Peer-to-Peer Service Sharing Platforms: Driving Share and Share Alike on a Mass-Scale

Completed Research Paper

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Abstract

The sharing economy has been growing continuously in the last decade thanks to the proliferation of internet-based platforms that allow people to disintermediate the traditional commercial channels and to share excess resources and trade with one another effectively at a reasonably low transaction cost. Whereas early peer-to-peer platforms were designed to enable file sharing and goods trading, we recently witness the emergence of a new breed of peer-to-peer platforms that are designed for ordinary service sharing. Ordinary services entail intangible provisions and are defined as an economic activity that generates immaterial benefits and does not result in ownership of material goods. Based on a structured analysis of 41 internet-based rideshare platforms, we explore and layout the unique characteristics of peer-to-peer service sharing platforms based on three distinct temporal patterns that entail specific consequences for platform use as well as provide insights about their overall design imperative.

Keywords: Digital Platforms, Peer-to-Peer, Service Sharing, Service Economy, Sharing Economy, Temporal Design Patterns

Introduction

The sharing economy has been growing continuously in the last decade thanks to the proliferation of internet-based platforms that allow people to disintermediate the traditional commercial channels and to share excess resources and trade with one another effectively at a reasonably low transaction cost. Whereas early peer-to-peer platforms were designed to enable file sharing (e.g. Napster) and later goods trading (e.g. eBay), we recently witness the emergence of a new breed of peer-to-peer platforms that are designed for service sharing[1]. In this case, services entail intangible provisions provided by individuals that generate immaterial benefits to others and do not result in ownership of material goods. For example, people share car rides, accommodation, and even homemade meals. Regardless of whether the motivation for peer-to-peer exchange is a post-crisis antidote to materialism and overconsumption, a highly developed environmental conscious, or simply a way to save a buck, proponents of service sharing believe

[1] While the IS field has been focusing on service in terms of 'software as a service' (see e.g. Xin and Levina 2008) or 'information services' (Mathiassen and Sørensen 2008), in this paper we are interested in 'ordinary services', i.e. intangible provisions and exchanges (Zeithaml et al. 1985) supported by digital platforms. Ordinary services are defined as an economic activity that generates immaterial benefits and does not result in ownership of material goods (Gawer 2009).

that "access trumps ownership" and the phenomenon picks up steam globally. In this paper, we explore the unique characteristics of peer-to-peer service sharing platforms and provide further insights about their functionality and overall design imperative.

For quite some time, consumers have been using an alternative mechanism of exchange to complement traditional commercial companies. In this alternative mechanism of exchange, the seller as a corporation and the buyer as a customer, are replaced with peers, selling, buying and sharing. This forms the base of a number of well known successful large scale digital platforms for peer-to-peer exchange (e.g. Napster, eBay). In the wake of global recession, the prevailing fundamental consumption patterns have been criticized (Botsman and Rogers 2011), and recently, in 2013, the Academy of Management chose "*capitalism in question"* as the main conference theme. In this vein, peer-to-peer collaborative economy, which was on the fringe for quite some time, has begun to gain grounds in the mainstream economy as well as the academic discourse (see e.g. Botsman and Rogers 2011; Gansky 2010). Alternative means of organizing and managing exchange can be found now in increasing numbers of areas. Applications are as diverse as the industries involved. For example, pre-owned items can be purchased or bartered, electricity from private home solar cells systems can be transmitted to the public grid and sold to utility companies, cars can be rented from neighbors, spare rooms let, etc. The ongoing expansion and proliferation of these cases would be impossible without dedicated IT infrastructure. The spread of mobile and social computing is frequently cited as a foundation on which digital platforms sprout in ever-increasing numbers and variants supporting peer-to-peer service exchange. Consequently, there are now platforms that cater for peer-to-peer exchange of digital media (e.g., Pirate Bay), physical goods (e.g. eBay), and more recently, service exchange (e.g. Avego ridesharing). All of these are dependent on network effects (Katz and Shapiro 1985), i.e. attracting a critical mass of peers to create enough perceived value (Rogers 2003).

The point of departure of our study was the presupposition that the nascent peer-to-peer service sharing platforms are different than their predecessors. In this vein, we questioned whether peer-to-peer service sharing platforms are a new phenomenon that is significantly different from what we have seen thus far in other peer-to-peer exchange cases. More specifically, in this paper, we explore and reveal the characteristics of Internet-based peer-to-peer service sharing services. Subsequently, we utilized a systematic exploratory case study approach to investigate the nature of a diverse set of existing peer-to-peer service sharing platforms using an exhaustive set of 41 rideshare services as a case domain.

The remainder of the paper is structured as follows. First, we explore and juxtapose the various archetypes of peer-to-peer exchange types and conceptualize the emerging peer-to-peer service exchange, which provides the foundations for a new class of peer-to-peer service sharing platforms (chapter 2). Then we present our research design and explain how the selected platform cases meet the service sharing criteria (chapter 3). Subsequently, we describe our findings and elaborate on the emerging patterns of service sharing services as well as their respective platform design (chapter 4). Based on these findings, we discuss their impact on platform design and adoption (chapter 5). We conclude the paper with a reflection on the limitations of the study and suggestions for future research of peer-to-peer service sharing platform (chapter 6).

