

Travelling by Taxi Brousse in Madagascar: An Investigation into Practices of Overland Transportation

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Abstract

Organising public mobility is a global challenge. However, most studies directed at ICT support approach the subject from the perspective of developed countries. In contrast, we conducted a modest and initial attempt to study practices of public transportation in Madagascar – one of the poorest countries in Africa. We found that central assumptions, usually unquestioned in prevailing studies, were challenged in the context of this developing country. We present an empirical study which analyses how collective taxis, locally called Taxi Brousses, are used in overland travel. The study reveals complex socio-political conditions which passengers face in this country. Security as well as corruption issues shape these transportation practices. Based on our findings, we indicate opportunities for supporting intra-organisational cooperation and the customers' interaction with ICT artefacts.

Introduction

How to organise mobility in an economically and ecologically viable manner is a global challenge. It seems obvious that public transportation and the sharing of means of transportation and even rides will play an important role in dealing with these problems. In HCI and CSCW discourses, it is understood that ICT will play an important role in making public transportation more accessible and will

enable new sharing concepts. However, the required pattern and the resulting mobility practices play out quite distinctively in different socio-economic contexts.

The current state of the art in the CHI and CSCW community is quite strongly influenced by North American and European perspectives on the framing of the problem. Transportation infrastructures, available means of transportation, mobility needs, and ICT support vary quite remarkably among industrialised countries. However, there is an even greater level of diversity when taking developing countries into account. For this reason, in this paper we will focus on Madagascar – one of the poorest countries on the African continent.

Many parts of Africa suffer from problematic transportation infrastructures and conditions. The World Bank expresses this fact in the following way: “Perhaps the most compelling problem is that of road infrastructure. There are fewer kilometers of roads in Africa today than there were 30 years ago. Some 70 percent of Africa’s rural population lives more than 2 km from an all-season road. And the cost of transporting goods in Africa is the highest in the world” (Teravaninthorn/Raballand 2009: xi).

For a long time, the international development aid community has tried to overcome these deficits by investing in infrastructure, specifically by building new roads. However, such a purely techno-centric approach did not lead to the intended results. The World Bank explains this phenomenon by arguing that policy or institutional failures prevented traffic infrastructures from being productive (Teravaninthorn/Raballand 2009: xii).

Within the CSCW and HCI community it is typically argued that mobile ICT may be able to render traffic infrastructure more effective. However, the specific requirements for supporting public transportation in the developing world are, as yet, neither well understood nor explored in a design-oriented manner. As Miteche et al. (2012) put it for the case of dynamic ride sharing systems (DRS): “The DRS systems that

are available have been designed for use within a developed world context and are therefore not relevant to the majority of the population of developing nations like South Africa” (1).

We therefore argue that design work should start with an ethnographic analysis of a distinct field of social (mobility and transportation) practice in a specific country (Wulf et al. 1999, 2011, 2015, and 2018; Rohde et al. 2017; Friedman/Wulf 2017). This paper is built on a long tradition in CSCW research which grounds ICT design in an empirical analysis of related social practices (Hughes et al. 1992; Crabtree/Rodden 2002; Adeel et al. 2013; Gajera/O’Neill 2014; Liu et al. 2014; Rohde et al. 2016; Shklovsky/Wulf 2018).

In the following we will present an empirical study, which investigates how collective taxis, called taxi brousses, are used in Madagascar for overland travel. Collective taxis in Madagascar offer the lowest transportation fares in urban Africa (GTZ 2008). Accordingly, it seems well worth investigating the corresponding mobility practices, even beyond the capital region.

The argument is structured as follows. In the state-of-the-art section, we link the northern dominated discourse on ICT in support of public transportation to particularities in African public transport. Following this, we introduce Madagascar, its socio-economic and historical background as well as its infrastructural conditions. Following a description of research methods, we present the empirical results. We discuss our findings with regards to the observed transportation practices as well and suggest some implications for design. We conclude by outlining a research agenda dealing with collective taxis and ways to improve their function.

State of the art

Looking at industrialised countries, there is a growing debate on applying (mobile) computing to improve public transportation. Peng (1997), for instance, showed the advantages that accrue when planning a trip

by making use of information and communication technology compared with paper-based solutions. Mobile computing and tracking solutions for individual means of transportation allow live information to be provided during transportation (e.g. Mac Lean and Dailey 2002). Research indicates the benefits of this information with regard to reduced waiting time, reduced uncertainty, increased ease of use, willingness to pay, adjustment of travel behaviour and increased flexibility in general (Dziekan/Kottenhoff 2007; Ferris et al. 2010).

More advanced approaches attempt to predict the information travellers will require in a given situation, based on tracking past behaviour. It is usually argued that it is necessary to include accounts of personal and social behaviour to understand where the users might be heading (Foell et al. 2013; Patterson 2014; Stein et al. 2017). Together with geographic positioning and schedule data, they are able to design “personalised information spaces” based on schedules.

Summing up, research in public transportation has developed from providing static schedules online. Advanced solutions offer live information and access to mobile information in order to increase flexibility and reliability when schedules are not met. The incorporation of personal and social behaviours is deemed interesting for the support of transportation activities in an even more advanced manner.

Interestingly, there is little ethnographic work in the HCI/CSCW community investigating the usage of public transportation in northern countries. Existing, mainly quantitative, empirical work focusses on information related to transportation activities, neglecting contextual factors of mobility practices (e.g. Ferris et al. 2010; Foell et al. 2013) and neglects to question some of the fundamental design assumptions. An exception is a study by Pritchard et al. (2014) that focuses on the question of how location-based services change the work practices of bus drivers in London, UK. The authors developed several design requirements based on the drivers’ practices and customers’ experiences. Meurer et al. (2014 and 2018) look into the mobility practices of elderly

in a rural environment and develop applications which combine access to public transportation with suggestions for ride sharing based on an analysis of mobility routines (Stein et al. 2017). However, in developing countries, specifically in very poor countries, public transportation may be structured quite differently.

