AHFE
International

Acceptance Analysis of Value-Creating Service Cooperations and Extensions for Mobility-on-Demand Solutions

**Mira Kern[1], Niklas Kluge[2], Benjamin Burkard[1],
Marco Raul Soares Amorim[2], and Nicolaj Motzer[1]**

[1]Institute of Human Factors and Technology Management (IAT), University of Stuttgart,
 Nobelstr. 12, 70569 Stuttgart, Germany
[2]Fraunhofer Institute for Industrial Engineering, Nobelstr. 12, 70569 Stuttgart, Germany

ABSTRACT

The mobility sector is considered one of the key levers for achieving the climate targets specified in the Paris Agreement and reducing carbon dioxide emissions in cities. To achieve this goal, lower-emission mobility solutions such as public transport, cycling or shared forms of mobility are increasingly strengthened and expanded. Mobility-on-Demand (MOD) offers innovative transport solutions that can compete with the private vehicle in terms of comfort or flexibility. However, this mode of transport faces the following major challenges: the user group is still very small as the service is operating only in specific cities or regions and the operation is quite expensive. Thus, it's quite difficult for MOD providers to elaborate a sustainable business model. A good way to achieve more profitability is to exploit potential synergies through service collaborations, which at the same time increases popularity. Therefore, this study addresses the research questions of whether and which specific service collaborations significantly increase the acceptance as well as the likelihood to use MOD. To answer the research questions, an online survey in Germany, Switzerland and Austria was conducted. Three different areas of cooperation were tested for acceptance: mobility service providers (e.g., public transit), other service providers (e.g., hotel, restaurant) and retail stores. A total of $n = 1403$ respondents were included in the online survey. Univariate ANOVA with repeated measures and *t*-tests were used to analyse the potential cooperations. The results show that the cooperation between MOD providers and other business partners is generally accepted as a value creating service extension, and that cooperation with public transport is descriptively the most attractive. Furthermore, cooperations with mobility service providers and other service providers lead to a significantly higher probability of using on-demand shuttles (even among non-users). Therefore, it is hypothesized that these two collaborative opportunities are a suitable means to increase the use and profitability of on-demand shuttles and attract new target groups. It is recommended that those collaborations should be pursued and analyzed in future research or pilots.

Keywords: Mobility-on-demand, Mod, Future mobility, Value creation, Mobility service extension, Business models

INTRODUCTION

Mobility-on-Demand (MOD) is considered as an innovative transport alternative that is intended to compete with the private car, especially in terms of flexibility and comfort. MOD can achieve a positive impact on the number of vehicles, congestions, and parking areas and therefore help to reduce emissions. However, on-demand mobility comes with a price. MOD systems in Germany, Switzerland or Austria are currently only implemented in several cities and are far from profitable. Many offers are currently running under special pilot or test phases and are thus subsidized by the state. Additionally, most mobility providers are still a long way from having a large customer base and have long idle times during low-demand periods. Thus, there needs to be a solution not only to attract new customers but also to use the idle time and low demand phases in an intelligent and profitable way. A solution to solve not only the lacking societal diffusion of MOD but also the load capacity might lie in value adding cooperations with other service providers. Those might not necessarily come from the mobility ecosystem but can also bring service adding value from other sectors and branches of the economy. Service cooperations can thus create a new business and financing model so that flexible and convenient on-demand mobility becomes profitable and viable. Since the acceptance of cooperations as a form of service extension for MOD was not investigated so far, the question is raised, which cooperations are accepted as service extension and whether they can help to increase the likelihood to use MOD.

THEORETICAL BACKGROUND

In recent years, there has been a strong growth of Transportation Network Companies (TNCs) which offer different app-based MOD services (Koutsopulos et al. 2023). A very sustainable and increasingly popular form of MOD is ridepooling (or ridesplitting), in which ride requests from different passengers are intelligently bundled as spatially and temporally corresponding transport requests by algorithms in real-time (König 2022; Viergutz & Brinkmann 2018). Especially in combination with public transport the use of ridepooling is attractive (Knie et al. 2020). In course of the MOD Sandbox program of the Federal Transit Administration (FTA) in the U.S., the project examples of Los Angeles County and Puget Sound showed an increased use of public transport by cooperating with a TNC for MOD for the first and last mile. However, the MOD service was subsidized and had a poorer cost recovery than mobility alternatives like scheduled buses or the already existing vanpool (Martin et al. 2022). A comparable scenario emerges in countries such as Germany, where the provision of on-demand services is not economically viable and is therefore subsidized by the government (Mehlert & Schiefelbusch 2018).