Peer-to-Peer Exchange Platforms

The concept of platform has diverse meanings and has been researched within different theoretical fields (Baldwin and Woodard 2009). A predominant use of platform is in the context of 'product platform' (Gawer and Cusumano 2002) in which firms leverage on complementary relationships among products in order to gain market advantage .Industrial economists adopted the term to describe products, services, firms and institutions that mediate transactions between two or more groups of platform actors (Rochet and Tirole 2003). In the information systems domain, scholars have investigated different types of digital platforms from a firm perspective, pointing at internal platforms (used within a firm), supply chain platforms (operating outside the boundary of the firm), and industry platforms that support a loosely organized network of collaborating firms (Tilson et al. 2013). These firm-centric digital platforms (e.g. Amazon, Spotify, and Apple's Appstore) enable the steady growth of e-commerce, through which both physical and digital goods are being sold and distributed in ways not possible otherwise. In turn, the economic viability combined with ruthless competition for market share has spearheaded an ongoing evolution of digital platforms and platform complexity.

The sharing of primarily intangible digital content over digital platforms has been discussed at length (Belk 2007; John 2012). However, sharing is arguably one of many ways of interacting with peers. For instance, Fiske (1992) suggests four main interaction models: communal sharing, equality matching, authority ranking, and market pricing. Whilst a thorough analysis of these interaction modalities is beyond the scope of this paper, fundamentally, and regardless of their underlying motives, individuals in peer-to-peer exchange display similar interaction patterns to those found in traditional commercial settings. Roles seem mostly asymmetric where one peer supplies the other with something in a certain *peer provider/peer consumer* exchange pattern. Though in general such transactions are a common part of our daily lives, we are interested in IT-based peer-to-peer platforms that are specifically designed to facilitate such services. As detailed in Table 1, peer-to-peer exchange can be categorized according to what is actually being exchanged—that is, the focal *object* of sharing. An object of sharing can be purely digital, physical, or a service interaction. It can be also categorized according to the prevalent coordination patterns that are involved in a mediated exchange. Physical coordination can be decoupled (no co-location coordination necessary), or coupled (collaborating peers coordinate in time and space).

Table 1: Four Archetypes of Peer-to-Peer Exchange

	Peer-to-peer File sharing	Peer-to-peer Trading	Peer-to-peer Goods sharing	Peer-to-peer Service sharing
Object of exchange	Digital material	Tangible material	Tangible material	Intangible encounter
Timing requirement	No	Not necessarily	Not necessarily	Yes
Meeting requirement	No	No	Not necessarily	Yes
Example	Napster	eBay	AirBnb	Avego

Building on the basic characteristics of peer-to-peer sharing, we have grouped existing peer-to-peer exchanges into four archetypes: *file sharing, trading, goods sharing*, and *service sharing*. Note that although the current set represents the bulk of available peer-to-peer platforms, the suggested classification is not intended to be exhaustive and the boundaries between the categories are somewhat fuzzy. As pioneered for example by the music sharing site Napster, *file sharing* platforms facilitate the sharing of digital media content such as music, movies, software or books. In this case, the peer-to-peer attribution refers to the sharing taking place between individuals as well as to the architectural principles of the computing platform itself. Digitized content is easily replicated and shared in asynchronous fashion that is facilitated and managed by a file sharing technology (e.g., BitTorrent protocol). Indeed, decoupling transactions and making them asynchronous in terms of human interaction lies at the heart of peer-to-peers sharing of files. A very different archetype of peer-to-peer exchange is facilitated by *trading* platforms, such as eBay, that enable trading of physical goods. These platforms frequently facilitate asynchronous interaction (e.g. bidding via agents) between peer consumers and peer providers. Add-on services such as payment facilitation may be offered but physical coordination (i.e. delivering purchased goods) is often not specifically catered for by such platforms. Another modality of exchange is enabled by peer-to-peer *goods sharing* platforms. This exchange is fundamentally different from peer-to-peer goods trading because it does not involve transfer of ownership. Instead, the platform facilitates limited time access and use for a set fee. Such platforms coordinate access to relatively expensive physical objects and include peer-to-peer car rental variants (e.g. Relay rides), parking space (e.g. ParkatmyHouse), and accommodation (e.g. Couchsurfing, Airbnb). The transaction is usually agreed upon well in advance and the peer consumer is completely or partially decoupled from the peer provider (e.g. the car is made available for use when it is returned to the peer provider).

Over the last few years, *service sharing* has emerged as a fourth archetype of peer-to-peer platforms. Pure services are ephemeral because they are produced and consumed simultaneously (Zeithaml et al. 1985). In service sharing, peer provider and peer consumer collaborate at the same place to produce a mutually beneficial encounter. This entails a highly coordinated arrangement of resources in a tightly defined timeframe. Collaboration in peer-to-peer service sharing is arguably more complex than earlier types of peer-to-peer exchange due to the ephemeral and interactive nature of the exchange, which renders the asynchronous approach of previous service platforms inadequate. In this paper, we explore the prevalent

patterns of peer-to-peer service sharing and reveal their unique characteristics through a systematic analysis of digital platforms that were designed specifically to handle complexity of service sharing.

Research Design

The focal point of this study is digital platforms that support peer-to-peer service sharing. We adopted an exploratory case study approach, which is especially suitable for the exploration of emerging phenomena (Yin 2012). Exploratory case studies must be flexible and open, yet they also need to be designed and managed in a structured fashion. Subsequently, we designed a four-phased study that provided a framework for a structured analysis that could surface the underlying patterns of peer-to-peer service sharing platforms (see Table 2).