Over the past decades, developing countries have seen a range of different political, economic, and regulatory regimes governing public transportation. Teravaninthorn/Raballand (2009) state that during colonial times in many African, Asian, and Latin American countries, bus services were often owned and managed by monopolies of expatriates as subsidiaries of major suppliers in the colonising country. In the early postcolonial period, they were taken into national ownership but continued to operate as protected monopolies. In socialist economies, such as Madagascar, they were often taken into nationally owned public sector monopolies. These monopolies have now mostly been abandoned. Public road transportation in Africa is nowadays mainly in the hands of privately-owned companies of varying sizes, operating under distinct regulatory regimes. Kumar/Barrett (2008) argue that abandoning state monopolies has also changed the vehicle base of public transportation. It has shifted from large buses towards minibuses, at least in urban public transport.

Overall, the development aid community assumes that public transportation in Africa cannot meet the demands of the population (see Abuhamud et al. 2011, specifically for urban transportation). To better understand the diversity in Africa's public transportation, the German development agency has conducted a price comparison of transportation in African cities. As a result, they indicate that "[p]rivate collective taxi fares differ tenfold (between Madagascar 10 US cent and Senegal US cent 100 [...])" (GTZ 2005: 3). While these figures are more than ten years old by now and biased by exchange rate issues, still Madagascar seems to be an interesting case, as it is operating a low-price public transportation system.

There is a considerable amount of literature in the field of developmental studies which deals with improving transport systems. While for a long time the community of development aid studies mainly focused on the importance of road building, newer studies argue that the way (public) transportation is organised on these roads plays a key role in achieving developmental goals (for the case of rural transport services see Starkey/Njenga (2010)). However, developmental studies are understandably geared to policy making and typically lack a serious empirical investigation into the social practices to be changed.

ICT4D has not yet dealt with ICT support for transportation issues in any depth and the area of public transportation has been specifically ignored. For a notable exception see O'Neill's group's recent empirical work on transportation practices in Bangalore, India (Ahmed et al. 2016) and Windhoek, Namibia (Kasera et al. 2016). Inspired by the success of platforms such as Uber and Lyft, they investigate practices of urban transportation. We believe, however, that mobile computing may offer opportunities for improving the effectiveness of overland transportation even under the very specific conditions of developing countries.

In a related sense, Schaub (2012) explores how mobile phone infrastructure supports Africans to migrate overland to Europe. The use of mobile phones is demonstrated to be central to the migration process: migrants draw on the accessibility of contacts equipped with mobile phones to tie together their expansive help and transportation network. Phones are also used by migrants' "helpers" for the purpose of internal coordination. Miteche et al. (2012) present early design ideas for developing an appropriate dynamic ride sharing system for people on hitch hiking trips in South Africa. Given, however, the fact that empirical investigations into local hitch hiking, ride sharing or public transportation practices remain rare, the claim for design-related particularities in ride sharing support remains vague. One exception is that of Williams et al. (2015), who investigated the semi-formal bus system

of Nairobi, Kenya, focusing on the use of mobile phones to create open source data for better planning of transportation and services. Their study discusses the relevance of data gathering, especially with regard to standardised open-data architectures and the impact on the development of mobile routing apps.

There is an emerging line of research inside the ICT4D community which uses mobility patterns from mobile phone users to collect and extract socio-economic information. Frias-Martinez et al. (2012) present a model that approximates socio-economic levels based on human mobility variables derived from mobile phone call data. Blumenstock (2012) relies on the same type of data to investigate patterns of internal migration in Rwanda. The author argues that he is able to compute patterns of temporary and circular migration, which are difficult to observe using standard techniques. While these techniques to analyse structural mobility are specifically attractive in the context of weak administrative institutions, the data offers considerable potential for state surveillance and other abuse.

The related discourse in the HCI/CSCW community is focused on infrastructural conditions and the transport practices of industrialised countries, specifically the US and Europe. The resulting design assumptions have not yet been questioned by looking at transport systems in developing countries, specifically very poor ones. To our knowledge, there is not yet any ethnographic study in the field of ICT4D which has looked into overland transport practices in the developing world. Moreover, there are also only very few studies which have looked at ICT4D research opportunities in Madagascar. From the perspective of market sociology, Cholez/Trompette (2013, 2014) provide two interesting studies on local fish markets and mobile phones (2013) and note how second-hand car batteries are used to recharge mobile phones, listen to music, or watch TV (2014).

Madagascar: a brief history

Madagascar is an island country in the Indian Ocean, off the coast of Southeast Africa. It has a population of about 23 million. According to economic measures, Madagascar is one of the poorest countries in Africa. Various sources report that between 50 and 70% of the population live below the poverty line (CIA 2015, wikipedia 2015). At only 64.5%, the literacy rate is low (CIA 2015). With regard to the Human Development Index, Madagascar is ranked 155 among 187 listed states (UNDP 2013).

Man has been settled on the island for less than 2,000 years. The initial human settlement of Madagascar occurred around 350 BC by Austronesian peoples who now mainly live in the central highlands. They were joined around AD 1,000 by Bantu migrants from mainland Africa, who now mainly populate the coastal areas. Madagascar was, therefore, ethnically and politically divided into two for a long time. In the 19th century, the island was politically unified by the Merida kingdom, situated in the highlands around what has since become the capital, Antananarivo.

Europeans began to influence Madagascar in the 17th century. At the same time, Arabs were using the island as a base for their slave trade. Madagascar formally became a French colony in 1896, gaining independence only in 1960 following a violent uprising in 1947.

Post-independence, Madagascar has experienced a considerable level of political instability. For one and a half decades after gaining independence, it remained subject to French influence (first republic). Following a military takeover, it became a member of the socialist block under the first presidency of D. Ratsikara (second republic, 1975-1993). After a considerable period of transition, contested presidential elections and a seven-month standoff, Marc Ravalomanana eventually became president in 2002. He moved the country towards market reforms and political alignment with US rather than French interests (third republic). The country benefited considerably from the engagement of international donors, specifically the US. In early 2009 Ravalomanana

was pushed from power in a process internationally condemned as a *coup d'état*. The new strongman, A. Rajoelina, ruled until 2013 while the international community drastically reduced its financial and technical support. Finally, H. Rajaonarimampianina was declared the winner of the 2013 presidential election, which the international community deemed acceptable.

Due to sanctions imposed by the international community, the economic situation has considerably deteriorated since 2009. Moreover, the country faces increasing security problems. Organised bandits, often called 'dahalo' (cattle thieves), often attack not only vehicles on national roads but even entire villages. The political, administrative, and security systems are also characterised by a considerable level of corruption. Madagascar ranks 133 of 175 countries in the Corruption Perceptions Index (Transparency International 2014).