There are only a few studies on cooperations of MOD with public transport, but none on other service cooperations with MOD. Aside from optimizations within MOD, there has been no research to increase the cost-effectiveness of MOD based on service cooperations. Therefore, potentially

attractive areas of cooperation will be explored below to enable MOD operators to achieve sustained profitability.

METHODOLOGICAL APPROACH

Since only limited research exists on theoretical background on customers' acceptance and potential of service extensions of MOD, this study investigates the acceptance of different cooperations and collaboration partners. To narrow the possible areas of cooperation, three scenarios were developed in collaboration with a German on-demand provider, that is suitable or considered profitable for future cooperation. The potential cooperation partners and areas were developed together with an MOD provider and tested in advance for realistic feasibility. The three collaboration sections are: Cooperations with mobility service providers (public transport companies, sharing service providers, airports and park and ride services), cooperations with other service providers (recreational operators, hotels, organizers of events, restaurants, and tourist localities) and cooperations with retail stores to integrate parcel delivery into MOD (grocery stores, other stores such as drugstores, local stores such as organic stores, and online retailers).

Based on the selection of possible cooperation areas, the following three research questions were explored in more detail:
RQ1: Will collaborations be accepted to expand the service of MOD?
RQ2: Which collaborations are accepted the most?
RQ3: Are collaborations an appropriate way to increase the usage of MOD?

To provide comprehensive answers to the research questions, an online survey was conducted in the German-speaking DACH region which consists of Germany (D), Austria (A) and Switzerland (CH). A total number of $n = 1403$ respondents were gathered with the help of an online access panel provider. The participants came from Germany ($n = 601$), Switzerland ($n = 200$) and Austria ($n = 602$) and the online survey was conducted from the 2nd of November until the 9th of November 2022 (max. field time of seven days). The sample was quoted based on representative age and gender distribution whereas the usage or knowledge of MOD was not set as a participation requirement. The questionnaire consisted of four different sections. Section A included all sociodemographic and latent variables of personality. The second section, B, was devoted to general mobility behaviour. Section C looked in more detail at the existing and potential use of on-demand shuttles and surveyed specific service requirements. The last survey section contained the assessment of the acceptance towards the service extension of MOD. Each respondent evaluated each potential cooperation and the probability of using MOD. These cooperations were evaluated on a 5-point-Likert attractiveness scale as well as their probability of usage. Respondents indicated the likelihood of using MOD without a service extension and additionally the probability of using MOD in combination with each of the three collaboration options.

To answer the first research question, the results of the survey were examined descriptively to gain a first impression of whether the collaborations are accepted. To answer the second and third research questions, statistical tests

are conducted (univariate analysis of variance (ANOVA) with repeated measures and *t*-tests). If significant results are found, post hoc tests are applied to interpret the results with higher detail.

RESULTS

To get an impression of the general acceptance of service extensions of MOD by cooperating with other service providers, a descriptive analysis was conducted. Table 1 shows the average attractiveness rating of different collaboration opportunities within the three areas (mobility providers, other service providers, retail stores).

The results show that, in general, all the cooperation options that were presented to the respondents are perceived as attractive. All mean values are above the neutral value, three. Only cooperation with online retailers is rated close to neutral and meets with less approval. Public transport is rated as the most attractive cooperation partner. In sum, the results show that the respondents are open to cooperation in the MOD sector.

To answer the second research question, the three different cooperation sectors were analzsed in detail to identify if there are significant differences in the perceived attractiveness.

Mobility Providers

The univariate analysis of variance showed that the perceived attractiveness of the different mobility providers differs significantly $F(2.903, 4069.61) = 218.48, p < 0.001$. Table 2 shows the post hoc analysis for further detail.

The perceived attractiveness of cooperating with public transport is significantly higher than the attractiveness of cooperating with other mobility service providers. Furthermore, the attractiveness of the cooperation with airports is significantly higher than the attractiveness of the cooperation with

Table 1. General attractiveness of cooperation partners.

Cooperation partner	Mean (*M*)	Standard Derivation (*SD*)
Public transport companies (PT)	3.97	1.047
Sharing providers (SP)	3.30	1.084
Airports (AP)	3.88	1.115
Park & Ride companies (PR)	3.72	1.084
Recreational operators (RO)	3.75	1.102
Hotels (HO)	3.86	1.083
Organizers of events (OE)	3.90	1.085
Restaurants (RT)	3.56	1.100
Tourist localities (TL)	3.80	1.063
Grocery stores (GS)	3.63	1.189
Other stores (e. g. drugstores) (OS)	3.45	1.165
Local stores (e. g. organic store) (LS)	3.40	1.187
Online retailers (e. g. amazon) (OR)	3.03	1.285

n = 1403; (1 = very unattractive, 5 = very attractive)
Q: How would you rate the cooperation of On-Demand-Systems with the following services?