We selected the ridesharing services platforms as the empirical case domain to study the general peer-to-peer service sharing phenomenon. The motivation for selecting the subset of ridesharing services was the relatively large number of such platforms which were the harbinger of the service sharing platforms and have expanded rapidly. In the first phase of the research process, we *identified key concepts of the ridesharing services in order to create a coding scheme* that in turn can be used to analyze a sample of peer-to-peer service sharing platforms. As a first step, we created a catalog of all ridesharing services platforms. We approached four of them directly and interviewed key people in order to get a better understanding of the specifics of the ridesharing services and the peer-to-peer service sharing platforms used in this domain. In addition, the researchers actually used these platforms in order to obtain firsthand experience and further insight. This initial set of pilot data was analyzed in an open-ended manner enabling us to design what Yin (2012) labels as a pilot protocol constituting a coding scheme of what emerged as the salient dimensions of ridesharing and peer-to-peer service sharing in general. More specifically, we compared and contrasted the four cases in the initial data set to highlight platform design and use differences. The variations judged most distinct or liable to generate important distinctions later on were used as a basis for generating a coding scheme (Miles and Huberman 1994).

The complete coding protocol including its indicators and scales was tested and validated. As a first step, an independent third party was asked to analyze three separate cases of peer-to-peer services sharing platforms using the coding protocol. In parallel, two of the researchers used the coding protocol to analyze the same cases. The results from the three independent analyses were compared in order to assess inter-rater reliability (Woodside 2010). The outcome displayed a pattern of agreement that is greater than could be expected by chance. The inter-rater reliability (i.e., inter-judge agreement) was found to be (83%) and the few disagreements that emerged from this initial test were easily reconciled[2].

The second phase of the research process aimed to *delineate and select platforms to be analyzed*. Given the wide range of ridesharing services in all corners of the world, we used the diverse case-selection technique (Gerring 2007) in order to highlight the variation in ridesharing platforms. Using this technique generated a relatively large data set of 41 platforms as detailed in the appendix. Data sources were the Internet portals of the ridesharing services, together with any information pages, mobile application stores (e.g. Apple's App Store and Android Market), mobile applications, news articles, bloggers entries, and other accounts describing the platforms.

In the third phase of the research process *each sampled platform was analyzed*. The researchers explored the selected ridesharing services and investigated them from the inside to gauge levels of activity, functionality and so on. The analysis was done in parallel by two researchers; each analyzing a particular platform independently using the code protocol. Results were documented in a dedicated database that was developed for the project. The data collected by the two researchers were compared after roughly half of the total number of platforms had been analyzed. Interpretational differences were present in 41% of the observed cases. However, 73% of these non-agreements were related to the activity level indicator, which was difficult to assess given the dynamic nature of these services and lack of direct information. The initial inter-rater reliability was 59% but after adjustment to the activity level indicator, it went up to 89%

[2] Each of the three raters made 12 analyses (on 3 platforms using 4 indicators) resulting in 36 analyses done in total. When comparing the results the raters exhibit full agreement in 83% of the analysis performed and nearly full agreement in 17% of the cases. The disagreement was related to the activity level indicator, which subsequently was fine-tuned.

which is in line with phase 1 of the analysis[3]. After the remaining rideshare platforms had been analyzed, the two researchers assessed the entire set from the beginning once again to ensure consistency of interpretation.

The main objective of the fourth phase of the research process was to *reveal distinct patterns*. We particularly looked for distinct patterns that reverberate throughout the entire data set and that can provide meaningful insights with regard to service sharing peer to peer platforms.

Table 2: Exploratory Case Study Framework

	Phase 1: Exploration of the ridesharing services and pilot study	**Phase 2: Selection of service sharing platforms and pre-analysis preparations**	**Phase 3: Analysis of peer-to-peer service sharing platforms**	**Phase 4: Pattern analysis**
Purpose	Identifying key concepts of the empirical context in order to create a coding scheme	Delineating and selecting platforms to be analyzed	Analyzing each platform	Revealing peer-to-peer service sharing patterns
Steps	1) Select service sharing domain case, 2) Investigate in-depth four cases, 3) Create coding protocol, 4) Validate coding protocol, both intra-researcher and with third party	1) Delineate and select representative cases, 2) collect data from 41 platforms, 3) organize the data in a research database	1) Analyze in parallel 20 platforms by two researchers, 2) Determine inter-rater reliability, resolve issues, adapt coding scheme, 3) Complete the analysis of the remaining 21 platforms	1) Perform structured comparison of the coded platforms data, 2) Elicit patterns and contributions to platform design and platform adoption.
Data Sources	Recorded interviews, Participative observations, Platforms and Documents	Platforms and Documents	Platforms and Documents	Data collected and stored in research database
Output	Understanding of the ridesharing services domain and a coding scheme (see Table 3)	Main case selection: 41 cases (see appendix)	Main case analysis: 41 cases (see appendix), Revised coding scheme	Findings and key lessons (see Table 4)
Who	Research team+ external coder	Research team	Research team	Research team
When	March 2012- July 2012	August 2012 – October 2012	November 2012 – December 2012	November 2012 – January 2013

[3] The two researchers made in this first phase 40 analyses (on 10 platforms using 4 indicators) resulting in 80 analyses done in total. When comparing the results the researchers had perfect agreement for 59% of the analysis performed. In 41% of the analyses the researchers disagreed. . The disagreement was related to the activity level indicator, which resulted in the operational definition of this indicator being improved. 5 non-agreements were related to differences in how long the service had been available, 4 non-agreements were related to technical platform and 24 non-agreements related to the indicator activity level.

Analysis and Findings

In this section we present the four phases in the research process with a focus on the output that was produced in each phase.