French is still one of the two principle languages and is taught in all schools, together with Malagasy. All higher education is conducted in French. Due to the poor state of the (basic) education system, the capability to engage in meaningful discussions in the French language is not equally distributed but rather limited to the middle class and people working in the tourism and partly in the transport branch.

Transportation, Electricity, and mobile Phones

Madagascar has a rather limited network of paved roads: 5,613 km (CIA, 2015). The structure of this network is directed towards the capital, Antananarivo. The four main lines of tarred roads, Route Nationales (RN), leave the capital to go north (RN 4 and 6 to Diego Suarez (Antsiranana)), east (RN 2 to Tamatave), west (to Morondave), and southwest (RN 7 to Tuléar).

This limited network of sealed roads is extended and in parts connected via non-sealed roads, which are often only operational during the dry season. For instance, to travel the 400 km from Morondave (west) to Tuléar (southwest) there is an infrequently operating taxi brousse in the dry season which takes two to three days on unsealed

roads. The main city of the country's south, Port Dauphin (Taolagnaro) can only be reached via unsealed roads. To reach Port Dauphin is a 600 km ride via a camion brousse from Tuléar, taking some 30-60 hours, depending on the road conditions.

The network of trains is fragmented as well and basically offers two unconnected lines with a length of 854 km. As for flights, 12 internal destinations are served by Air Madagascar's domestic services. However, these flights are expensive and scarcely affordable for the vast majority of the population.

In Madagascar, many rural areas do not have electricity; according to the ministry of transportation, only 4% of rural Madagascar is covered (Madagascar Laza, 2014). The cities are mostly supplied with electricity. However, they suffer from shut downs for a number of hours every day - except for the living quarters of the upper class. During our stay, we experienced electricity breakdowns quite frequently.

At the time of research, there were four mobile phone providers active in Madagascar (Airtel, Telma, Zain, and Orange). However, none of them covered the whole country. The large, very poor part of the population is not yet well equipped with mobile phones, not even with old ones. This seems to be specifically true in rural areas. Payment is by prepaid vouchers of 1,000 Ar (0,30 €) or more. While different operators were advertising special rates for connections within their networks, the price for internetwork calls was quite high at 300 Ar (0,09 €) per minute.

Internet was typically accessed via mobile operators: connecting a computer to a mobile phone. The connection was not always stable. The price for data services seems to be fairly reasonable. A French hotel owner told us that he can work on his email via a web browser for some 50 minutes using a 1,000 Ar card. There were also flat rates available. So mobile networks allow people to access the internet even in regions where neither electricity nor landline telephones are available - given they find ways to charge the batteries of the mobile phone. Cholez/

Trompette (2014) describe how old car batteries are charged in border areas which still have access to electricity. By transporting them to uncovered areas close by, accessibility of electricity is extended in a manner often sufficient to charge mobiles.

Research methods

The data for this paper was collected during a four week stay in Madagascar in August/September 2014. While travelling the country, the first and second authors used public ground transportation, mainly taxi brousse. However, they also used a train, various (cargo) boats, shared taxis, and hitchhiked via a truck.

In the first phase of the study, the authors travelled via taxi brousse from Antananarivo east to Moromanga (RN2), took a train to Andranokoditra, and a cargo boat on the Pangalan channels to Tamatave. From there they took a taxi brousse via RN5 (first paved, later unsealed) to Cap des Reyes for a boat transfer to Isle St. Marie. On this island they travelled first to the northern end and later to the south. Later on, they returned to the main island and took two taxi brousses back to Antananarivo (on RN5 and 2).

In the second phase of the study, the authors travelled in four different steps south to the southwestern town of Tuléar and back in a single night ride to Antananarivo on RN7. Most of the roads they used were sealed, except for a small part of RN 5 north of Saonierame-Ivongo. Overall, they travelled some 3,000 km, more than half of all paved roads. They spent some 70 hours in taxi brousses, taking 16 rides altogether. The length of the rides varied from 20 km to 950 km, their duration from 1 hour to 19 hours. The waiting time for the taxi brousses was used to investigate the operation of the respective transportation organisation.

While interested in public transportation in general, and ICT-based opportunities for its improvement in particular, the authors wanted to explore how the mobility practices were structured around taxi brousses. Taxi brousses appeared specifically interesting since they

offer a rather affordable means of public transportation in one of the poorest countries in Africa.

Our study is limited mainly to taxi brousses operating on paved roads in Madagascar. These are the infrastructurally more developed parts of the county where we assumed that mobile phones and their networks would be more readily available.

Using taxi brousses extensively, our research methods are based on observations and interviews. Observations were often accompanied by informally imposed questions to better understand the phenomena at hand. We interviewed a variety of different actors. Many of them we met while organising rides, others we met as passengers in the taxi brousses. We observed a large variety of drivers and assistant drivers and interviewed different local managers and matchmakers at taxi brousses stations. During our trips, we talked to other passengers such as a doctor, a retired seaman, and a textile engineer. We also collected information on transport conditions and practices by interviewing employees and owners of local hotels. With regard to the institutional framework, we conducted an interview with an officer of the Madagascan Ministry of Finance.

Overall, 18 interviews were conducted, each of which lasted between 10 minutes and 3,5 hours. While the context for the interviews was chosen deliberately, the interviewees were selected on an opportunistic basis.

The interviews were non-structured and open ended. After some relationship and trust building between the interviewers and the interviewees, the local actors were typically asked to describe their personal background, where they were going, and how they use public transportation. When speaking to the employees and drivers at the taxi brousse stations, we were particularly interested in how they performed their job and which artefacts they used to do so. We also observed and asked about the different actors' use of mobile phones – specifically with respect to their application regarding enabling public transportation.



Fig. 1: Writing of field notes: a bit sick (Anakao, South Western Madagascar)

The interviews were conducted in French and sometimes in English depending on the interviewees' foreign language capabilities. We decided not to include a translator for the different Madagascan dialects in our research endeavour because we were most interested in an immediate and unmediated contact with the different actors. However, we used French-speaking locals to translate for us where necessary.

To avoid disturbing the relationship building during the often-casual encounters, the interviews were not recorded. To document some of our observations, we took photos selectively with an iPhone. Comprehensive summaries of the interviews and observations were written every evening. Overall, we collected some 60 photos and some 30 pages of field notes.

