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A Concept of Crowdsourced Delivery for Small Local Shops

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Abstract: Small and medium-sized companies, in particular small local shops, suffer from increased competition via e-commerce channels, e.g. by Amazon and its same day delivery services. Consequently, local shops need delivery options to remain competitive. However, available delivery options such as express delivery are too expensive. A crowd-based delivery platform that leverages free capacity of cars from craftsman and nursing services as well as individuals can be one solution to organize affordable deliveries for small local shops. In this paper, we develop a first version of such a transportation platform within an action research study. Based on the early version of the platform, we discover smart data related challenges that need to be solved to establish the platform successfully. These challenges cover (1) identifying matches between the drivers' routes and transportation requests within a large data set, (2) governing the different parties participating in the platform ecosystem, (3) incentivizing users to join to overcome the "chicken or egg" problem, (4) establishing trust among platform users, and (5) ensuring privacy of user data. The solutions to these challenges will not only facilitate the implementation of a transportation platform for small local shops, they will also contribute to other platform-based business.

Keywords: crowd-sourced delivery, local shops, transportation, goods, action design research, agile development.

1 Motivation

With big online retailers like Amazon and even originally brick-and-mortar retailers like Walmart offering their goods online, the sales in e-commerce are growing from year to year. This can also be seen in figure 1, which even forecasts nearly a doubling in global business-to-consumer (B2C) e-commerce sales from 1233 billion dollars in the year 2013 to 2356 billion dollars in the year 2018 [SDC16].

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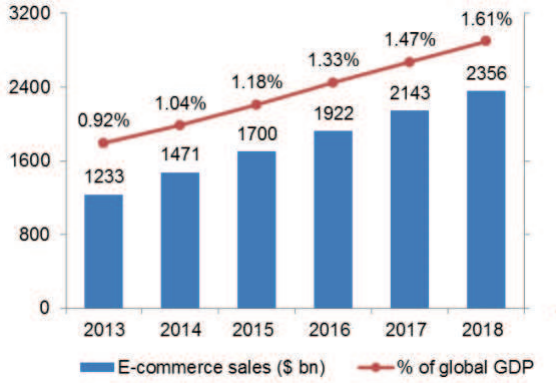

Figure 1: Global B2C e-commerce sales and percentage of GDP (in billion U.S. dollars) [SDC16]

Besides from the absolute numbers rising, the graphic also shows that the sales in e-commerce grow faster than the global gross domestic product (GDP), resulting in an increase of the percentage of the e-commerce sales relative to the GDP. This means that the importance of e-commerce for a B2C business is rising. At the same time, the delivery times of products are getting shorter. An example for this is Amazon: After offering next-day delivery in 2007, in some metropolitan areas the company is now even offering same-day delivery for goods that were ordered in the forenoon [Am15]. To compete with the big online retailers, small- and medium-sized businesses and in particular small local shops also need to be able to offer quick deliveries to the end customer. This however poses a problem to smaller businesses as maintaining an appropriate delivery network is cost-intensive.

At the same time, a huge number of cars are driving through the city and still have capacity for transporting goods. Individuals but also companies that have business processes within cities (e.g. craftsman or nursing services) could leverage these free capacities by accepting delivery requests from local shops organized by a transportation platform. The platform would allow drivers to reduce the costs of their trip by utilizing otherwise empty space in their vehicle while at the same time allowing shop owners or others to perform quick deliveries at an economically reasonable price. This idea appears especially promising due to a similar concept being used successfully in the food delivery market. Businesses like foodora offer food delivery for restaurants that do not have an own delivery service and cannot deal with the logistical overhead of having one [Fo16]. This business model seems to work for foodora, as the company's revenues are rising every year and the enterprise is currently expanding into new markets.

In this research-in-progress study, we chose an action design research approach following Sein et al. [SH16] to develop and evaluate a first version of a crowd-based delivery platform. By evaluating the first prototype, we identify challenges related to the smart data context that need to be solved in the subsequent progress of the research project. These challenges comprise smart algorithms but also aspects such as platform

governance and privacy.

2 Logistics of Small Local Shops

Before proposing a research method, a concept and outcome, this chapter gives some background information about the situation of small local shop owners at the moment. A focus will be the question, how they cope with the increasing importance of e-commerce.