Phase 1: Exploration of the Ridesharing Services and a Pilot Study

Given the exploratory nature of the underlying phenomenon, we utilized a case study approach that was focused on a specific application area from which we selected a number of cases of service sharing platforms. An initial review gave us a progressive development of four main archetypes of platforms with increasing degrees of physical coupling ending in service sharing platforms. Seeking empirical material suitable to exploring the arguably complex socio-technical nature of service sharing, dependent on physical coupling and ephemeral encounters, we selected a specific type of service sharing platform, ridesharing. In being mobile, ridesharing has a higher degree of coordination complexity than that found in most prominent peer-to-peer platforms, e.g. peer-to-peer accommodation (e.g. "Airbnb"), parking (e.g. "Park At My House"), or peer-to-peer car rental (e.g. "Relay Rides"), all of which deal with fixed locations or hardware rather than direct personal service provision. Our case of ridesharing also made it easier to distinguish how the various platforms examined differed, not in terms of a multitude of supported sharing services, but rather focus the actual platform implementations. We wanted to have a comparable set of services in order to isolate distinguishing differences in design between platforms from differences between service types.

In essence, ridesharing entails the participation of one or more riders (peer consumers) who, together with a driver (peer provider), share a vehicle, typically a car, when travelling from start points to destinations. To accomplish this, peer providers together with peer consumers agree on various aspects before or throughout the service performance; e.g. pick-up and drop-off points, waiting time, music playing, smoking policy, compensation, etc. (Teodorović and Dell'Orco 2008). A specialized type of peer-to-peer service sharing platform, a ridesharing platform, facilitates this. Since this peer-to-peer activity is ephemeral and requires the collocation of peer provider and peer consumers throughout the duration of each discrete service performance, it matches our research scope well.

One estimate based on an extensive Internet search dating from 2010 states that there were 613 ride matching services in North America. This included internet based as well as offline services (Shaheen 2011). Indeed, while phenomena such as car- and vanpooling are far from novel, digital service innovation occurring within the fields of telecom, telematics and social web are adding new aspects to peer-peer travelling. Workplace- and long distance sharing of rides has been supplemented with digital services for dynamic, or instant, ride sharing. In these digital services, car-drivers advertise their rides and form a surplus that can be matched algorithmically by riders' needs, as entered into a mobile often GPS-enabled digital service. Design rationales seem equally diverse as Facebook group pages compete with smart phone apps with integrated automatic payment systems. Workplace or neighborhood municipal digital groups co-exist with regional, national or even global initiatives, indicating diverse takes on social design dimensions. Proprietary systems laden with functionality coexist with less complex designs, more open to users and developers alike.

There are several characteristics of ridesharing platforms that make this peer-to-peer service sharing application interesting. First, there is a complex incentive structure. The majority of rideshares seek to reduce their travelling costs or to minimize environmental impact. When available, schemes allowing access to HOV lanes and other incentives may be a factor. The societal benefits are obvious: sharing rides reduces the total number of trips significantly. Additionally, though gaining increasing media attention**,** ridesharing through peer-to-peer platforms is still not a widespread practice (Hansen 2010; Loose et al. 2006). There are several hypotheses as to why. First, peer-to-peer platforms are perceived as lacking official endorsement (e.g. insurance coverage). Second, cognitive factors such as security, status, privacy and skepticism about consumption without ownership play a part (Clay and Mokhtarian 2004). Third, the matching and coordination of peer provider and consumers is challenging (Hansen 2010). Ubiquitous, mobile platform access is seen as an important feature to facilitate this (Kemp and Rotmans 2008). In order to gain a deeper understanding of ridesharing platforms, we selected and explored four platforms that we sensed had a set of properties that clearly set them apart from each other.

The first platform, 'Blablacar' was founded in France in 2004. It is currently used by some 500 000 members per month. A user can post a lift request or a lift offer on a web board for other users to find by manually searching the ride posts for a specific region. The rides are sorted by country and can be displayed on a map. The service provides basic functions to arrange planned ridesharing or carpools. It contains the functionality of making a driver or rider description for the ride advertisement posted on the web board. There is no mobile computing functionality supporting driver-passenger interaction, instead all communication is managed by email, externally. Indeed, there was little functionality provided within the service, merely advice on how to create an attractive ride advertisement to be posted on the web board, or how to choose a good ride. For instance, it is intended that members specify their level of chattiness on the scale "Bla", "Blabla" and "Blablabla", hence the name. Rides seem to be posted well in advance. Based in Paris with offices in London, Madrid, Milan, Hamburg and Warsaw, it operates in ten countries across Europe.

The second platform, 'Skjutsgruppen' started in 2007. It currently lists some 30 000 members. It is entirely based on a large social media platform (Facebook), enabling it to tap the vast social network contained within it. People post rides on the page and manually scroll through the stream of messages to find matches. This makes it hard to get an exact measurement on what types of trips are advertised, but at a glance it seems that rideshares are planned days or even weeks in advance. Payment is negotiated entirely outside the platform. The service is clearly targeting Swedish users, though the group managers briefly expanded the scope to incorporate the whole of Europe during the 2010 ash-cloud incident. However, this extreme adaptability and near zero maintenance has had equally clear drawbacks. Functionally, Facebook is ill suited for the search and match behavior at the heart of rideshare services. Members have voiced complaints over difficulties finding rides in the fast updating board.

The third platform, 'Avego Driver', was first released in 2008 as a prototype of an "experimental travel network". Avego has run a number of pilots in various contexts and variants. However, the Android market reports a modest 1000-5000. It was originally deployed on the Apple iOS platform. The platform includes features for instant/dynamic matching, socalled "slugging" (casual ride sharing), payment, navigation, tracking, peer rating, and more. The developers have had a market-influenced approach to payment. Both rider and driver are connected to the service backend, which calculates the cost for the trip and transfers funds automatically, while the digital service provider keeps a percentage. Based in Kinsale, Ireland, the company has expanded, opening offices in e.g. San Jose, CA, Washington, DC, and Dalian, China in 2009.