Understanding taxi brousse

The concept of taxi brousse is rather vague in Madagascar and often misunderstood and misrepresented in its diversity. It is typically associated with its operational mode: a taxi brousse will not leave before it is completely filled with passengers, which makes their schedules rather unpredictable. While we found this assumption often met, specifically in rural areas we also found operational modes where the car started its route with empty seats, relying on a rough schedule.

Taxi brousses circulating on longer intercity paved roads are typically 20-30-year-old Toyota mini buses. For some destinations south of the capital and on the long-haul trip from Tulèar back to Antananarivo, newer Mercedes Sprinter mini buses were in use as well. On unpaved roads old trucks circulate, whose loading areas are equipped with wooden benches. Driving a taxi brousse requires a high level of sensitivity and skilfulness in maintaining the operational state of the ageing vehicles, which are in constant requisition.

A business that is run by one owner (typically a natural person, 'le patron') is called a 'cooperative' in Madagascar. These cooperatives can be of very different sizes. The largest cooperatives run more than 100 taxis, the smallest just one. Cooperatives can serve one or more lines, which can be either at national, regional, or urban level.

The cooperative needs to be registered with the government and pays a license fee per vehicle on a specific line (2 Mio Ar, some 650€). Moreover, the cooperative pays a yearly tax per vehicle of about 400,000 Ar (some 130€). Furthermore, the import of vehicles to Madagascar is highly taxed (depending on size; for a mini bus about 6,500€). Gas is taxed as well - diesel costs about 90€ cent per litre, gasoline 1.10€ (fig. 2).

Inside a taxi brousse

A taxi brousse offers a specific physical and social environment. Regional and local services are typically systematically overloaded by 40-90%; e.g. Toyota mini buses can carry 22 adults on 12 regular seats.



Fig. 2: Taxi brousse at a station in the town of Ambositra (Central Madagascar)

Additionally, smaller children typically travel on the laps of their parents and do not pay. These conditions create a physical density of bodies which requires openly articulated or physical negotiation for space. Latecomers are typically disadvantaged and need to gain their appropriate seating space over time. Particularly on night rides, the space issues can become conflictual.

Exiting a taxi brousse can also be a challenge. If somebody from the rear seat wants to leave, most of the other people need to get out as well. Young men sitting at the rear often leave the bus via a small acrobatic exercise through one of the rear windows. Another 'pleasure' of riding in a taxi brousse, we discovered, is children who get travel sick during the drive and vomit in their vicinity. Besides their seat neighbours, it is the mothers who are typically most affected and try to clean themselves and their child up when the taxi brousse comes to a stop.

A taxi brousse trip typically contains breaks for breakfast, lunch, and dinner. In such a case they stop in a town or village in front of a food stall or roadside restaurant for some half an hour. The passengers can decide what to do – stay in the bus, walk around looking for food themselves, or enter the restaurant. The different cooperatives seem to have certain agreements with specific places to stop. By deciding on the parking, they contribute to the allocation of the passengers' buying power. We observed that the drivers often do not pay for their food - getting at least the food as a pay-back for their decision to stop in front of a specific restaurant.

Taxi brousse drivers and their passengers like pop music: local as well as in English and French. Though the taxis are decades old, the drivers typically have their own portable digital storage and play their music via the taxi's radio, which was working in each of the minibuses, no matter how rundown it looked. The passengers often join the performance and a rhythmic atmosphere fills the bus.

A taxi brousse tries to satisfy certain customers' needs very closely. For instance, whenever a customer requires a toilet stop, the driver typ-

ically stops directly on the road and lets the passengers out. On such an occasion, most other passengers will join in and satisfy their physical needs, either directly next to the bus or, in the case of the ladies, first searching for a nearby ditch or bush. Even passengers of the middle and upper middle classes act in this way.

A taxi brousse does not (only) stop at fixed stops. The driver typically allows the passengers to decide where to leave the bus. Thus, when approaching the final destination, a taxi brousse can stop quite often to let individuals out, close to their homes (fig. 3).

Traffic and road conditions

In Madagascar, even the main roads such as RN2 and RN7, are typically rather narrow two-lane streets. They pass through the centres of cities, towns, and villages. Even these roads have in parts huge pot-holes, typ-



Fig. 3: Inside a Toyota taxi brousse

ically they make it necessary to reduce the travelling speed strongly to careful circumvent them. Many of the bridges have only one lane and thus can only be crossed in one direction at a time.

The traffic speed is, therefore, regulated at quite a low level. Heavy trucks are only permitted to drive up to 45 km/h, taxi brousses 75 km/h. During the day, the taxi brousse rarely reaches this speed and typically runs at an average speed of 40 km/h. Hence the average traffic speed is rather low.

Problems resulting from the road conditions are described in the following field note:

“Later at night, there was a severe accident on the route. A truck was literally broken into two pieces – the connection between the front part and the container carrying part behind was broken (‘deattaché’) because the steel was obviously exhausted. We [our minibus and the whole traffic on the national road] had to wait 5 hours before the rear part [of the truck] could be moved from the very narrow main street [RN2], so that other vehicles could pass the place of the accident. The driver and we tried to sleep during the waiting time (difficult in the narrow confines of the minibus). The village [in which the accident had happened] got sort of rich from the things people [several hundreds of passengers of all the vehicles travelling in both directions] were trying to buy (beer, drinks, food). With regard to this accident one of the other passengers told us: ‘I am happy that the traffic is so slow in Madagascar. Otherwise we would have many more victims in this type of accident’. Indeed, the RN2 [which connects the capital with the country’s main port] is mainly a winding street of two mostly rather narrow lanes.”

Organizational structure and work practices

As already mentioned, the taxi brousse business is run by cooperatives. One cooperative can serve different destinations. We investigated spe-

cifically into the organisation of mid-size cooperatives, which run between 8 to 25 vehicles on national and regional lines. In these mid-size cooperatives, the managerial labour is divided between the patron who mostly works from a central office and local station managers who run small stalls in places where a taxi line starts. The station works with additional local staff who help to attract passengers, mount and fix luggage on the buses' roofs and help organise. Each taxi is operated by a driver who is supported by one assistant driver. In the case of very long-distance rides, the taxis are run by two drivers.

