts are needed once starting the activities. Note that further development of these contracting procedures is required when entering the exploitation phase of the presence of MaaS-pilots.

Trust and commitment were crucial in this exploratory alliance. Several partners expressed their confidence in the technical competence of the service provider, although this was also one of the reasons this firm was selected. On other aspects concerning the relational dimension commitment was enhanced during the project by a number of group meetings in which not only the formal component was present, but also the informal one with breaks, drinks and social talks. During these meetings the joint objective of the pilot was discussed. This is consistent with proposition 10 (trust, long term commitment, and willingness to share resources are important in the exploration phase. In the exploitation phase formal contracts become more important for the continued success of alliances.). Note that in some cases individual participants had to convince the managers within their mother organization to participate in the alliance. This reveals the importance of having good ambassadors for the MaaS initiatives.

A further assessment of the relevance of the determinants and propositions were conducted by means of a small survey and follow up dialogues among the stakeholders of SliM Nijmegen. The stakeholders were asked to score eighteen statements (based on the conceptual framework presented in section 2) on a five-point Likert scale to delineate their motivation of forming a MaaS alliance with specific focus of SliM Nijmegen. The survey was communicated among the representatives of six alliance partners of SliM Nijmegen, all employed at the decision-making level for the MaaS alliance.

Findings suggest that the learning objectives are crucial for all partners, confirming the relevance of the propositions on developing knowledge. Success of this alliance will be measured in terms of lessons for

future decision-making. Important contributing factors are the complementarity of the resources and the flexibility offered by the alliance. On the other hand, these private organizations consider the role of the government to have the least priority. This is prudently noticeable, as local public parties funded the realization of the interfaces as well as some start-up costs of SliM Nijmegen. This finding poses the more general question to the demarcation of the role of public agencies in MaaS actor networks. Further reasoning of the responses was explored through dialogues with the providers. We found out that for the platform provider, the subsidies by the government were convenient, but without that, MaaS would have developed as well, though in a little different direction. It would mean less emphasis on public transport and more on car and bike sharing. Also, public transport providers consider participation as their own choice and not the result of external pressure, as this was not part of a formal tender call by the government. This finding more precisely highlights the type of influence local governments can exercise in steering the directionalities of MaaS towards larger societal ambitions.

There are some noticeable differences between the stakeholders. While the incumbent transit providers consider the limited risks as an important motivation to join the MaaS alliance, the provider of the platform services does not. Travelers' demands are considered to be a driving factor in MaaS for the transport providers while the platform provider does not give this aspect a high score. Our further dialogue with the respondents suggests that the platform provider scored demand from travelers low because it is not easy to find new travelers who will be interested in MaaS at this stage. They consider MaaS as a typical "supply creates needs" example. This is evident by the hard time the actors in the pilot experienced in motivating potential users to become an actual participant in the MaaS service.

5. Conclusion

Mobility as a Service (MaaS) is an emerging concept based on the integration of various transport services and added platform services. Realizing this concept in practice requires different suppliers of these services (transport, real time update, ticketing) to cooperate despite their divergent interests. In this paper, we used theories of alliance formation to extend our understanding of the formation business coalition aimed at offering MaaS. Based on the economic, sociological and business literature on alliances, we proposed a conceptual model for alliance formation and summarized key antecedents for successful alliances in terms of ten propositions. We applied these to a pilot MaaS-project in Heyendaal, in the city of Nijmegen, the Netherlands. The analysis confirmed most of the propositions; it appeared premature at this (exploration) stage to evaluate proposition seven on the role of external developments and ten on the role of trust and long-term commitment.

A shared goal among the partners appeared crucial for the formation of the alliance, which could be called an exploration alliance aimed at learning about the effects of MaaS on the key drivers of the participants (revenues improvement, costs reduction, risks avoidance, and long-term continuity

maintenance). Exploration alliances are typically associated with innovative services. The current interests of the partners are safeguarded by limiting the scope, the number of involved partners and the duration of the pilot. Learning objectives are safeguarded by agreeing upon an extensive evaluation of the results of the pilot. External factors regarding public policies with respect to mobility services and the developments in technology and consumer preferences could not be tested in this pilot.

