

## From hand-held radio to ride-hailing platforms: Research on a local technical network of taxi drivers in China

Wenjie Zhang<sup>1</sup>; Wanxin Tang<sup>2</sup>; Tiantian Yu<sup>3</sup>; Hongzhe Wang<sup>4</sup>

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**Abstract.** This paper investigates how Chinese taxi drivers utilize low-tech equipment, such as handheld radios and mobile phone services, to form local ride-hailing networks. Previous studies have analyzed how Internet platforms like Didi Chuxing have reshaped labor relations through technology and policies, but they have ignored the fact that outside metropolitan areas, traditional technological solutions, such as on-call radio platforms, have not been replaced by the rapidly expanding ride-hailing platforms. Therefore, to outline China's diverse ICT practice environment, this paper focuses on a case study in two Chinese towns (Laizhou, Shandong; Ziyang, Sichuan), shifting the attention from metropolitan areas to neglected fourth- and fifth-tier cities. After reviewing the previous advancements in mobile communication technology, we discuss the economic, cultural, and social motivations behind the use of 'low-tech' devices and cooperative services by the Chinese taxi drivers in question.

**Keywords:** Chinese taxi drivers; ICT; low technologies; ride-hailing apps; wireless transceivers.

### [es] De la radio portátil a la plataformas de transporte: Estudio sobre una tecno-red local de taxistas en China

**Resumen.** Este artículo investiga cómo los taxistas chinos utilizan equipos de baja tecnología (*low tech*), como radios portátiles y servicios de teléfono móvil, para formar redes locales de transporte. Estudios anteriores analizaban cómo las plataformas digitales como Didi Chuxing transformaron las relaciones laborales sin llegar a reparar en el hecho que las soluciones tecnológicas tradicionales, como el radiotaxi, fuera de las áreas metropolitanas resistieron la plataformización del sector del transporte. Este artículo presta atención a la diversidad del ecosistema TIC en China. Tras la revisión de los avances en las tecnologías de la comunicación móvil, analizamos las motivaciones económicas, culturales y sociales que propician el uso de soluciones *low tech* y medios cooperativos por parte del sector de taxistas a partir de dos estudios de caso de ciudades de cuarto y quinto nivel (Laizhou, Shandong; Ziyang, Sichuan).

**Palabras clave:** aplicaciones de transporte; emisora inalámbrica; soluciones 'low-tech'; taxistas chinos; TIC.

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### 1. Introduction

As Mr. Wang, a Chinese taxi driver from a small town, said, «...we don't use Didi that much. Undoubtedly, we want more freedom to earn money, which is the reason. Didi is not very helpful for either passengers or us in a small city». The ride-hailing

platform has swept the traditional taxi industry like a wave, showing a trend of replacing original cruising and on-call dispatch modes in big cities, while the situation remains quite different in fourth- and fifth-tier cities. Cab drivers outside metropolises have been proactively building new technological networks for community interaction through a combination of

<sup>1</sup> Peking University (China)  
E-mail: [eggplantzjw@pku.edu.cn](mailto:eggplantzjw@pku.edu.cn)  
ORCID: <https://orcid.org/0000-0002-3533-8330>

<sup>2</sup> Peking University (China)  
E-mail: [sin\\_tang@outlook.com](mailto:sin_tang@outlook.com)  
ORCID: <https://orcid.org/0009-0002-0375-4185>

<sup>3</sup> Peking University (China)  
E-mail: [2101210745@pku.edu.cn](mailto:2101210745@pku.edu.cn)  
ORCID: <https://orcid.org/0009-0001-7629-1858>

<sup>4</sup> Peking University (China)  
E-mail: [whz@pku.edu.cn](mailto:whz@pku.edu.cn)  
ORCID: <https://orcid.org/0009-0006-2756-9135>

ICTs, to adapt to the overall technology upgrade. However, this survival strategy is often overlooked by advocates of technological solutions.

The diversified ecology of ICT practices among Chinese taxi drivers is rooted in the enlarged network society, both theoretically and practically. As Manuel Castells (1996, p. 475) argued, «Labor is disaggregated in its existence, divided in its collective action». The social relationships between capital and labour are profoundly transformed in the network society. Inspired by the perspective of class analysis, Jack Linchuan Qiu (2009) proposed the existence of a third force between enterprises and states: 'network labour'. Here, Qiu (2009) was not arguing that the new working class would break through the restrictions of the existing hierarchical structure with the help of ICTs during social and technological transformations. According to Qiu (2009), with industrialization and urbanization, the information have-nots spontaneously participate in processes of social space remodelling and system adjustment by using ICTs. Meanwhile, the top-down model of elite monopoly has also combined with technology, imposing new forms of oppression on workers.