In the following, we describe the work practices of a mid-size cooperative serving a long distance line; in this case the route between Tamatave and Antanarivo.

Placement Agents

The central taxi brousse station in Tamatave (second biggest city with some 200,000 inhabitants) stretches several hundred meters along a rather busy street. Given that 25 cooperatives serve the line to Antanarivo, it is not easy for the passengers to find out which one offers the best value service and leaves soonest. Consequently, Tamatave has a rather large and pushy community of poor freelancers with some language skills whose aim is to convince travellers to move towards the stall of a particular cooperative. The cooperative pays them a fee for securing customers to fill up the taxis (we later learnt that this fee may be up to 10% of the fare).

The placement agents search for potential customers by checking who is approaching the taxi brousse station. They watch out for travellers who are either walking towards the station or arrive by taxi, rickshaw, or another taxi brousse. They typically ask the potential customers where they want to go and use the ensuing conversation as an opportunity to guide the travellers towards a specific cooperative. Placement agents are in competition with each other, at least in larger places, and so they can be quite aggressive when competing for poten-

tial customers and persistent in convincing the travellers to be guided by them. For travellers who are not familiar with the local conditions, it is often very hard to judge whether an agent is trustworthy and which placement strategy he follows. Moreover, it is often not clear whether their provision ends up on the bill, especially where foreign travellers are concerned. Thus, travellers often try to avoid these agents wherever possible, gathering the necessary information by themselves, or at least choosing the agent by themselves.

Arriving in Tamatave in another mini bus, we tried to avoid a group of placement agents who jumped on us even before we had really left the bus. To do so we needed to cross a larger puddle in front of the bus door which physically set us apart from the agents. However, walking along the road and looking for the best way to travel quickly to Antanarivo, we finally felt the need of support and agreed to let two agents help us. They took us to a parking lot away from the main street, covered by puddles.

We came across these agents in almost all the towns we visited. They are of specific importance in towns from which only a small number of services run. These towns rather rely on vehicles passing through for their transportation opportunities. In Moromanga, a city on the way between Antanarivo and Tamatave, we observed one particular local placement agent who was standing at the main junction of the road, matching travellers looking for rides with passing cars, trucks or taxi brousses. We arrived in the afternoon when there was no further direct service starting from the taxi brousse station. The agent told us directly that there was going to be a local mini bus that would still come and indeed, after waiting for 30 minutes, a young guy came along with an empty Toyota. While a crowd of waiting passengers jumped on the vehicle, the agent offered us preferential access. However, the pricing conditions were unclear, and a specific surcharge for foreign travellers was imposed by both driver and agent (which we decided not to accept and, therefore, had to stay overnight in Moromango).

At the Cooperative's Stand

At the places where lines start, cooperatives have small wooden stalls on which their name and the destinations they serve are advertised. Upon arrival in Tamatave, the local agents guided us to a half-full Toyota minibus which was waiting to fill up and leave. Since this was a direct service to the capital, it needed to be filled up to the very last seat (which, in our case, took another 45 minutes).

Before the taxi leaves the station, the local manager is in charge of all activities. He organises the seating of new passengers and collects the money. He is also responsible for the administrative procedures, which are all paper based. The local manager had drawn a rectangle in a notebook, subdivided the bus into 5 x 3 fields representing the driver's seat and 14 seats for passengers arranged in 5 rows of 3 places. In each field, he marked a passenger's name, an abbreviation for the destination the traveller wanted to go to (unless traveling to the final destination), and the fare paid. At the bottom of this page he noted the mobile number of a passenger who had made a seat reservation for this service by phone the day before. Based on this map, he could easily see which places remained to be filled. He sometimes rearranged the seating by crossing out names with a small bottle of tip-ex.

For each passenger or group of passengers, he issued a ticket on a smaller piece of paper on which the 5x3 map of the taxi was printed. By making circles around the space and its number, he documented the seat assigned to the customer. He also put the passenger's name on the ticket and some further information (e.g. date, taxi number). He finally stamped the ticket with the company's stamp.

After having bought the ticket, our luggage was lifted to the roof of the mini bus and fixed there with ropes by the assistant driver and local assistants. Finally, when the bus was filled, the local manager copied the filled rectangle from his notebook into a notebook belonging to the car. Thus, all the passenger information in his books was now additionally in the driver's notebook. This document was signed by both the

driver and the local manager. Finally, he handed over all the fares he had collected from the passengers to the driver (fig. 4a-b).

We found similar practices in other cooperatives operating on longer distance routes. On the long-distance line between Tuléar and Antananarivo, almost all seats were reserved in the days immediately before the departure. In such cases, the local manager works from the beginning with two representations of the taxi's seats: the additional diagram containing the passengers' mobile numbers. In the hour before departure, the local manager and his senior assistant called all the passengers with a previous reservation to ensure they will really take their place (otherwise the seat would be reallocated). This cooperative works with two notebooks to be handed over to the driver: the first containing a list of the individual names and the fares paid plus phone numbers of those passengers who will enter the taxi at a later stage of the jour-



Fig. 4a: Preparing for the departure of a long-distance service

many passengers to add in a specific situation, and whom to allow to take a seat. He also pays for the petrol from the fares he has received.

The driver is also responsible for handling the official documents required. In all cases we observed that the driver was equipped with a folder containing official documents such as his driving license, 'a carte de crise', the taxi's transportation license and a certificate to document that the annual tax had been paid. Since this folder has to be presented rather often to policemen at control posts, it was typically placed over the windshield at the driver's seat. Next to it, the driver would deposit the notebook specific to the intra-organisational purposes of the cooperative.

On the road, it is mainly the driver who does the driving. The assistant driver supports him by letting passengers in and out and loading and unloading their luggage from the roof of the taxi brousse. He also typically collects the fare but hands it directly over to the driver. He does not have a seat in the taxi, so he typically rests half-standing next to the rolling door on the right side of the minibus. In case the bus is completely overcrowded, he has to leave the interior and hangs outside the bus, e.g. on a ladder at the rear.

The assistant driver also helps to fill the taxi brousse. He shouts the taxi's destination when passing potential customers and clarifies the directions and fares with them. He also communicates passengers' needs to the driver; for instance, when they request a toilet stop or want to exit the taxi en route. On the described trip from Tamatave to Antanarivo the assistant driver was less busy with filling the taxi since about two third of the seats had been booked by people traveling the entire length of the route. The taxi driver is typically hired by the cooperative and rather well paid on a monthly salary of 200,000 Ar (65€). The assistant driver is not hired on a fixed basis by the cooperative but is rather badly paid per ride.