2.1 E-Commerce

The importance of e-commerce is rapidly increasing. Seidenschwarz et al. [Se14] give evidence that the amount of e-commerce has increased significantly and is prognosticated to growing further. In Germany, a large share of the e-commerce business is held by eBay and Amazon. However, the major part is not processed by the companies themselves. As a response to the increasing importance of e-commerce, a lot of midsize companies use the marketplaces of eBay and Amazon to sell their products online.

In future, the amount of e-commerce will continue to increase. Ewert, Kallenbrunnen [EK14] analyze the potential of e-commerce and present auspicious results. In combination with optimized product portfolios and an appropriate degree of specialization e-commerce contains great potential in some branches. Based on that they predict an increase in e-commerce, if businesses seize this relatively new and promising though very technical business area. Such a structural change in the sales process has an effect to various sectors. The research approach of this paper focuses on the consequences and challenges of increasing e-commerce for a delivery system of local shop owners.

2.2 Delivery Options

When it comes to delivery tasks, small and medium-sized businesses and in particular local shops have different options. The most intuitive possibility is to deliver goods on their own. However, such businesses often are too small to implement an efficient delivery network. They cannot leverage economics of scale. As a consequence, delivery is inefficient and time consuming and causes unbearable disadvantages and costs. A solution in this situation could be to outsource the delivery by hiring a professional delivery company. An advantage of this strategy is that it shifts the responsibility and effort to another party and is therefore easy to use for a small shop. However, this comes along with either too long delivery times or comparatively high costs. Standard package delivery e.g. is cheap but takes too long to compete with offers like Amazon’s premium delivery. Express delivery is a really fast service but in comparison very expensive.

A third new and innovative alternative for this problem would be crowd-based delivery platforms. Such structures have been approved in the food delivery business and could be transferred to general transportations as well. UberRush [Ub16] represents one first example of a similar crowd-based platform in the New York City Area, San Francisco and Chicago. Following the third approach with a crowd-based solution, this paper analyzes aspects and challenges of such a delivery platform in Germany.

3 Research Method

The project was executed according to Sein et al.'s methodology action design research (ADR) from 2011 [SH16]. The artifact that was aimed at is a software architecture for implementing a platform for crowd-based goods transportation sharing. However, this study comprises only a first version of the platform, as the user requirements for such a platform are not yet completely explored and therefore additional steps have to be taken before the final artifact can be produced. This is also the reason why Action Design Research was the chosen research approach, as it contains a generic schema that features a research process which uses early end-user tests to refine the initial requirements. The schema can be seen in figure 2.

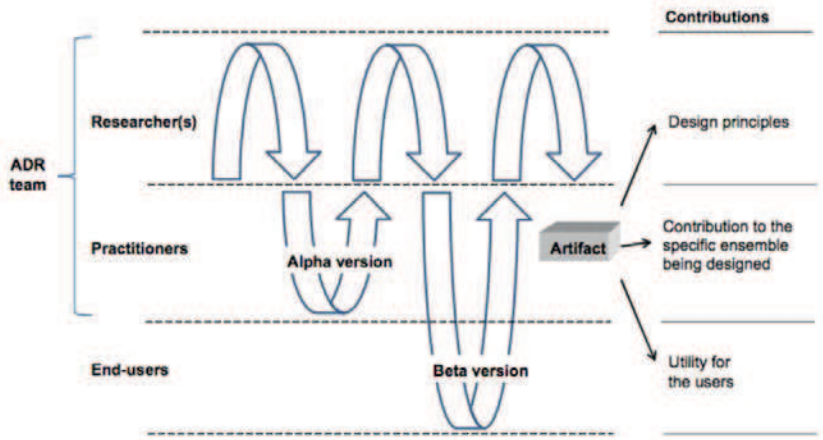

Figure 2: The generic schema for IT-dominant BIE (building, intervention and evaluation) [SH16]

Therefore, the aim of this paper was the development of an alpha version of a prototype application which features the basic functionality for a crowd-based delivery platform. By implementing the platform, we built on an existing solution for ride-sharing that was developed as ride-sharing service for students at Technical University of Munich and has been provided as open source project [Tu16].

The final prototype will then be taken into lab and/or field studies to assess the user acceptance and usability, gather feedback and find out about advanced feature requests.