Beyond investigating ICT use by labor groups in urban settings, some scholars have focused on changes in communication patterns in China's rural areas. Elisa Oreglia (2014) argued that ICT use by marginalized groups is a process of self-selection, self-education, and self-adaptation. Although the spread of ICT innovations was regarded as key to solving the problems of farmers, agriculture and rural areas in general, in a socio-historical context dominated by developmentalism, the digital divide and the discourse hegemony of urbanism and technology/platform capitalism have nullified the potential of media empowerment (Qiu, 2009; Sha, 2020). Nevertheless, many researchers have rediscovered marginalized groups, leading to a new aspect when discussing ICTs: the subjectivity, organization, and commonality of these hierarchically underprivileged groups.

With platformization, the new oppression of labour mentioned by Qiu (2009) has garnered widespread attention in academia, wherein labor process theory has commonly been used as an analytic framework (Gandini, 2019). From Karl Marx (2004) to Harry Braverman (1979) and Michael Burawoy (1982), labour process theory has developed to underpin research into new occupational groups like ride-hailing drivers, couriers, short-term hired journalists, writers, and short video bloggers. In the platform society, the control imposed on labourers through technology, organization, and ideology has become increasingly invisible (Wu and Li, 2018; Chen, 2020; Liu, 2020; Liu, Li & Liu, 2021). In the case of ride-hailing platforms, some studies have found that Uber controls the labour process and the spatial practices of drivers through algorithms, and the autonomous practices of resistance by drivers in response only

serves to strengthen the existing algorithm and data system instead of undermining it (Rosenblat and Stark, 2016; Chan and Humphreys, 2018). Subsequently, the criticism of capital's technological control has been accompanied by a gradual questioning of how workers respond to labour control with autonomy in China. Sun Ping (2019) revealed that delivery workers strive for self-determination through strategies of an inverse algorithm in labour practice. Focusing on the use of ICTs by a community of taxi drivers from Hunan Province in Shixia, Shenzhen, Ding Wei (2021) was aware of taxi drivers' practical know-how in circumventing the coercive strategies of platforms.

Specifically, the services provided by taxi drivers are both public and private, so the methods and negotiations within the taxi industry are complicated, especially since the emergence of ICTs. On one hand, a large number of studies have looked into taxi industry management, trying to suggest reforms of the industry overall in the 'Internet+' era (Liu, 2015; Zhang, Qin and Zhang, 2015; Mi, 2016; Yang and Wei, 2016). By examining DiDi's business pattern, datafication strategies, labour management systems and relations with the Chinese government, Julie Yujie Chen and Jack Linchuan Qiu (2019) argued that platform companies could become providers of digital utilities because they are able to bridge the public/private divide, accumulating data generated by the constant intensive labour of users, to build a digital ecosystem. Meanwhile, other studies have focused on legitimacy acquisition and labour relations of online ride-hailing, aiming to clarify the vague boundaries of rights and responsibilities of the various parties and to serve for more efficient management and service provision (Su, 2015; Peng and Cao, 2016; Jin and Zhu and Zheng, 2017; Zheng, 2017; Chen, 2018; Han and Liu, 2020; Zhao and Deng, 2021). Some researchers began to investigate drivers' living conditions and resistance strategies as a result of frequent taxi strikes (Chen, 2009; Tian, 2012; Chen, 2015). Representative studies use the Shenzhen taxi sector as a case study since Shenzhen is a first-tier city where uptake of technology is typically thought to occurred early on. Ding Wei (2009, 2018) and Tian Qian (2009) investigated how immigrant cab drivers in Shenzhen create distinctive social and spiritual networks by using ICTs. Hu Yangjuan's and Ye Weiming's (2019) study on the mobile work of drivers in a car-hailing platform in Shenzhen shows that technology creates different possibilities of mobile work for each driver, with the means of production (own, rent or loan to buy a car) and household registration status (natives/outsider) as the key variables affecting the empowering effects of technology.

Paying attention to marginalized groups, these studies presented the creativity of the middle/lower classes in using ICTs and communication. Instead of explaining the Chinese context through classical

Western theories, they approach the phenomenon of localization from a multidisciplinary perspective including media history, political economy, development sociology, and cultural studies. Inspired by this, we aim to focus on fourth- or fifth-tier cities where network effects are not as prominent as in cities like Beijing, Shanghai and Shenzhen. We will then conduct a historical and systematic investigation into how traditional taxi drivers have built technological and social networks.

## 2. Methods

We chose Laizhou, Shandong Province, as the main site, and Ziyang, Sichuan Province, as a secondary case for our study, to present local taxi networks in fourth and fifth-tier cities. Field observation and literature research were combined. Snowball sampling was adopted when interviewing taxi drivers and other actors involved in the taxi industry. Documentary materials such as laws and policies about the platform economy and taxi industry in China (You, 2020), were collected, sorted, and analyzed to demonstrate the general institutional environment surrounding taxi dispatching.