The Use of Mobile Phones

Given the unpredictability resulting from the technical state of the vehicles and the road conditions, mobile phones have started to play a major role in organising mobility and linking transportation chains. When travelling to Isle St. Marie, three old 4W jeeps were used as taxi brousses. They transported passengers from the landing of riverboats to a cape from where they could take small motorboats to cross the Indian Ocean to the island. The owner stayed at the cape with his mobile phone and coordinated the jeep drivers who commuted from there to the landing stage of the river boats at a distance of 18 kilometres via a bad dirt road. He also coordinated the circulation of the small boats, commuting between the cape and the island. We observed one of the jeeps breaking down on the dirt road and needing to be repaired by the drivers. However, the entire 18 kilometres of dirt road were not covered by mobile networks. Thus, passing drivers needed to carry the information about the delay resulting from the jeep's breakdown to the owner.

Mobile phones are also used to connect with passengers who want to be taken in picked up along the route. Since the arrival times at certain destinations can vary, the drivers use the mobile phone to inform waiting passengers when they are close by. Mobiles also play a major role when passengers arrive – especially at night – which can be dangerous in some places. When we arrived in Antananarivo in the middle of the night following the major blockage of RN 2, travellers asked to be picked up or ordered taxis using mobile.

Corruption Issues

In all parts of the country, we found taxi brousse drivers bribing policemen. A detailed description of this phenomenon follows (from the field notes):

“The other striking phenomenon that we could observe...was the way the taxi brousse driver handed over bribes to the police and gen-

darmerie on the way. Leaving Ilakaka [a mining town in the South], there were three control posts, one after the other. On stopping, he [the driver] took a bill of 2,000 Ar [0,65€] in his left hand, closed his fist, and hung his left arm out of his window but below the level of the window, so that neither the passengers nor the second policeman standing at the other side of the car could see what was happening. When the policeman came to the window, he could take the money out of the driver's hand. Of the first three control posts, he only paid at one that way. He put the money back into the middle console of the Toyota. At the next post, two policemen were both standing in the middle of the street. When he saw that, he put the money into the folder containing the official papers. I could see that the policeman only briefly opened the folder, took the money, did not even bother to look at the rest of the papers, and let the taxi brousse pass.

For the rest of the trip, the driver had deposited 2,000 Ar in his folder and he had to refill the folder a couple of times. I think he paid some 10,000 Ar in bribes to the police and gendarmerie (the equivalent of one passenger's fare). ...the manner of paying bribes requires that the handing over of the bribe remains concealed. One of the policemen got a bit nervous when he saw me ('a vazahr' [foreigner]) trying to follow the driver's hand and observing their interaction. Standing at the driver's window, he addressed me, and I decided to quickly look somewhere else so the hand-over could take place.

At another place I observed what would happen when no payment takes place. On approaching the car, the policeman saw a vazahr sitting there [on one of the front seats] trying to observe. Not finding any money in the driver's hand, he [the policeman] grew a bit irritated. He asked for the papers which he was given (containing the bribe). But he could not open it easily, so he went to the rear of the car, starting to complain about something concerning the left rear tire. He then went behind the car [out of sight of his police colleagues, the passengers, and the vazahr] and checked the papers.

When he had found the money, there was no longer any problem and we could continue our journey.”

Overall 2,000 Ar (0,65€) looks like a very small bribe, but given the salary of the drivers and policemen it is about 1% for each monthly salary [corresponding to 20€ in German income terms]. Policemen working on the streets are therefore privileged since they have the chance to collect quite a number of bribes in this way.

Interestingly, modern taxi brousses on intercity routes did not seem to pay bribes (or at least not so often). A local manager described this phenomenon as follows: *‘You only pay when your things are not in order’*. However, the local and mid-distance taxi brousse system is constructed in such a way that things are not in order. So, policemen will always find reasons to demand a bribe.

Security Issues

Security is a major problem in Madagascar. The problem of groups of organised bandits, dahalos, impacted security in substantial parts of the country and on parts of the national roads – specifically at night. The security situation impacted the way we could travel and explore the field. The following observations shed light on the security conditions in parts of the country.

While staying at the south-western coast of Madagascar, we experienced a dahalo attack on a neighbouring village. The village we stayed was some 15 km south of the city of Tulaér but we had to take a boat from there because there was no viable road connection. The village which was attacked by a gang of dahalos was some 20 kilometres inland. When the news of the attack spread, panic reactions could be observed by the local villagers. The beach suddenly emptied, the local people started to hide in their houses. The expat hotel owners started to get nervous. Their hotel had been robbed on two occasions by dahalos within the last two years. Following the first attack, they had hired three local peo-

ple armed with locally produced guns. However, when a group of bandits approached for a second attack, these guardsmen disappeared. The hotel owners assumed that the guardsmen were cooperating somehow with the dahalos. After the second attack in which the hotel owners were also physically mistreated by the dahalos, they decided to bribe a high gendarmerie officer in Tuléar (some 65€ per month [corresponding to 2.000 € in German income terms]) to have two policemen staying permanently in their hotel - armed with Kalashnikovs, while dahalos are often only armed with self-made guns.

When the dahalo attack happened in the neighbouring village, the security situation in the hotel got out of hand. The two policemen who were based at the hotel got the order to move to the village which had been attacked. So, the hotel was without protection. One of the hotel owners directly called the gendarmerie officer in the city - but in vain. The hotel's two policemen left the village, together with two more policemen who were based in another hotel. Without protection, the hotel owner became very nervous and called his partner who happened to be in Tuléar that day. His partner went to the high police officer and requested three more policemen to protect their hotel. It cost him an additional and rather high bribe, some 195 €, to have them deployed for three days at the hotel. The three policemen took a specially rented boat and arrived in the village in the afternoon, sporting a Kalashnikov each.