The fourth platform, 'iCarPool', has been available for 7 years in the US. This platform targets organizations – employers of various kinds and universities, rather than individual users. This means that it has been difficult to gauge usage accurately, since data on this is primarily managed by the roughly 50 organizations that have chosen to adopt the iCarPool platform, and updated global data on actual usage is hard to come by. Though available on a mobile platform (iOS), the platform is primarily stationary and aimed at the managing organization. There is support for social group management to keep track on e.g. schedules in carpools. Multiple modes of transport such as carpool, vanpool, bike, walk and transit, are integrated. A distinguishing attribute is the advanced integrated features for managing external incentives, to be provided by either employers or regional public agencies. For instance, a company could encourage employees to use this comparably environmentally sound means of reaching the workplace by granting users privileges in terms of parking spaces etc.

As mentioned earlier, our exploration of these platforms was a means to create a set of codes with which to analyze a larger set of platform cases (Yin 2012). By viewing salient differences, we created a pilot coding scheme to aid our analysis of ridesharing platforms including codes such as technical platforms, i.e. if the platform had mobile device support or a primarily stationary web, compensation support, namely to what degree the platform supported payment or not, how big or active the user community was and geographical coverage.

Phase 2: Selection of Platforms and Pre-Analysis Preparation

In order to prepare the analysis, the research team during the early fall of 2012 further delineated which platforms to select in order to create our diverse empirical base, and which to omit. Platforms to include were those that advocated the sharing of rides, not merely advocating the user to be a part of or start up a

car sharing pool. Platforms that both facilitated the sharing of a vehicle and the sharing of rides were however included in this diverse data set, as these platforms incorporated functionality of peer-to-peer service sharing. Using the keywords "rideshare" and "ridesharing" Google was used as a means to sample additional candidates of platforms to be included in the data material in addition to the ones identified in the first phase. This search resulted in 18 additional platforms and also revealed that additional services could be found within the iOS as well as the Google app store.

Using the same keywords the research team probed both these stores identifying additionally 17 platforms for peer-to-peer ridesharing by October 2012. In total 41 platforms were identified using the diverse case-selection technique through phase 1 and phase 2. In addition to the name of each platform and its demographic information, we also completed a small platform description (maximum 110 words) based on the information that was available about the platform from diverse sources on the web. This description included available information about the purpose of the service, the year it was launched and information about the owners of the platform. After completing the description, the research team turned to the pilot coding scheme crafted in the first phase. The four indicators were operationalized as described in Table 3.

Table 3: Operationalization of the Coding Scheme

Indicators	Theoretical definition	Operational definition	Scale
Years available	The number of years that the platform had been available for peer-to-peer service sharing	Years the platform has been available for usage	• <1 year • 1-4 years • 4-8 years • >8 years
Activity levels	The level of peer-to-peer service sharing on the platform	Activity level in terms of stated peers who share rides supported by the platform, or an estimation on peers sharing rides based on e.g. the number of rides advertised via the platform	• N/A • <10,000 peers sharing (✓) • 10,000-100,000 peers sharing (✓✓) • 100,000-250,000 peers sharing (✓✓✓) • 250,000-400,000 peers sharing (✓✓✓✓)
Technical platform	The technical platform by which the service is made available for the user	Technical platform in terms of stationary computer and/or mobile devices	• Stationary • Mobile
Geographical coverage	In what geographical area the platform is operated	Geographical coverage in terms of US and/or EU and/or other area	• US • EU • Other

Phase 3: Observation and Analysis of Each Platform

The analysis was divided into two steps. During the first step each researcher in the research team using the coding scheme observed and analyzed a set of 20 selected platforms. During this individual analysis they also expanded the platform description with an individual account of what type of rideshare service pattern the platform supported. This step, covering the first 20 platforms, was completed by a joint comparison of the outcome of the individual analysis in order to validate the individual analysis performed. Differences were discussed and resolved through joint analysis of the data. After the joint validation of the first 20 platforms, the researchers began the individual analysis of the 21 remaining platforms.

The second part of the analysis was performed at the beginning of December 2012. Also during this step the description was expanded with each researcher's own account of what type of ridesharing pattern the

platform supported, using the variable pattern that had been included in the platform description in the research database. Based on the joint evaluation of the first 20 platforms, indications of a pattern had emerged pointing towards the conclusion that rideshare platforms aim to support multiple types of peer-to-peer service sharing patterns. This resulted in the coding scheme being expanded, with "Pattern" as a variable. The latter became, together with the platform description, the primary base for the pattern analysis, which comprises the fourth step of the research process.

After the second observation and analysis step the researchers once more met and evaluated their individual analyses. New differences were identified and resolved by returning to the data. In total, the researchers had reached significantly different outcomes (non-agreement) in 44% of the observed platforms. Of these 73% were connected to the observation of the activity level. The reason for this is that it is commonly observed that rideshare platforms do not state the number of peers that are using their platforms. Instead, the researchers often had to base their estimations on a triangulated approach using data such as number of advertised rides, number of downloads of apps (if applicable), and social media activity (if applicable) to judge activity level. These estimations were too discrepant, especially during the first step of the observation and analysis, and needed to be resolved.