Laizhou is a county-level city in Yantai, Shandong Province, with six sub-districts and eleven towns under its jurisdiction. It is in the Northwestern part of the Jiaodong Peninsula, Eastern China, covering an area of one thousand nine hundred and twenty-eight square kilometres and a coastline of one hundred and eight kilometres (Yang, 1996). According to the Seventh National Population Census in Yantai, Laizhou has a population of 824.708 thousand (Yantai Municipal Bureau of Statistics, 2021). Laizhou, like most fourth- or fifth-tier cities or county-level cities in China, lags behind megalopolises in terms of economic development, infrastructural conditions and geographical and population size. There is also a clear trend towards more and more local citizens, especially young people, migrating from the countryside, thus intensifying the anaemic condition of some of China's lower-tier cities.

In 2009, an on-call platform appeared in Laizhou, allowing residents to call 3071111 from phones to hail a taxi. A few years later, online ride-hailing platforms, represented by Didi Chuxing entered Laizhou. As of February 2022, there were two hundred and ninety-three taxis, of which one hundred and sixty-six belonged to five cab companies and one hundred and thirty-three were managed by individuals. Only thirty-three online taxis belonging to six licensed online cab platforms had registered operating frameworks. However, the actual number of ride-hailing taxis in operation is much greater. In Laizhou, the co-existence of ride-hailing and on-call platforms

is technologically outdated, and is uncommon in other regions, even those counties presenting similar economic and political conditions. Given the need to explore the causes of these particularities, we have chosen Laizhou as the primary case in the three field sites. At the same time, Ziyang, a town of similar size and level of development to Laizhou, has been chosen for horizontal comparison and additional illustration.

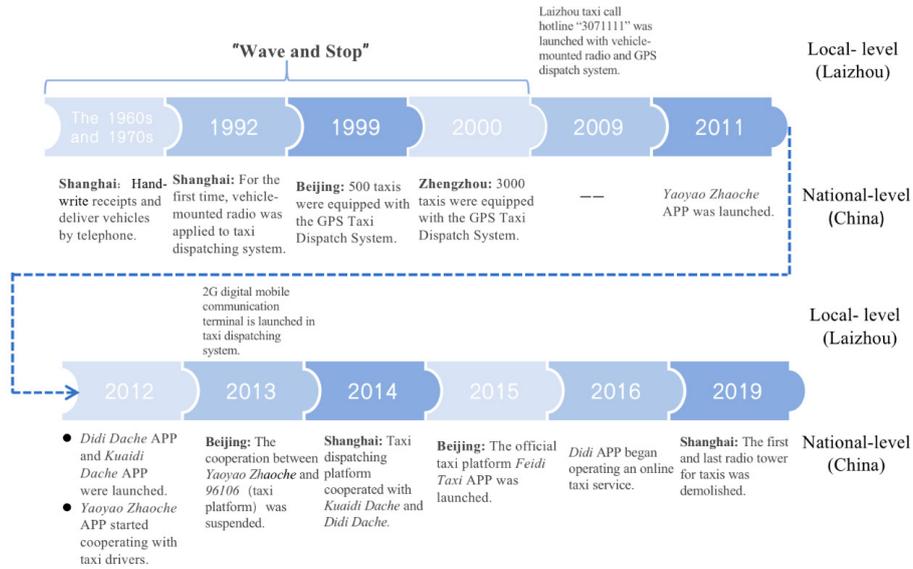
In early 2022, we returned to Laizhou and Ziyang to undertake field observations within and outside the cab industry. This consisted of in-depth interviews with twenty-two taxi drivers through acquaintance and snowball sampling, as well as conducting several informal focus group interviews. While investigating the work process of taxi drivers, we observed their ICT use, peer interaction, and characteristics of labour relations, etc. Additionally, to observe how local subjects participate in the taxi industry, we visited a local taxi company, which was responsible for managing an on-call taxi platform in Laizhou, where we could observe the general workflow of telephone operators. In July and August 2022, Zhang, as an intern of Yantai Transportation Bureau (the parent government unit of the Laizhou Transportation Bureau), surveyed the history, policies and market structure of the local taxi industry by interviewing civil servants and checking materials like statistical yearbooks, laws and regulations. In order to fully protect the privacy of the interviewees, part of the information has been modified and/or anonymized, and the interviewees were referred to using pseudonyms.

## 3. History of taxi driver ICT use and taxi dispatching

Reviewing the history of technology and the taxi industry, it's evident that ICT use is closely related to cab dispatching patterns. On one hand, the local taxi industry has been influenced by general technological innovation and diffusion. On the other, local institutional and market conditions, cultural patterns and social structure, have played an important role in technological and organizational changes in the taxi sector.

In the 1960s and 70s, taxis were dispatched through hand-written receipts and telephone calls. In Shanghai, for example, passengers could go to a taxi station or call for a taxi (Shanghai Transportation, 2019). After receiving a call from a passenger, the operator would record the passenger's location on the ticket board and pass it along a conveyor belt to the dispatcher. Finally, the dispatcher would call the staff at the taxi station to send a driver to pick up the passenger.