The complementarity of the transport and MaaS services provided by the partners significantly contributes to the agreements to participate. At this stage competition among the services through the inclusion in the alliance of partners competing with the same modes of transportation was avoided. In addition, public authorities contributed to the pilots by offering subsidies to realize the interfaces needed (between public transport providers and platform service providers), and for evaluation of the pilot, due to which the costs for the private suppliers were limited. Knowing this, it is striking that the firms devalue the need for public support, financial or otherwise, in the formation of MaaS alliance, which begs the question of the role of local authorities in MaaS. Although the institutional perspective was taken exogenous to this paper, it would be a useful in a next phase of research to explore the role of local and regional authorities in the alliance, particularly regarding the operational practices. Public authorities can play a role to oversee and guide smart mobility solutions to offer equitable service provisions without excluding certain sections of the population from mobility services in the long run. Finally, relational aspects were found to be important. The elements of trust and willingness to cooperate on the learning objectives of the alliance positively influenced an active participation of all relevant partners. This is evidenced by the formulation and signing of rather open agreements between the participants.

This paper provides a clear conceptual model for the formation of MaaS integration pointing out the crucial elements and extending assessable propositions for each of those elements. The conceptual model together with the propositions might serve as an instrumental checklist for new MaaS systems to develop. The conceptual model is rooted in multi-disciplinary theories of alliance formation while being practice-oriented at the same time. For the same reason, it would appeal to policy makers and strategy developers as well.

In the future, the conceptual model and the results of the pilot will be used to assess the way this specific alliance can develop into an exploitative alliance with a sustainable business model. Such alliances aim at commercializing the knowledge gained through the current exploration phase. Once again, the stakeholders have to decide whether they want to develop the exploitation within house or through alliances. However, in that stage commercial interests will become more important. This requires more attention to the formal aspects of alliances including less open agreements between the partners and more formal contracts guarding their interests. In the specification of these contracts, lessons learned from the exploration phase will be important. In addition, the role of public policies may have to change.

Sustainable innovations like MaaS can hardly be put as a stand-alone mobility intervention. Transition studies show that transitions are subject to complex processes across several levels, ranging from political landscapes to user practices. The multi-level perspective developed by Geels (2012) has been used by numerous scholars to explain such transitions, including a previous study on the governance of demand responsive transit system in the same Dutch region as for the MaaS-pilot (Sharmeen and Meurs, 2019). It shows how environmental and political landscapes play a key role for socio-technological innovations to lose its niche character and become mainstream and addresses the critical mass issue of transport innovations.

The paper introduces a conceptual model used in a single application as part of the grounded theory approach suggested by e.g. Eisenhardt (1989). The modal and resulting propositions can and should be refined and tested in other MaaS-applications as well in other to confirm the results of obtained in this application. These studies may also use different insights from e.g. the service design literature and social network theories to refine the propositions (Stuart, 1998; Subrahmanian et al., 2013) . In addition, different business models should be examined more rigorously, e.g. by using game theoretical approaches. Such approaches are helpful in exploring more in-depth the roles of the actors with regard to each of the propositions and to identify which actors takes, or should take, the lead. For some propositions it is straight forward, for example, the first one (transport providers are increasingly forced to assess the pros and cons of a MaaS-alliance in terms of the crucial drivers for value creation) is to be led by public transport authorities, while for others (e.g. proposition five - in case of unequal distribution of power among MaaS partners, it is imperative for the success of the alliance that the larger partners recognize the value of smaller partners and that resource sharing commitments are established accordingly) appointing a leading actor is less obvious and perhaps less efficient (see discussion in section 2.2.3). Similarly, the form of alliances can also vary across contexts and across phases within a given context. This might call for the introduction of a new actor, e.g. a network manager, who might offer an impartial perspective or alternative decision-making arrangement (Agranoff and McGuire, 2001). In short: intriguing questions remain that need careful considerations and should be subject to further research.

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