The hotel owner was in a difficult situation. He did not want to lose his costumers, us and six others. However, he needed to say something to explain what was going on. So, he first told us a deliberately wrong story that played down the potential risks of the situation. However, during the morning we spoke to one of the other guests to whom the owner had told the actual story. There was no viable land road to leave the village, so we thought about finding a boat (pirogue or a speed boat) to leave. Given the conditions, boats were, however, difficult to find. So, we hesitated and finally decided to stay after the hotel owner had told us about the three additional policemen coming from Tuléar (fig. 5).



Fig. 5: Hotel near Tuléar (South Western Madagascar): Waiting for the Dahalos' attack

Finally, in the evening the two policemen came back from the village which had been attacked. They brought information about what had happened there. According to their account, two soldiers had arrived in the village before them – armed with Kalashnikovs. They had beaten up the badly armed bandits, killing one and injuring 4 out of a group of 10 dahalos. The bandits had robbed all houses, bothered ladies of the village and taken away some 2 Mio Ar, some 700€. In revenge, the villagers had mistreated the body of the dead bandit, cutting his arm and legs with machetes. The policeman showed the photos of the defiled body to the hotel owner who commented on the death toll: *‘The army does not take prisoners among the bandits. In this way that is good because they do not have the means to feed them in prison.’*

The security conditions described above affect public transportation specifically at night. In different regions, we were told that it was better to drive at night in a group of cars (convoy) on the RNs. Our experiences during one night-ride exemplify these conditions.

Going back from Tuléar to Antananarivo, we took a night trip in a taxi brousse which left at 3.30 pm, took RN 7, and arrived in the capital at 9am. After dawn, the two Mercedes Sprinter taxis of the same cooperative started to drive close together and were soon joined by a third Sprinter. The size of the convoy grew at a gas station where several taxi brousses were waiting. After some two hours, we came to a barrier of stones on the street; it did, however, contain a gap big enough for us to pass through. The drivers explained that these barriers are made by the dahalos to stop cars, which they do by closing the gap with additional stones. After passing the stone barrier as fast as possible, the driver informed drivers passing in the opposite direction about the upcoming ‘dahalo barrage’ on their route. Some of them got a nervous facial expression on hearing the news.

On the first half of the night ride (to the city of Fiana), we did not see a single control post organised by the army or any of the police forces. The senior taxi driver explained to me *“No, there is no control post in this region...”*

but it is better this way because they [the gendarmerie] cooperate with the dahalos anyway...providing information about the cars". After Fiana, there were very few control posts in place. So, the drivers depend on themselves and each other to cross this part of the country, at least at night.

The situation becomes particularly dangerous when the mini buses have technical problems, or the road conditions force them to slow down or even to stop. We experienced two of these situations. At one point, our driver became aware of a noise from the left front tire. While the other mini buses of the convoy were passing us, the driver stopped, jumped out of the bus, looked at the problem, hectically took out a large screwdriver and tightened the screws. After some 10 minutes, he had reached the convoy which had moved ahead of us.

After another hour, we arrived at a steel bridge on the RN 7. It had a hole through which one could see the river below. Our driver was able to manoeuvre past the hole but the bus following us was not able to avoid the hole and its rear tire, therefore, finally hung in the air over the river. The group of drivers dealt with this dangerous situation very professionally and quickly – but made us somehow feel the pressure and danger of the situation. While the other passengers were asked to stay in their mini busses, the passengers had to leave the taxi which was trapped in the hole. Another mini bus drove onto the bridge, close to the one in trouble. An old rope was used to tie the vehicles together and, after some experimenting, the bus was pulled out. During this manoeuvre, another floor element of the bridge disintegrated, so the drivers needed to fix this problem as well by rearranging the steel elements. Overall, the whole operation only took about 15 minutes (fig. 6).

After all six vehicles of the convoy had crossed the bridge, a Toyota bus left the convoy to speed up his journey. The senior driver commented to me ‘They are trying it solo’ and shook his head. The rest of the trip went rather smoothly. In the early morning, our mini bus also left the convoy – to pick up some bags of charcoal in the village the driver was from, which were to be sold in the capital.

Later that morning – after the coffee break – the senior driver informed all the passengers that during the previous night a taxi brousse circulating on the same line had been attacked by dahalos. They had thrown a stone from a higher position onto the front window at the driver’s side. Fortunately, the driver had been able to escape this attack with only the window broken. The fellow passengers were surprised, a female teacher travelling with her two-year-old sons told me “*Now I am really scared to go back by taxi brousse ... however, a plane ticket is too expensive for us*”. The senior driver told me later on in a private conversation that he had already been attacked by the dahalos. He explained that they robbed him and the passengers of all their money, jewellery, and mobile phones, also some of the luggage was stolen – but nobody was injured at that time.

Discussion

In relation to public transportation in Madagascar, our study offers insights into the mobility practice of a large part of the population and reflects on political and socio-economic conditions. As we described at the



Fig. 6: Taxi brousse being pulled out of a bridge's hole at night (RN 7, Southern Madagascar)

beginning of this paper, Madagascar is characterised by a political and socio-economic situation which is very different from that of northern countries where almost all existing CSCW and HCI studies on public mobility have been conducted so far. First and foremost, national political conditions seem to be responsible for a high level of corruption and recurrent security problems which characterise the Madagascan transportation system. Our empirical data indicates that the low level of institutional reliability in the country plays out in a high degree of insecurity with regard to the organisational context in which public transportation takes place. For instance, businessmen reported that to start a business or lease land, they needed to pay bribes to officials at different levels. If they do not pay, processing may take endless amounts of time. Moreover, we heard rumours that some members of the government of the late president A. Rajoelina cooperated with gangs of cattle thieves (dahalo) and allowed them to export their prey to China via Port Dauphin, at the southern cape.

As reported in our study, both citizens and the operators of taxi brousses respond to this situation with a variety of practices in order to increase security. Since the late government at least seemingly did not want to interfere with criminality, in some places local cattle farmers armed themselves and killed bandits and their leaders. Arbitrary police controls are addressed by systematically paying bribes to the officers in a way so that it is not noticed by the passengers. On many national routes, driving in convoys of at least 10 vehicles is enforced. Driving in a convoy at high speed is the best defence against dahalo attacks. However, even such measures cannot guarantee a sufficient level of security. The many pot-holes in the streets and the very poor state of the bridges add to the fraught situation: They make a convoy very fragile (and individual taxi brousse even more so) because often, these places can only be passed at 5 km/h. During our stay, we read in a local newspaper that a taxi brousse, which had fallen behind its convoy, became the victim of an attack. To stop the vehicle, the driver was shot and all

the passengers were robbed. Furthermore, the security problem does not seem to be limited to night rides. When travelling from Ambolavao to Ihosy during the daytime, a soldier carrying a Kalashnikov sat on the right-hand seat in the first row for the first half of the journey.