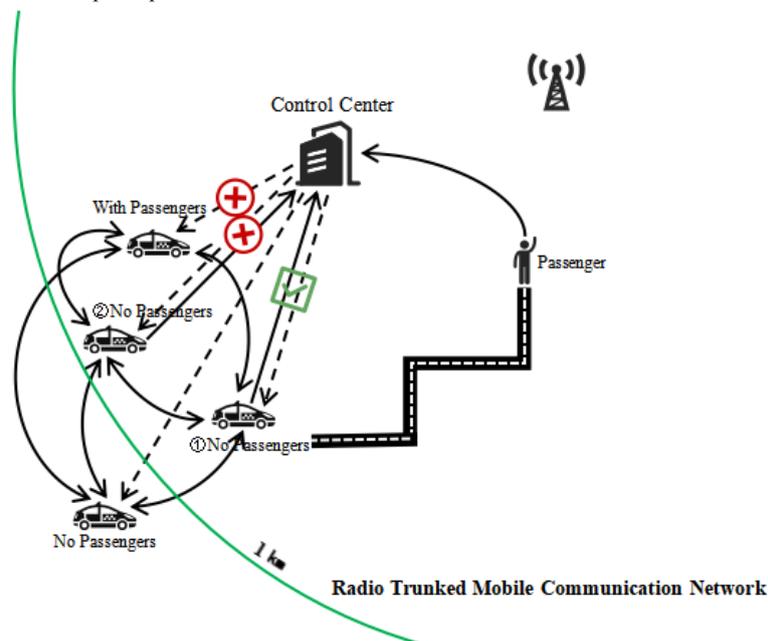
Figure 1. History of taxi dispatching patterns at local-level (Laizhou). Source: Eastern Broadcasting (2019)



In the 1990s, taxis began to be dispatched in real time. Shanghai was one of the earliest cities to implement wireless taxi dispatching. In 1992, more than two thousand taxis in Shanghai were installed with radios (Shanghai Transportation, 2019). The taxi dispatching system during this period adopted ultra-short-wave radio communication technology. A radio technology service company or a taxi company would set up the Command and Dispatch Centre (CDC), and each taxi was equipped with a vehicle-mounted radio or wireless transceiver to communicate with the control centre. After a passenger called the hotline, the dispatcher in the control centre would contact taxi drivers via intercom to find an available taxi near the

passenger. The taxi dispatching system could assist taxi drivers to receive orders remotely, thus reducing the the rate of vacant taxis. However, the vehicle dispatching system was not particularly efficient. Given that the dispatcher could not determine the location or additional information of the taxi driver, he or she had to communicate with individual drivers to find out who could take the passenger. The taxi drivers would subsequently confirm the distance between themselves and passengers based on personal experience, and then decide whether to accept the call-out and respond to the dispatch. It often took a long time to successfully dispatch a taxi driver to an interested passenger.

Figure 2. Operational principle of radio trunked mobile communication network. Source: Own production



At the turn of the 21<sup>st</sup> century, GPS (Global Positioning System) technology began to be used in

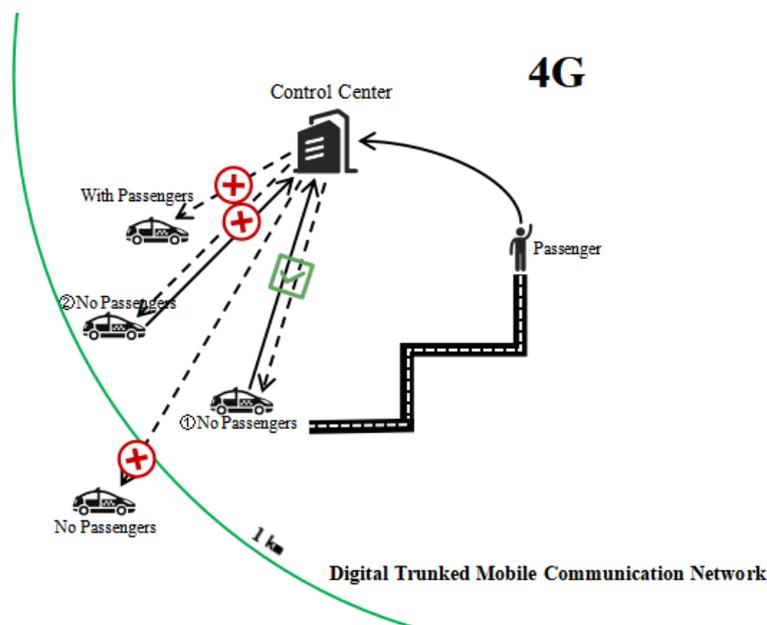
the taxi dispatching system. In 1999, five hundred taxis in Beijing were equipped with GPS dispatching