Based on that information the application is refined and after multiple design cycles, a final application could be developed in a next step, based on the source code of this prototype. As the requirements were not fixed before starting the development, an agile development model was chosen to allow for changes in requirements during the development phase. The method chosen was Scrum, as it is one of the major agile development models, has a big community that can provide additional support and some team members already had experience with it. To follow the procedure of Scrum, we started with getting the requirements right without deviating from the core idea. These requirements were translated into user stories and put in the product backlog for later assignment. Since the Scrum method is based on the concept of sprint based development, we had a development period of two weeks for each assigned user story. During the sprint meetings each user story would be given an estimation point which would represent the time and complexity that it would take for the changes to be realized. After every two weeks (sprint period), a scrum meeting was organized where every team member would report on what they were able to achieve since the last sprint, what they will be doing during the upcoming sprint and if there were any blockers for their development tasks. In the course of these scrum meetings, the requirements would be discussed and changes to the requirements or new requirements would be added to the product backlog.

4 Description of Concept

The main purpose of the software application developed in this project is to provide small and medium-sized businesses, in particular small local shops, with an opportunity to transport their goods in an optimal way via the communication between them and potential transportation drivers (individuals or businesses such as craftsman or nursing services). There are many features to ease the communication between the two parties. For the explanation of the features we use the following terms: requester (the person who creates a transportation request) and transportation driver (who can choose to accept the transportation request created by the requester). The software application we developed consists of two parts, one for each user group: A web application targets the requester (e.g. owners of small local shops) while a mobile application (iOS) targets the transportation driver (people who deliver the packages). The main features are as follows:

Both the iOS and the web application require the registration for both the requester as well as the transportation driver. The registration feature helps the user to be affiliated with the application as a requester or a transportation driver. This process includes providing the basic details of the user. Once the user is registered, then he/she will get an email as a confirmation for registration and a link to verify their account. The verification feature makes sure only the verified users are allowed to use the features provided by the applications. If the requester has a verified account, then the user can login with his/her credentials with the web application and add a transportation request

that meets his/her requirements. The users can add details about their transportation request which includes important details like the dimensions of the transportation goods they want to send, the pickup and destination location, the deadline and the amount for the successful delivery. If the transportation driver has a verified account, he/she can login with his/her credentials with the iOS application and view the transportation requests nearby as well as details regarding the request. The user has the choice to view the ratings of the requester and to accept the request if it meets his/her requirements. Once the transportation request posted by the requester is accepted by the transportation driver, a notification email will be sent to the requester. This will confirm that the transportation driver has accepted to deliver the good. The whole workflow of the package delivery can be viewed in figure 3.

Figure 3: Workflow of the package delivery

5 Discussion and Challenges for Future Research

Having seen the conceptual background and the features of this transportation platform, we will discuss the potential and challenges of this solution. Judging the potential of an innovation is most commonly difficult in advance. However, there are arguments indicating great potential for a crowd-based transportation platform on a city level. Delivery of goods is gaining more and more importance resulting in shorter delivery cycles and complex logistic networks. Same day delivery is a new service, which is used by companies to outperform competitors. Whereas companies like Amazon are able to offer same-day-deliveries to its customers due to their size, smaller local competitors are not. By cooperating in a crowd-based transportation platform, small and medium-sized businesses and in particular small local shops can compensate this inequality.

Another circumstance supporting the potential of a crowd-based transportation platform is the great number of start-ups with similar business ideas. Tech.co [Te15] for example

presents the five international start-ups Entrusters, PiggyBee, Packmule, Shipizy and Jib.li focussing on crowdsourced shipping solutions. The many different start-ups and the diverse set of approaches can be taken as evidence that there is potential in crowd based transportation solutions and a lot of people have already recognized this potential. Compared to the mentioned start-up, our solution follows a similar approach, but has a different orientation. The focus on short deliveries within the radius of one city and on the German market is a new alignment and generates therefore potential, which has not yet been covered.

Opposed to the potential of the solution, several challenges need to be overcome to develop a successful crowd-based-delivery platform. These challenges are related to the fact that a delivery platform gathers data to coordinate delivery processes via a platform. The challenges are summarized in table 1.