Phase 4: Pattern Analysis

The platforms in our study show great variability in terms of patterns (see the appendix); that is, the specific mode of peer-to-peer service sharing that they intend to facilitate. In our cases we found three distinct temporal patterns, and we argue that they are representative of peer-to-peer service sharing. Based on these findings we propose that peer-to-peer service sharing patterns can be characterized as *deferred, recurrent*, or *immediate*. This section will describe each pattern in turn followed by a typical example from our empirical material.

Deferred refers to a one-off peer-to-peer service sharing pattern. The service provider uses the ridesharing platform to advertise a unique trip well in advance of a sharing situation, to potential peer consumers who advertise their one-off transportation need, likewise well in advance. The lengthy period of time between advertising, matching and actual sharing is the characterizing feature of the deferred pattern. If a match occurs during this time, a peer provider and a peer supplier need to negotiate their specific service sharing. A ridesharing platform can contribute service features that facilitate this negotiation, e.g. through instant messaging. However, many ridesharing platforms operating within the deferred service sharing pattern do not provide such features, and instead intend that the peer consumer and peer provider use alternative means of communication, e.g. e-mail. Platforms employing a deferred pattern tend to provide services to the public, thus not engaging in preferential treatment or targeting specific groups in any way. 46 % of the analyzed cases are designed on the basis of this distinct temporal pattern.

As an example, the Zimride ridesharing platform, which connects inter-city drivers and riders through the service and is the largest rideshare program in the United States. Peers sign up to Zimride through their Facebook account, which creates a profile for the user on the platform. When a driver posts available seats in his or her car, along with personal preferences, riders can find a match for their destination. The service connects people that work at the same company, go to the same school, or have mutual Facebook friends. By doing this, the idea is that the anxiety of ridesharing with a stranger is reduced. The platform uses an algorithm that accounts for the distance to pick someone up and the time for detouring to a passenger drop-off point. The platform then ranks the options and assigns a score to the best matches.

The *recurrent* pattern refers to a repeated series of ride sharing events. Such concurrent activity is usually planned once and then occurs continuously at predetermined intervals, following a recurrent route. Similar to the deferred pattern, this pattern of service sharing typically involves a period of time between advertising, matching and actually ridesharing. The stability of the pattern tends to reflect the use context of the platforms that frequently target e.g. commuters to a specific employer. These platforms are frequently rich in features, sporting specific functions for incentive management intended to enable a central authority to boost usage via e.g. salary benefits, free parking etc. Only 2% of the observed platforms are based solely on this distinct temporal pattern. It is however an important pattern to distinguish as one of two or more patterns included in 32% of the platforms (see 'hybrid' platforms below).

As an example, the rideshare.com easy commute platform provides a customizable recurrent commuter platform that in addition to ride matching provides trip tracking tools and calculators, an environmental and cost-savings impact dashboard, information channels as well as advice on how to commute in an environmentally friendly way to and from the work place. The platform serves as the all-in-one portal where employees sign up, keep track of their commuting, and can even observe the overall impact they and the company are making to improve sustainable commuting.

Immediate refers to a one-off service sharing scenario similar to the deferred mode. However, this mode of ridesharing is characterized by a shortage of time between advertising, matching and actual ridesharing. A steady supply of peer providers and peer consumers is supposed to populate the platform, making instant matches possible. Platforms typically target the general public and not specific groups. Platforms designed for an immediate sharing pattern typically involve mobile computing and other advanced functionality including payment services and navigation among other things. 12% of the analyzed platforms are designed with this temporal pattern as the only pattern.

As an example, the SideCar ridesharing platform is an on-demand peer-to-peer rideshare service with the operation based in San Francisco. The platform for sharing is based on a mobile application which enables the peers to connect immediately. Drivers (peer producers) with a car can connect through the platform with riders (peer communities) in the community who are looking for transportation from A to B. A similar platform, Lyft, which is provided by Zimride, is a platform built around the Lyft app that allows peers to request a driver immediately, compared to the deferred request service provided by the Zimride platform.

Table 4 summarizes the key features of the three main types of peer-to-peer service sharing platforms. Planning horizon entails search, negotiations, and coordination before the actual service sharing takes place. The specifics of each pattern require specific planning behavior and entail specific consequences for long-term platform use.

Table 4: Archetypes of Peer-to-Peer Service Sharing Platforms

Peer-to peer-service sharing patterns	Deferred peer-to-peer service sharing	Recurrent peer-to-peer service sharing	Immediate peer-to-peer service sharing
Planning horizon	Long planning horizon for every service sharing	Long planning horizon for first service sharing	Short planning horizon for every service sharing
Service sharing characteristic	Every service sharing instance is unique and requires the platform to arrange a new instance	After successfully setting up a first service sharing, the platform is no longer needed by the peers	Every service sharing instance is unique and requires the platform to arrange a new instance
Example platform	Zimride	Rideshare.com	SideCar, Lyft

In addition to platforms that are designed to cater to only one of the three patterns, there are numerous platforms that encompass multiple variants of the three patterns. In total 44 % of the observed platforms are *hybrids*.

As an example, Carpooling.com is a multinational ridesharing platform of German origin more recently catering to UK and US markets and with well over 4 million registered users. Its modest beginnings in 2000 involved three students distributing flyers at the student cafeteria about reducing the travel costs for students wanting to go home for the weekend. The platform consisted of simplistic stationary web computing and basic search functionality, coordinating peer consumers and peer providers. Peers wanting rides advertised their destinations and points of departure along with intended travel dates, and searched for rides already advertised that matched their criteria, while peers wanting passengers did the same. There is no need to register to make use of the platform. Spurred by the initial interest, a national carpooling site; mitfahrgelegenheit.de, was launched just before the dotcom bubble burst. However, the

platform proved stable and the user base steadily grew, allowing the two founders to focus wholly on the platform business and hiring their first employees nine years after the inception of the initial platform. The booking and evaluation system was launched in 2010. The platform was attracting a steady stream of peer consumers and producers of rides, coordinating 1.3 million registered users, and between 10 000 and 30 000 shared journeys every day. A Facebook application followed, and the following year an iPhone application. In February 2011, the site began to offer partner trips by train, bus and plane.