terminals (Investment Guide, 1999). Subsequently, Zhengzhou (Henan Newspaper, 2000), Chengdu (West China City Daily, 2001), Hangzhou (Qianjiang Evening New, 2013), and other cities also began to promote the new taxi dispatching system. Based on wireless communication technology, network technology, GPS, GIS (Geographic Information System) and others, the system helped the control centre to automatically grasp real-time information about taxis, such as location and passenger load, rather than having to interact with individual drivers. Compared with the previous system, the new one could dispatch taxis rationally and efficiently by exploiting technology. Using data collected by the new system, dispatchers at the control centre could quickly find the nearest available taxi to the passenger and assign the ride to the driver to meet the customer's request. The system, which combined manual labour with technology, allowed dispatchers to save time in repeated communication with taxi drivers and improve dispatching efficiency. Nevertheless, it was not until 2009, a decade after Beijing's adoption, that Laizhou in Shandong began to apply the taxi dispatching system based on intercoms and GPS. Before that, the only way for passengers to get a ride was to wait on the side of the road for an empty taxi that happened to pass by.

With the development of 3G and smartphones, ride-hailing apps have come onto the market. In

2011, the Yaoyao Zhaoche APP was launched (Global Business Classic, 2013). In 2012, the Didi Dache and Kuaidi Dache, the predecessors of Didi (Didi Official Website, 2023), were launched. This ride-hailing software was based on 3G/4G supporting mobile communication and smartphones as terminal hardware. When a passenger sent a request for a taxi via the app, it could automatically match the passenger with a taxi nearby. The emergence of ride-hailing platforms created both opportunities and challenges for the taxi industry, with the taxi industry attempting to cooperate with ride-hailing platforms in many cities. In 2014, the taxi dispatching platform in Shanghai began working with Kuaidi Dache and Didi Dache (Yangzi Evening News, 2014). In 2015, Feidi Dache, an official ride-hailing platform in Beijing, was launched (Beijing Morning News, 2015). At the same time, taxi drivers in Laizhou also began to use these Internet platforms. As of February 2022, six licensed ride-hailing platforms in Laizhou owned a total of thirty-three online hailing vehicles that were fully compliant with legal requirements. However, Didi, the largest ride-hailing platform in China, has not yet been granted a license to operate in Laizhou. As a result, many drivers registered on Didi were in fact not licensed to operate taxis in Laizhou legally.

Figure 3. Operational principle of digital trunked mobile communication network. Source: Own production



As ride-hailing platforms expanded in the market, the traditional dispatching system has gradually disappeared in China's big cities. In 2019, the first and last radio tower for taxis was demolished in Shanghai (Shanghai Transportation, 2019). However, as mentioned above, the development of taxi dispatching systems in the counties lags far behind China's metropolises. In Lanzhou, the on-call

mode based on GPS navigation systems for taxis is currently still in use.

#### 4. A local technological interaction network

With the upgrading of ICTs, the information infrastructure network that supports the taxi industry

has been constantly updated and altered. The ‘wave-stop’ (cruising) mode prioritizes face-to-face human engagement over communication technologies, while on-call and ride-hailing modes involve heavy reliance by cab drivers on ICTs such as radios, landlines, and mobile phones. The integrated infrastructure network of taxi drivers has been steadily built, adjusted, and moulded, and then embedded into local cultural spaces and grassroots communication networks, from cruising to on-call to ride-hailing.

#### 4.1. Infrastructure networking

In the cruising mode, passengers hail taxis on the street and drivers are required to stop at an appropriate spot to pick them up. In this case, drivers and passengers negotiate or even bargain face to face, to individually arrive at an agreement.

While in the on-call phase, following the application of radio communication technology to the taxi intercom dispatching system, drivers ‘snatch orders’ via radio intercoms under the centralized management of the control centre. Although it appears to have control over drivers through the radio network, taxi drivers also privately form an internal communication channel, adjusting their own intercom frequency to chat with their peers, forming an ‘air community’ with a supportive atmosphere (Ding & Tian, 2009). Concurrently, the adjustment of radio frequencies can also improve the speed of snatch orders, interfering with the normal dispatch from the control centre, which undermines fairness among drivers as the following statement indicates:

At that time, drivers whose phones had higher computing speeds were more likely to be successful in taking orders. Out of all the brands of smartphone, iPhone was the best. To improve my success rate, I bought a 3G phone and began to use mobile data traffic to compete for orders (Taxi driver Mr. Zhang, Laizhou, Shandong, January 24, 2022).

The on-call mode has undergone technological innovation from radio to digitalization. Around 2013, in the taxi industry of Laizhou, digital communication terminals replaced radio intercoms, and drivers were incorporated into a ‘digital trunked network’ based on 2G communication technology, which was currently replaced by 4G. At this stage, the trunked network was completely in the service of information management and resource allocation. Drivers’ access to FM (frequency modulation) was blocked, so they could only interact with the dispatcher through one-to-one communication and could not interfere with the control centre by taking advantage of the system’s leaks. The air community eventually disintegrated.