Table 2. Comparison of mobility providers (post hoc).

Comparison	Mean Difference	SE (Standard Error)	p (probability)	95% Confidence Interval	
				Lower limit	Upper Limit
PT - SP	.67	.03	.000	.60	.75
PT - AP	.09	.03	.014	.01	.16
PT - PR	.25	.03	.000	.17	.33
SP - AP	-.59	.03	.000	-.67	-.51
SP - PR	-.43	.03	.000	-.50	-.35
AP - PR	.16	.03	.000	.09	.23

PT = Public Transport, SP = Sharing Providers, AP = Airport, PR = Park & Ride
Values based on Huynh-Feldt-Correction, adjustment for multiple comparisons: Bonferroni

sharing providers and park & ride. The attractiveness of the cooperation with park & ride services is also significantly higher than the attractiveness of the cooperation with sharing service providers.

Other Service Providers

The ANOVA leads to the result that the perceived attractiveness of other services differs significantly $F(3.90, 5473.30) = 53.74$, $p < 0.001$. Comparison of other services (post hoc) Table 3 shows the post hoc analysis in detail.

The perceived attractiveness of cooperation with recreational operators is significantly higher than the attractiveness of cooperation with restaurants. The cooperation with hotels is significantly higher than cooperations with recreational operators and restaurants. The cooperation with organizers of events is significantly higher than the cooperation with recreational operators, restaurants, or touristic localities. The cooperation with touristic localities is higher than the cooperation with restaurants.

Table 3. Comparison of other services (post hoc).

Comparison	Mean Difference	SE (Standard Error)	p (probability)	95% Confidence Interval	
				Lower limit	Upper Limit
RO - HO	-.12	.02	.000	-.18	-.05
RO - OE	-.15	.03	.000	-.22	-.08
RO - RT	.19	.03	.000	.11	.26
RO - TL	-.05	.03	.463	-.13	.02
HO - OE	-.04	.02	1.000	-.10	.03
HO - RT	.30	.03	.000	.23	.38
HO - TL	.06	.03	.108	-.01	.13
OE - RT	.34	.03	.000	.26	.42
OE - TL	.10	.03	.001	.03	.17
RT - TL	-.24	.03	.000	-.31	-.17

RO = Recreational Operators, HO = Hotels, OE = Organizers of Events, RT = Restaurants, TL = Touristic Localities
Values based on Huynh-Feldt-Correction, adjustment for multiple comparisons: Bonferroni

Retail Stores

The ANOVA leads to the result that the perceived attractiveness of retail stores differs significantly $F(2.27, 3185.48) = 115.05$, $p < 0.001$. Table 4 shows the post hoc analysis in detail. The cooperation between MOD with a grocery store is perceived significantly more attractive as all the other retail options. The attractiveness of cooperation with other shops (such as grocery stores) is perceived significantly higher than the cooperation with online shops. The cooperation with local stores is rated significantly higher than the attractiveness of the cooperation with online shops.

To answer the third research question, the usage probabilities of on-demand shuttles with cooperative options are compared with the usage probability of classic on-demand shuttles (without cooperation). Thus, a t-test for dependent samples is performed.

Table 5 shows a statistically significant difference between MOD service only and MOD cooperating with Mobility Providers ($t = -14.34$, $p < .001$, $n = 1403$). The cooperation of Mobility Providers and a MOD service leads to a significant higher willingness to use the service ($M = 3.45$, $SD = 1.207$) in comparison to MOD only without cooperations ($M = 3.13$, $SD = 1.145$). The effect size is $r = 0.71$, which means a strong effect as per Cohen (1992). There is also a statistically significant difference between MOD service only and MOD cooperating with other services (e.g., hotels) ($t = -10.76$, $p < 0.001$, $n = 1403$). The cooperation of Other Services and a MOD service leads to a significant higher willingness to use the service ($M = 3.41$, $SD = 1.193$) than without the service extension. The effect size is $r = 0.64$ which is perceived as a strong effect. The comparison between MOD service

Table 4. Comparison of retail stores (post hoc).

Comparison	Mean Difference	SE (Standard Error)	p (probability)	95% Confidence Interval	
				Lower limit	Upper Limit
GS - OS	.18	.02	.000	.12	.23
GS - LS	.23	.02	.000	.16	.29
GS - OR	.60	.03	.000	.51	.69
OS - LS	.50	.02	.180	-.01	.11
OS - OR	.42	.03	.000	.34	.51
LS - OR	.37	.04	.000	.28	.47

GS = Grocery Stores, OS = Other Stores, LS = Local Stores, OR = Online Retailers,
Values based on Huynh-Feldt-Correction, adjustment for multiple comparisons: Bonferroni

Table 5. Impact of cooperations on likelihood to use MOD.