First, a **smart matching algorithm** will be necessary to match the routes of drivers with transportation requests. The algorithm needs to process a large number of routes and requests in real-time. An inverted-index data structure to store the information of routes can be used to reduce calculation times. More detailed explanations of such an algorithm are given in [Sc16]. It provides an implementation and evaluation of a dynamic and performant ridesharing service, matching ride offers and requests in real-time. In the further course of the study, those algorithmic features will be incorporated into the existing platform.

The second challenge for such a platform to coordinate crowdsourced transportations will be to incentivize a critical amount of users to benefit from **network effects**. With regard to the transportation platform only a big enough number of users guarantees the necessary local coverage of transportation requests and drivers for a successful running. Strategies and important issues in this context are elaborated in [Ei06].

A key step is for example to attract publicity in the first roll-out phase. It is very likely that there will be an overweight of requests compared to transportation offers at the beginning, resulting in unanswered transportation requests. Partnering with inter-trade organizations to guarantee that all transportation requests are met could then help to address the target group effectively and to overcome the time period until a critical number of users is reached.

Another important factor for the success of such a transportation platform is the quality of the UI (User Interface). Only if the layout appeals the users, the platform will cause a positive impression and has the chance of success. A/B-Testing as described in [Jo06] is an effective method to evaluate different UI designs.

Platform governance is the third challenge and comprises how a flourishing platform ecosystem can be created by the platform owner [Ti14]. [Sc16_2] structures current literature about design and governance of platform ecosystems with regard to different perspectives and concepts. The paper identifies the definition of roles, pricing, boundary resources and openness as most relevant issues. In the further development of our

platform, all these topics need to be considered. For example, when deciding on the platforms' pricing, one needs to pay respect to both platform owner and transportation provider and find an agreement that provides enough incentives for the transportation provider but still allows an economical platform operation. Besides that, in particular the degree of openness of the platform and the decentralization of decision processes needs to be balanced with control mechanisms.

Privacy as fourth challenge is critical as users share location data. Privacy therefore needs to be considered already in the implementation phase with a privacy-by-design approach [Sc10]. The seven key principles of privacy of design according to [Ca10] are proactive not reactive, privacy as the default, privacy embedded into design, full functionality, end-to-end security, visibility and transparency and respect for user privacy. Taking this framework as guidance, those principles of privacy by design will be applied to our transportation platform in a next step. A concrete example for that can be found in the context of doing data analysis on user location data in order to optimize the matching process. By hashing personal information at first, anonymity of users during the data analysis phase is ensured. Furthermore, transparency of the data storage and processing is necessary.

Finally, **trust** among the platform users needs to be established as the requester gives his goods to the transportation driver. Therefore, the security and resistance to criminal actions of the transportation platform is essential for the success. Since up to some extend crowd-based approaches always rely on trust in the crowd, this risk cannot be prevented completely. However, approaches to minimise it are for sure possible and range from regulative measures like the mandatory record of an ID card to crowd-based mechanisms like ratings. For delivery goods with high value, an insurance and money return policy could also be introduced. This would make the transportation requester more comfortable by compensating financial losses in the case of improper handling or loss of the delivery good.

No.	Challenge	Possible solutions to be evaluated
1	Smart matching algorithm	• Real-time matching • Inverted index structure
2	Leverage network effects	• Publicity from the very beginning • Partnering • High quality UI
3	Platform governance	• Decentralization • Openness • Control mechanisms
4	Data privacy	• Privacy by design • Transparency
5	Trust	• Mandatory registration with ID

	• Ratings • Insurance and money return policy

Table 1: Challenges for the further development of the transportation platform

6 Conclusion

This project has produced a first prototype of a transportation platform. Based on this current state a two-pronged approach should be adopted. On the one hand, since the current prototype contains all core features of a crowd-based transportation platform the current version of the prototype will be evaluated to decide which features need to be implemented. A follow-up project will therefore be a field study to present the solution to shop owners and other representatives of the target group in Munich. In subsequent interviews and surveys feedback from this target group will be gained. On the other hand, the five challenges identified in this research-in-process study need to be addressed and the solutions can directly be tested in the field study. The outcome can provide valuable information about positive and negative aspects, priorities of intended users and possible fields of improvement. The results do not only contribute to the project at hand but support researchers and practitioners that implement data-driven platform ecosystems.

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