During the technological promotion of the on-call mode, ride-hailing platforms emerged and grew rapidly, giving taxi drivers and passengers more options for picking up and finding rides. To test

the market, the earliest ride-hailing platform took advantage of already active taxi drivers instead of private motorists. The prior request mode of the ride-hailing platform was not the same as today. It was initially based on a manual ordering match instead of an automatic geographical matching operated by an algorithm. Taxi drivers could view basic information on the app such as passenger location and choose whether to take the request. In the manual order competing mode, a driver’s order rate was directly affected by his smartphone model and mobile data limit, requiring some drivers to quickly update their mobile devices. Later, the ‘automatic order matching’ mode gradually superseded the previous mode. The back-office system, based on an algorithm, automatically determines the location of the vehicle, and sends orders according to a set of standardized criteria, so that drivers are under algorithmic and evaluation pressures with fewer options than before for filtering requests.

To summarize, as ICTs developed, numerous forms of technological interface have played a key role over time in the taxi industry. This has been accompanied by the material formation and change of transportation and communication infrastructure networks, as well as the social formation and transformation of taxi dispatching modes. During the construction of the top-down network, the centralized control logic has infiltrated technology apps and personnel management. Taxi drivers’ freedom to choose and communicate as ICT users has been reduced, and they have been assimilated into the system of all-around supervision and control, so they must be managed and deployed by resource allocation and evaluation systems.

However, it is worth noting that following the logic of technological change, not all taxi drivers were obliged to accept this trend, to the contrary, they developed diverse technological strategies serving their own interests by flexibly combining media tools. For example, those drivers who adapt to media changes faster can use better phones to snatch orders from both on-call and ride-hailing platforms. Moreover, there is evident diversity among taxi drivers, who employ a variety of techniques. For example, even after the radio-trunked communication network was replaced by the digital trunked mobile communication network, some drivers continued to use walkie-talkies to build a tiny shared radio communication network.

#### 4.2. Grassroots governance network

It has been indicated above that taxi drivers can break through the established technological and institutional frameworks, building a ‘grassroots communication network’ by flexibly and independently choosing and combining means of communication depending on their own interests. This network was not only used to share information but also to provide economic

opportunities and mutual support (Stokes, 1983). Although the invisible grassroots communication network formed by the local taxi drivers has shown periods of variable strength and weakness over time, it does not exist in a vacuum, as the exclusive domain of driver interests. In a dynamic interplay of compromise and alliance with government, capital and other forces, it constantly adjusts and integrates itself, and is deeply embedded in the network of social governance.

The general perception is that strong Chinese government regulation and services are a single repressive force for the market economy. But the examples of Laizhou and Ziyang demonstrate other forms of government involvement. During the on-call phase, radio companies, taxi companies, the Taxi Management Office, Public Security Bureaus, and other actors worked together to promote the on-call platform, which prioritized residents' transportation interests. In the early stages of ride-hailing, the government's strict vetting procedures for the entry of Internet platforms into local communities, to protect the interests of residents, indirectly mitigated the attack and erosion of digital capitalism on the uniqueness of local economic strategies.

More noteworthy is the government's involvement in the emerging grassroots communication networks. Traffic data produced by taxis was shared through collaboration between radio companies and taxi drivers, the government's Taxi Management Office, the Roads and Traffic Authority, and other departments. This has led to the standardization and transparency of taxi management while also improving the efficiency of the recording, circulation and deployment of traffic information and resources. Ride-hailing is a modality in which the government and drivers work more closely together. The Public Security Bureau has been able to leverage the existing air community to quickly set up a WeChat group of taxi drivers, through which public safety education courses are organized and conducted to help drivers improve their ability to deal with emergencies. For example, when a driver finds out that his passenger is a wanted criminal, they can turn on the camera installed on the rear-view mirror and contact the Public Security Bureau directly for identification and assistance with arrest through the shortcut in the in-vehicle ICTs. The same can also be done through WeChat groups to notify the Public Security Bureau, or in the air community to ask for help from peers. In these ways, the power of local authorities, capital and communities come together actively, taking advantage of the mobility of the taxi driver community and forming an important link in the grassroots governance network. This is indicated by the following views:

In cooperation with the Laizhou Roads and Traffic Authority, our firm has installed a locating device on every taxi in Laizhou. We can monitor the location

of every taxi in real time, and the backups are stored by the government department of taxi management and Public Security Bureau of Laizhou (Manager Mr. Liu from a Taxi Radio Company, Laizhou, Shandong, February 7, 2022).

The Public Security Bureau involves us in safety training regularly ... If our passenger is a druggie or a wanted criminal, we can call the police directly via the radio or mobile phone, or contact our peers to help call the police, which also protects the safety of our drivers (Taxi driver Mr. Liu, Ziyang, Sichuan, February 9, 2022).

### 4.3. Local space network

From the history of ICT use in the taxi industry we can conclude that taxi drivers exhibit group characteristics beyond simply being technology users and grassroots political actors. Their use of technology serves immediate economic concerns, enabling local technology networks to establish themselves in more discrete ways. Local spatial networks reveal themselves in richer detail through intricate negotiations with other urban actors.