Discussion

In this paper we characterize and explore the peer-to-peer service sharing platforms. Our aim has been to find archetype patterns of peer-to-peer service sharing and discuss how these patterns influence platform design and the adoption of these platforms reaching a critical mass.

Our first contribution is our conceptualization of peer-to-peer service sharing as a unit of analysis compared to peer-to-peer file sharing, peer-to-peer trading and peer-to-peer goods sharing. When services between peers are exchanged, the object of exchange is an intangible encounter between a peer provider (e.g. a driver) and at least one peer consumer (e.g. a rider). As a consequence there is a requirement to meet in time and place that is not a necessity in the other three exchange types. The requirement of timing implies that temporal aspects are key to service sharing platforms.

As a second contribution we distinguish three archetypes of temporal patterns that constitute peer-to-peer service sharing. Either peers may want to share a service immediately or they might not need to share or use a service straightaway. This suggests that there is a basis for at least two archetypes for temporal patterns in relation to service sharing. Each of them views every service sharing instance as unique and requires the platform that supports the pattern to be able to arrange a new instance every time a peer wants to share a service. However, for the deferred pattern the timing requirement is extensive, but for the immediate pattern the timing requirement is rapid. Consequently for the deferred pattern the planning horizon for every sharing is long and for the immediate pattern every sharing is short which creates different needs of coordination support by the different platforms. In addition to these two patterns, peers might want to share services on a regular basis. This means that the provider and the consumer set up a recurrent sharing of services over time. For the first service sharing setup the planning horizon is as long as the deferred pattern. However, after successfully setting up a first service-sharing instance, the platform is no longer needed by the peers for the recurrent service exchange. This differentiates this pattern in comparison to the deferred and the immediate pattern.

A third contribution is the identification of overall design imperatives for each of the three temporal patterns. Platforms exclusively supporting immediate service sharing need a simple design that shows the present available service exchange opportunities in the current area. The motive is that knowledge about the present availability of exchange opportunities is the primary basis for achieving the prompt meeting and timing requirement that comes with immediate service sharing.

Availability of prompt service exchange is however not required when designing platforms that only support deferred ridesharing. Instead the main principle in these situations is to create a platform that shows richness in the service exchange provided by the platform. In immediate ridesharing the user wants to know the availability of drivers that can take him from point A to point B within a short time space. In deferred ridesharing time is not crucial and the planning horizon is long. Instead it becomes important to understand who will travel to what destination and when; in other words the richness or variety of the exchange opportunities provided by the service-sharing platform. When the rider knows who will travel to what destination, the rider can initiate negotiations and coordination leading to the successful sharing of a ride.

In the recurrent platforms, richness is not the primary design principle, and neither is the prompt availability of exchange opportunities. Instead, platforms that are exclusively designed for recurrent sharing of services are preferably designed so that the user ascribes reliability to the sharing provided by the platform. Reliability concerns the matches facilitated by the platform, consequently reliability in the shared route, that the service sharing should occur, and who will share the service in a recurrent way.

As a fourth contribution, we can trace influences of archetypical service sharing patterns on platform adoption. First, evidence suggests that critical mass must be obtained by all platforms and that the most successful platforms have managed to do so using a simplistic platform design attending to a bare

minimum of facilitating functionality (i.e. matching). In contrast, none of the platforms in our data set that were initially focused on advanced mobile functionality have shown signs of attracting a sustainable community of peer consumers and peer producers. The reliance on deferred pattern sharing generates many potential connections between peers, generating positive reinforcement, while the open nature of such platforms gives them a virtually unlimited growth potential.

Second, recurrent pattern platforms seem to struggle with gaining high adoption rates. The stability implied by repeated service sharing does not translate into long-term sustainable use of the peer-to-peer service platform. A plausible explanation of this might be that once a recurrent service sharing pattern has been established, the perceived need of a platform is greatly reduced, since the nature of social bonds are what makes a recurrent service sharing successful or not. Yet another reason might be that recurrent pattern platforms tend to be directed towards specific localities, often targeting e.g. employers. This makes growth cumbersome – each potential peer is gained through a complex prior negotiation with another party, which is not conducive to rapid growth beyond the first group. Recurrent pattern service sharing is a stable, but slow and cumbersome way of expanding the user base on a platform. New users need to be attracted in a steady stream to counterbalance the necessity for the platform amongst peers to cease when a match is made.

Third, the immediate pattern needs massive throughput to prevail, which entails the requirement to rapidly reach a critical mass of peers. This in turn requires that peer producers (drivers) are attracted to the platform, as they are the key to instant availability. However, this strict demand on timing generates very few connections between peers. None of the observed service sharing platforms has met with large scale or sustainable success at the time of this study. Indeed, contrary to assumptions of mobile computing as a crucial component of service sharing, most of these struggling platforms have been unable to use extensive mobile computing functionality to create critical mass. In order to cope with this challenge the collected data set points toward the conclusion that platforms based on the immediate pattern that have the economical means, evolve by including the recurrent or the deferred pattern (from solely immediate to hybrid platforms; e.g. Avego). So one way forward seems to be to attract new riders to the platform by promoting the availability of great numbers of drivers, or evolve into a platform offering more than immediate ridesharing as a service. Another trend is that the immediate pattern is currently being adopted by large platforms founded on deferred modes of peer-to-peer service matching (e.g. Carpooling). It remains to be seen if such platforms can successfully couple one pattern of service sharing to facilitate critical mass in another.