Cooperation	M	SD	t	p (t-test)	r	P (r)
MOD only	3.13	1.145		—		
MOD + Mobility Provider	3.45	1.207	-14.34	.000	.71	.000
MOD + Other Services	3.41	1.193	-10.76	.000	.64	.000
MOD + Retail Stores	3.20	1.223	-2.58	.010	.62	.000

$n = 1403$; (1 = very unattractive, 5 = very attractive)
Q: How likely is it that you would use On-Demand-Shuttles if the following collaborations exist?

only and the cooperation with MOD and Retail Stores is also showing a significant difference ($t = -2.58, p < 0.001, n = 1403$) that leading to a significantly higher likelihood to use MOD than the On-Demand-Service without the cooperation ($M = 3.20, SD = 1.223$). It can be assumed that each of the three cooperation options leads to a general increase in the intention to use MOD. The effect is most pronounced for cooperation with mobility services.

CONCLUSION

In general, the (potential) users of MOD seem to be very open towards the service extension of on-demand-shuttles. The results show that each cooperation leads to a significant increase in usage probability. However, the effect of the cooperations with mobility service providers is the highest, followed by the cooperations with other service providers and the cooperations with retail stores. Within the cooperations with mobility service providers, cooperations with public transport companies are significantly more attractive than other potential cooperation partners. This effect could be explained by the fact that in the countries covered by the study, on-demand-systems are often integrated in the public transport system and are considered in fare structures. Accordingly, this cooperation option could have been rated so well by the respondents due to existing positive experience. Within the cooperations with other service providers, the cooperation with organizers of events is the most attractive. However, this potential cooperation partner does not differ significantly from the cooperation with hotels. Nevertheless, these results show the general interest and willingness to use MOD services to manage the trip to a hotel or event instead of the private car. The cooperation with restaurants is the least attractive one, differing significantly from all other potential cooperation partners. Within the cooperation with retail stores, the cooperation with grocery stores is the most attractive. Interestingly, the one with online shops is the least attractive, even though people ordering from these store types mostly online.

The results indicate that cooperations are an effective way to increase the usage and attractiveness of MOD. This is especially the case since the effects also apply to respondents who don't have any usage experience. The results thus support the assumption that service expansion can address new target groups and thus not only increase the user base but also could enable more profitable business models. Due to the very high acceptance and the great potential of MOD cooperation with other mobility providers such as public transport operators or airports, as well as cooperation with other service providers such as event organizers or hotels, future research on this should investigate the implementation and effectiveness. In addition, future research on potential collaborations in other regions and countries is valuable.

A limitation of the study is the hypothetical approach. Querying the probability of use for a potential service extension is not yet an indicator of whether such cooperation will ultimately lead to use. Accordingly, follow-up research should focus on designing and testing these collaborations. Based on the results, cooperation in the mobility sector is particularly suitable as an early implementation case. In addition, it must be verified whether a service

expansion will lead to substituting emission-supporting means of transport, for example. Substituting environmentally friendly means of transport would reduce the positive effect of MOD usage.

ACKNOWLEDGMENT

REFERENCES

Cohen, J. (1992). Statistical power analysis. Current directions in psychological science, 1(3), 98–101.

König, A. (2022). Flexible Public Transport - Analysis of User Requirements on Mobility-on-Demand Systems (Doctoral dissertation, Technische Universität Braunschweig).

Knie, A., Ruhrort, L., Gödde, J., & Pfaff, T. (2020). Ride-Pooling-Dienste und ihre Bedeutung für den Verkehr. Nachfragemuster und Nutzungsmotive am Beispiel von" CleverShuttle"-eine Untersuchung auf Grundlage von Buchungsdaten und Kundenbefragungen in vier deutschen Städten (No. SP III 2020-601). WZB Discussion Paper.

Koutsopoulos, H. N., Ma, Z., & Zahedi, S. (2023). Increasing Shareability in Ride-Pooling Systems. Reengineering the Sharing Economy: Design, Policy, and Regulation, 146.

Martin, E., Wong, S., Cohen, A., Soysal, S., Shaheen, S., & Brown, L. (2022). Mobility on Demand (MOD) Sandbox Demonstration: Los Angeles County and Puget Sound First and Last Mile Partnership with Via Evaluation Report (No. FTA Report No. 0239).

Mehlert, C., & Schiefelbusch, M. (2018). Rufbus meets Mobility 4.0: Lernen aus 40 Jahren flexiblem Nahverkehr. Nahverkehr, 36(10).

Viergutz, K. K., & Brinkmann, F. (2018). Ridepooling – a model for success? Digitisation in local public transport. SIGNAL+ DRAHT, 7(8), 13–18.