Due to the poor road infrastructure, poor capital stock with cars, the low-income level of customers, low labour costs, etc., we find public transportation in Madagascar to be very different from the that in the industrialised world.

In the north, research on mobile ICT support for public transportation focusses on buses and trains which run on static schedules. Tracking devices allow these schedules to be adjusted in the case of situated delays (e.g. Dziekan/Kottenhoff 2007; Ferris et al. 2010). However, taxi brousse – a shared public transportation service – does not operate on fixed schedules.

Moreover, in the north it is assumed that means of (public) transportation typically do not necessarily use all the available seats. ICT support thus offers opportunities for better coordination and spontaneous booking (otherwise just displaying transportation schedules without referring to available seats would not make sense). These assumptions were not confirmed in Madagascar for the most part. Rather, the taxi brousse departure times were organised in an ad-hoc manner on the condition that all seats were taken. In rural areas, where this was not realistic, however, different practices prevail.

Also, specific arrival times cannot be met due to the fact that drivers stop at various places in order to drop passengers off close to their destination. Where available, mobile phones are used to coordinate arriving taxis with the passengers waiting for them. Using a taxi brousse in Madagascar hence requires passengers to accept a different conception of time planning compared to northern standards.

The ICT design for industrialised countries facilitates the situated finding of regularly circulating means of public transportation (Dziekan/Kottenhoff 2007; Ferris et al. 2010), nowadays even adding ride

or car sharing opportunities (Meurer et al. 2014, Stein et al. 2017). ICT support is based on smartphones; however, in Madagascar, one of the poorest countries in Africa, mobile phone penetration is still limited, and parts of the population do not even own low-end mobile phones, let alone smartphones. Access to electricity is still a major issue (Cholez/Trompette 2014).

So, the northern discourse on ICT support builds on a number of unquestioned assumptions about the nature of public transportation and passengers' practices. Our study challenges these assumptions and consequently opens an interesting design space for ICT4D in the south (Morozov 2012).

Inside the cooperatives, we find rather sophisticated paper-based practices for operating the buses at full capacity. The scheme of the bus' seats can be understood as a coordination mechanism for local as well as for distributed purposes (Schmidt/Simone 1996). Copying the scheme from the local manager's notebook to the driver's notebook and having it signed and stamped by both of them provides a certain security concerning fraud. The decisions of drivers and local managers are taken de-centrally. There is an inherent tension between the high level of autonomy the drivers need to have in deciding what to do during a trip and the interest of the cooperative to keep the business running reliably and economically profitably.

Placement agents play a pivotal role for the assignment of seats, particularly for travellers who are not familiar with local methods of organisation. Placement agents are plentifully available and poorly paid. From the perspective of travellers and the cooperative, they act in a way which is not transparent, and which is primarily guided by their income interests. Hence, ICT support might be considered. For the distribution of seats, mobile phones are already used despite the low coverage among the population. More sophisticated ICT services based on live information and location tracking – as advocated, for example, in Mac Lean/Dailey (2002), Dziekan/Kottenhoff (2007), Ferris et al. (2010),

Foell et al. (2013) or Patterson (2014) – might yield a high potential for improving the situation but would require a significant increase in smart-phone availability among the passengers. Given the existing practices, one could think of the following opportunities for ICT support regarding public transportation:

- Mobile technologies could help to find taxis more effectively, especially in larger stations such as Tamatave or Fiana where a large number of parallel travelling opportunities exist. Mobile functionalities would not only be of help for foreigners but also for non-locals in finding connections, stop-over-connections, planning longer-distance journeys, or booking seats. Mobile ICT support could provide transparency on trips, e.g. on time schedules or when empty taxis will arrive.
- Mobile banking could help eliminate risks for the driver who currently still carries all the fares with him in cash. This is specifically relevant for long-distance routes in less safe and controlled parts of the country.
- ICT could support the transfer of data between local taxi stalls and stations on the route as well as between the local store and the cooperatives' central office and administration.

Conclusion

Our study represents what is still an initial and modest attempt in that it has approached the problem of public overland transport from a rather specific perspective. Nevertheless, we were able to observe that mobility challenges in Madagascar proved to be remarkably different from the ones in northern countries. Assumptions which are central to the prevailing literature about the organisation of transportation could not be verified there. In this way, Miteche et al. (2012)'s claim, which deems technological concepts from the developed world inappropriate for the contexts of developing countries, were confirmed. Although our

data about the taxi brousse was collected from a foreign traveller's perspective, we were able to uncover interesting local practices.

Furthermore, the distribution of labour within the cooperatives which organise the journeys was investigated. We found that, so far, mobile phones have played a limited role with regard to the practices of these organisations. However, ICT support could significantly contribute to improving security and rendering transportation and travelling smoother and more predictable. Nevertheless, it seems that the first step in improving public transportation would require a change in the socio-political conditions which are at present the main source of the problems with which passengers are faced.

On a methodological level, the study shows the additional value of studying actual practices of transportation compared to merely higher level studies typically provided by development agencies such as the World Bank (Kumar/Barrett 2008). Their policy recommendations nowadays go beyond pure investments into road infrastructure. However, Kumar/Barrett (2008) still propose a large scale, top-down approach to improve public transportation in Africa's urban centres. The authors suggest creating metropolitan transport authorities with jurisdiction over roadways and vehicles, enforcing 'controlled' competition among providers of transport services and reintroducing large buses to improve the public transportation in urban areas. Given the problematic road and security conditions, the introduction of large buses, for instance, may not improve the public transportation in Madagascar. The level of corruption may render centralised metropolitan transport authorities problematic, as well.

Studies like ours may help the development aid community to appreciate the sophistication of given practices and to question their interventions with respect to particular local conditions. Following a practice-based computing research program (Rohde et al. 2017; Wulf et al. 2018), we are in a position to provide empirical insights and early design considerations from a bottom-up perspective. Such an approach to

analyse real world settings in the Global South seems to us highly relevant to policy making – not only in the transportation domain.

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