Conclusions and Future Research

In this paper we have explored peer-to-peer service sharing using an explorative case study design (Gerring 2007; Woodside 2010; Yin 2012). As a point of departure we compared peer-to-peer service exchange with three alternative archetypes: file sharing, trading and goods sharing. We found that time and space become crucial requirements to meet for successful exchange, and this in turn places unique demands on digital platforms that aim to support peer-to-peer service sharing. This conclusion adds to the notion of platform complexity (Tilson et al. 2013). Using the upcoming rideshare industry as case, we utilized a four-phase research process that involved the investigation of 41 rideshare platforms.

The outcome of the research process is that we identified and characterized three distinct temporal patterns for peer-to-peer service sharing. The deferred peer-to-peer sharing pattern involves a long planning horizon for every service sharing occurrence, which requires that the platform needs to support that pattern. The immediate peer-to-peer service sharing requires rapid planning and synchronization of peers, which require that the platform meet these demands in order to provide support to the users. The recurrent peer-to-peer service sharing pattern has a long planning horizon for the first service sharing. However, as the pattern is recurrent, users seem not to need the platform to coordinate actions after successfully setting up the first service sharing. Similar to other matchmaking platforms with this sole pattern, it must add on new users as peers in order to survive. The investigation also provided insights that numerous rideshare platforms aim to meet more than one of these three distinct temporal patterns.

As our approach in this study has been an exploratory case approach there are some limitations to our research that would form suitable venues for further inquiries. One such limitation is that we have not taken into account how hybrid platforms have evolved. As specific platforms develop multiple patterns, an interesting question is how such development has progressed over time. Which evolutionary paths have

been successful for platform owners, and which have not, in terms of platform design and platform adaption? This study can form the base of an explanatory case study with the aim of trying to explain why and how progress occurs, which can contribute to the theoretical knowledge about digital platforms in general and peer-to-peer exchange platforms specifically. It is consequently of interest to investigate through a wider lens how digital platforms catering for peer-to-peer exchange evolve,, focusing on the evolvement both from a technical and a social perspective.

Finally, platform design and adoption has been treated on an aggregated level, and to a far lesser degree on actual user experiences. Detailed accounts from an extended study of peers – peer producers as well as peer consumers – together with platform designers, would further our understanding of peer-to-peer service sharing platforms in regard to patterns, design and adoption. Finally, we have focused on the phenomenon as it plays out in the transport industry. While we believe our findings are transferable to other settings, extended empirical studies in other domains as well as theoretical studies would help refine our findings based on the rideshare industry case domain.

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Appendix

Years	ID	Rideshare Platform	Activity Level	Technical Platform		Geographical Coverage			Peer-to-peer Service Sharing Pattern(s)		
				Stationary	Mobile	US	EU	Other	De-ferred	Recur-rent	Imme-diate
<1	01	Ants Social Trans	✓		X		X		X		
	02	Carpool friends	N/A		X	X			X		
	03	Carsurfing	✓	X			X		X		
	04	CoWaG	N/A		X		X		X	X	
	05	FirstThumb	N/A	X	X		X		X		
	06	iHitchhike	N/A		X	X			X		
	07	Indian Aggie	✓	X		X			X		
	08	Lyft	✓✓	X	X	X					X
	09	Omits	N/A		X	X					X
	10	Pickride	N/A		X			X	X		X
	11	RideJoy	✓	X	X	X			X		
	12	Rideshare4Less	✓	X			X		X		X
	13	Share a Ride	N/A	X			X		X		
	14	SideCar	✓✓		X	X					X
	15	Sobrio	✓		X	X			X		X
	16	Tickengo	✓✓	X	X	X			X		X
	17	Zhitch/fundride	✓	X	X		X		X	X	
1-4	18	Amovens	✓✓	X	X	X	X		X	X	
	19	Flinc	✓		X				X	X	X
	20	Green Monkeys	N/A	X	X		X		X	X	
	21	Green Riders	✓	X	X		X		X	X	
	22	HitchPlanet	✓	X	X	X			X		
	23	Megacarpool	N/A	X				X	X	X	
	24	Orcas Island	✓	X		X			X		
	25	Rideshare.com	N/A	X		X				X	
	26	Skwez	N/A	X		X			X		
	27	Von A Nach B	✓	X	X		X		X	X	
4-8	28	Avego	✓		X	X	X	X	X	X	X
	29	Blablacars	✓✓✓	X	X	X	X		X	X	
	30	Carticipate	N/A		X	X			X	X	X
	31	GoLoco	N/A	X		X			X	X	
	32	iCarpool	N/A	X	X	X			X		X
	33	iThumb	N/A		X	X			X		
	34	PickupPal	N/A	X	X	X	X	X	X		
	35	Skjutsgruppen	✓✓	X			X		X		
	36	Zimride	✓✓	X	X	X			X		
>8	37	Carpooling	✓✓✓	X	X	X	X		X	X	
	38	CarpoolWorld	✓✓	X		X	X	X	X		
	39	Craigslist	✓	X	X	X			X		
	40	eRideshare	✓✓	X		X			X		
	41	Share your ride	✓	X		X	X	X	X		

Note: "Years" refer to platform age in December 2012. "Activity level" refers to a self-reported volume of ride sharing transactions, from low (✓) to very high (✓✓✓).