In smaller cities with more stable and lower demand for taxi services in comparison to bigger cities, it is more efficient for taxi drivers to calculate costs and benefits for time, fuel consumption, and maintenance using personal experience rather than relying heavily on technology which may reduce matching chances. Therefore, drivers opt to park and wait near busy city landmarks (or 'explicit nodes'), including high-speed railway stations, hospitals, and schools, to minimize costs. Once the driver notices that the density of parked taxis exceeds demand at these explicit nodes, s/he would begin to circulate flexibly instead of just waiting there. These explicit nodes largely determine the distribution of taxis in small urban areas and accordingly influence passenger choice for hailing. By contrast, some landmarks such as gas stations, stores, and entertainment venues, which we call 'implicit nodes', are invisible to passengers but are frequently shared by occupational drivers. Lines of communication between seemingly heterogeneous driver-retailer groups in urban spaces were effectively established through the drivers' unspoken rule of «share out bonus orders» that was adopted in the early hand-held radio and the Internet platform (WeChat) days. Together, these explicit and implicit nodes constitute the evolving system of small cities, integrating detailed spatial knowledge. Drivers link these nodes into the current transportation infrastructure network, resulting in a more complete panoramic map and a localized spatial network in economic and cultural terms, as well as an urban imagination much more detailed than residents and commuters can access. This is the case when Mr. Chen stated:

Merchants give us some bread and water at the gas station and let us scan the code and join WeChat groups. They also join in some private walkie-talkie channels owned by drivers... When passengers ask me, I will suggest these storeowners. And if I can take the client there, I receive some money from those storeowners (Taxi driver Mr. Chen, Ziyang, Sichuan, February 10, 2022).

Drivers equipped with communication technology create a more sophisticated, flexible, and humane system of information sharing and operation than in large cities. The dynamic local space network and the air community mediated by hand-held devices jointly contribute to taxi drivers' decisions to employ another ICT navigation system. The incomplete infrastructure and low economic returns make it difficult for Didi Chuxing and navigation apps to quickly keep up with traffic changes in small cities, which local on-call platforms and the WeChat groups built by drivers can. Compared to navigation apps, drivers can plan a more efficient and rational route based on real-time traffic information obtained by radio and WeChat groups and their lived experience of small cities and negotiate with passengers to apply it. This negotiation is usually successful because both the driver and the passenger share common knowledge of the spatial layout of a small town. Furthermore, the cruising and on-call modes in counties share similar forms of negotiation, including 'one price or not', refusal, and bargaining, which are infrequent in ride-hailing systems.

Moreover, this negotiation based on ICTs used for economic purposes shows its effectiveness and flexibility in the case of long-distance transport between cities. Drivers have developed a negotiating method with clients for cross-city trips that avoids the exploitation of high prices by ride-hailing platforms: if a taxi (a) from city (A) to city (B) meets a taxi (b) from B to A, then they can make a passenger swap to avoid extra costs from empty return trips, which allows both drivers and passengers to benefit from the negotiation. However, the negotiation of cross-city trips was complicated by the difficulty of reaching prior agreements. The communication network spontaneously formed by the hand-held devices and the self-built WeChat groups provides more chances of car-passenger swap matching by negotiating in advance.

The differences in ICT use in small cities undoubtedly reveal the intricate details of embedding communication technologies in local space networks and living traditions, the flexibility of local experience amplified by technology, and the reconfiguration of driver subjectivity within these processes.

## 5. Discussion and conclusion

As Neil Postman (1992) pointed out, technology has held a central position throughout the 20<sup>th</sup> century,

imposing values such as efficiency, precision, and objectivity on human beings as well as subverting the authority of culture. Indeed, the logic of technological advancement in modern societies, driven by rationalization, has sought to introduce more comprehensive control and management over individuals.

This study not only confirms the trend described by Ding (2021), but also shows how regulations, training, and controls imposed on drivers are changing as technology is gradually integrated into the taxi sector. We argue that digital capitalism is gradually replacing industrial capitalism from the control centre to ride-hailing platforms. Capital begins to hide behind data, erasing the hierarchical presence between the controlling and controlled parties in an algorithmic logic that appears fair, rational, and regulated. For instance, through GPS and onboard monitoring systems in on-call modalities, the control centre strengthens control by capturing data compared to cruising. Then, the time prediction and real-time order-taking settings of Didi Chuxing additionally strengthen management of the time dimension.

Meanwhile, a hierarchical relationship between passengers and drivers has been formed and intensified. Drivers under the control of digital platforms must obey standard service terms, such as prohibitions on drivers accosting passengers and mandatory reminders to passengers to fasten their seatbelts, and to keep personal belongings safe. The technological design of digital capitalism's management systems positions taxi drivers as merely an economic element in the transportation network, stripping away the composite attributes consisting of spiritual, social, and biological dimensions. As a result, the drivers' identities are simplified from relatively free property owners, residents, cultural contributors, and communicators to simply functional instances tightly controlled by technological and hierarchical centres. Meanwhile, the diversity and heterogeneity of the group are also eliminated.

However, this is not the sole reality. Karl Polanyi's (2001) critique of the ideology of the 'self-mediating market' in *The great transformation* extended his theory of 'embeddedness'. The technological practice of taxi drivers in small cities provides support for this: in the seemingly irresistible trend of technical rationalization, the platform economy cannot fully integrate taxi drivers into the system of data and algorithmic operations, which would make them completely subject to its control. When the homogenous principle of technology is applied within an idealized market, the numerous contingencies of social composition are concealed, and the technology is thereby 'disembedded' from society. Taxi drivers in small towns, however, give us a glimpse of the fundamentals of how technology could be embedded in society. As information 'have-lesses', they are not just information-poor, but rather become problem solvers. They make voluntary and

spontaneous technological decisions based on a dynamic, historical, and spatialized experience, and then use and combine different forms of ICTs in a flexible manner, embedding technology in their socio-spatial networks.

We identify the basic dynamics of technology uptake in classifying and comparing processes of ICT upgrading nationwide, as well as the history of change in taxi dispatching in the two counties, by turning to the small-scale local community that has largely been ignored by previous studies. Namely, the transformations and spread of ICTs in fourth- and fifth-tier cities reveal a certain gap and some regional differences when compared to megacities such as Beijing, Shanghai and Guangzhou. Nonetheless, the promotion of onboard ICTs basically follows a local selection rule: the development of technology based on information infrastructure networks confirms the diffusion of innovations to some extent. Meanwhile, together with market subjects and local governments, taxi drivers use ICTs to build bottom-up grassroots communication networks and construct local space networks that reflect drivers' diverse and autonomous adoption and transformation of technology, information sharing, and social interaction.

Several factors influence the taxi sector in small cities, including the stable spatial layout and limited mobility of the population. The aging trend and secure, safe environment also play a role. Moreover, government projects encourage infrastructure development, impacting market characteristics. Taxi drivers in small cities are encouraged to be flexible in their choice of technology by factors such as their relatively well-off economic context and infrastructural conditions, the inevitable requirement for group communication, and economic pressures for cost reduction. Additionally, a variety of stakeholders in the decision-making and implementation processes, such as taxi companies, radio stations, the transportation department, and the police, promote a dynamic balance of forces with other components that constitute multiple dimensions of local technology choice. Taxi drivers provide a valuable service to customers while also possessing a distinct perspective on county life and culture. They physically connect various parts of the city within the local space, turning the anonymous urban transportation infrastructure into a unique, historic local presence.

In contrast to taxi drivers in Laizhou, those in other counties demonstrate a different style of communication and survival. Because of regional differences in culture, society and economy, technology selection and deployment by grassroots groups are relatively localised. Moreover, this cross-regional field observation prompts us to reflect on and redraw the future picture of a networked society in a newly energized China. The purpose of ICT

development is not to head towards an entirely coherent future, but to explore how to integrate and stimulate local creativity and facilitate the development of the most appropriate technological means to fulfill the diverse interests of local societies. It requires the participation of multiple subjects to achieve a balance between social and technological forces. As a result, we must move away from the restrictive big-small city dichotomy and the traditional elitist perspective that advocated top-down technological transformation and suppressed local autonomy. Instead, we can take the greater agency of multiple subjects into account in the process of re-embedding technology in society and explore the possibilities of alternative market economies and network societies.

Expanding beyond particular cases to broader issues of social governance, we might consider Thomas Piketty's (2021a, 2001b) concept of 'participatory socialism', which has received widespread attention in recent years. Based on his studies of inequality in Western countries, the core of his proposal is to establish a trade union with substantial power to represent employees, allowing them to actually share real power in corporate decision-making. Piketty's ideas apply to China as well, however the specific practice in China differs from Piketty's reform initiative, which arose from the historical reality of the Western world. Piketty's concentration is on the national and international levels, and accordingly, further elaboration of the social-localist agenda, which should not be ignored, is not considered as a basic aspect of his analysis. Returning to the context of local Chinese society, grassroots organizations that appear to be excluded from the global capitalist network in nameless corners can develop heterogeneous local network societies with alternative possibilities. In practice, citizens from fourth- and fifth-tier cities in third-world nations with limited liquidity and sluggish economic development, are striving for their own place in the power structure based on their economic and cultural conditions (Sha, 2020). The interpersonal relations within groups in local Chinese society is generally much stronger than in Western countries, implying that the Chinese population has greater potential to participate in community building and governance.

## 6. Authors' contribution statement

Wenjie Zhang: Conceptualization, Writing - Original Draft, Project administration

Wanxin Tang: Methodology, Writing - Original Draft, Reviewing

Tiantian Yu: Resources, Writing - Original Draft

Hongzhe Wang: Framing the study, Writing-reviewing and editing, Supervision

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