Impact of Radio Frequency Identification Technology on the Construction for Smart Transportation

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Abstract

This research investigates how the new technology implementation in the transportation system in Hangzhou, China affected the work routines and the challenges reported by the managers of the system as well as their suggestions on improvements. Through the analysis of the interviews with the managers in the intelligent transportation system, the main effects of RFID on the development of intelligent transportation in Hangzhou were proposed. It also reveals the current status of RFID development in the intelligent transportation system, further proposes factors that affect the development of RFID, and reveals the core factors that affect the development of Hangzhou's intelligent transportation. This research can enrich the information management theory of the development of an intelligent transportation system, and have certain guidance and reference significance for the development of urban information system at the same time.

In this study, through direct communication with the managers of the main intelligent transportation departments in Hangzhou, this research analyzes the influencing factors of the development of RFID in Hangzhou. Based on the analysis results, this research put forward the strategy of urban informatization development in Hangzhou. The research has certain practical significance for improving the overall development level of smart transportation in Hangzhou.

The impact of RFID on the daily work of managers of intelligent transportation management departments has first improved the innovation of intelligent transportation. Second, improve management efficiency. Third, provide the management with more intelligence plans to solve the impact of eight aspects including transportation problems. However, it can be seen from the results of encoding and passing that the senior managers' lack of awareness, including learning information technology, information management capabilities, and other factors, has led to insufficient application of RFID technology in the field of smart transportation in Hangzhou. In response to this phenomenon, three main suggestions were put forward, attach importance to infrastructure construction, improve the information literacy of grassroots employees, and increase the intensity of traffic information management in Hangzhou.

Keywords

RFID; Smart Transportation; Smart City; Information Management; Information Technology
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<td>IoT</td>
<td>Internet of Things</td>
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<td>RFID</td>
<td>Radiofrequency Identification Technology</td>
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<td>ETC</td>
<td>Electronic Toll Collection</td>
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<td>IT</td>
<td>Information Technology</td>
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<td>GPS</td>
<td>Global Positioning System</td>
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CHAPTER 1 Introduction

1.1 Introduction

In recent years, the rapid and widespread application of information technology provided conditions for actively traffic control and predictive intervention management guiding to smart transportation development. Smart transportation arose as a dimension of the smart cities concept which aims to connect people, information, and city elements to create a sustainable, greener cities, competitive and innovative commerce, and increased life quality (Albino, Berardi and Dangelico, 2015). Smart transportation is the effective integration of advanced science and technology (Kyriazis et al., 2011), where information technology, computer technology, data communication technology, and artificial intelligence effectively integrated into the whole traffic management system, which can help to build efficiency and eco-energy integrated transport system (Dimitrakopoulos and Demestichas, 2010).

Advanced technologies such as the Internet of Things (IoT) implemented in the urban context set the stage for transportation to become more intelligent, and the efficiency of transportation infrastructure to become higher (Figueiredo et al, 2001). The use of IoT facilitates information exchange and communication through information sensing equipment which connects any object to the network following the agreed protocol. Therefore functions such as intelligent identification, positioning, tracking, and monitoring become feasible (Lee et al., 2015). RFID, sensor network, and mobile communication as IoT accomplishments in the transportation field can build an intelligent management and control platform for urban ground transportation, providing actively guiding traffic generation and implementing predictive intervention management which includes real-time flow monitoring, fixed-point speed measurement of vehicles, and intelligent control of traffic lights.

Given that RFID seems to be a revolutionary technology in the field of intelligent traffic control, researches have been carried out on many developed countries like the US and Europe. In the 1980s, many US and European companies recognized the importance of developing RFID technology and started to manufacture RFID tags. Soon scholars at MIT University opened an Auto-ID center to promote the use and implementation of RFID technology. But most of the scholars report that the first commercialization of RFID technology was done by Walmart as they launched RFID based material identifying system in 2005 (Shahram and Manish 2005).

This research investigates the application concept of radio frequency identification technology (RFID) in intelligent urban transportation by analyzing the case of the pilot project in Hangzhou, China from the managers of the system point of view and the challenges, they face handling it. Given that the transportation system is a complex and dynamic integrated system, a set of real-time, accurate, complete, reliable, efficient traffic management and control systems seems to be a complicated task this research is expected to provide useful insights of such a transportation system from the manager’s perspective as major actors in the implementation process.

1.2 Research Settings

In 2012, China set up a leading group for the creation of smart cities, which opened the prelude to smart city construction, and smart transportation has become an essential part of the construction. (Guo, 2014) The Ministry of Transport proposed the strategic task of accelerating the development of the "four transportations". (Li et al., 2015) Comprehensive transportation is the core, intelligent transportation is the key, green transportation is the lead, and safe
transportation is the foundation. Companies such as Alibaba help build smart transportation, vigorously promoted the concept of "city brains", and achieved a high-quality and efficient transportation environment through intelligent transportation systems. Intelligent transportation has become the "artery" of building a smart city. In recent years, mobile payment has become the primary payment method for Chinese people (Guo, 2014).

Hangzhou is the capital of Zhejiang Province, the political, economic, cultural, and financial center and transportation hub of Zhejiang Province. Its total area is 16,853.57 square kilometers, with 10.36 million permanent residents in 2019, including 9,119,000 urban residents. Hangzhou has a developed transportation system and is an important transportation hub in southeast China. (Hangzhou Statistics Bureau, 2019)In 2017, Hangzhou Bus achieved full mobile payment coverage throughout the city. Hangzhou Metro used the automatic payment function at the end of 2017. ETC is also widely used for high-speed traffic. (Lu et al., 2015) Given Hangzhou's excellent performance in the development of intelligent transportation, this research takes Hangzhou's intelligent transportation system as the research target, and the leading target group of the interview is the managers of the urban intelligent transportation system.

Figure 1: HANGZHOU City Brain System (It has been authorized by the Hangzhou transport department and Source: smartcitylab.com)

Hangzhou City Brain system uses artificial intelligence technology designed by company Alibaba to conduct global real-time analysis of the entire city, automatically allocate public resources, and fix bugs in city operations.
1.3 Purpose Statement & Research Questions

This research aims to investigate how the new technology implementation in the transportation system in Hangzhou, China affected the work routines and the challenges reported by the managers of the system as well as their suggestions on improvements. The following research questions are addressed:

1) What changes did the adoption of RFID technologies bring to the urban life of Hangzhou according to the employees of central intelligent transportation departments?

2) What are the challenges of the adoption of RFID technologies in the smart city transportation system for the managers of the central intelligent transportation departments (in Hangzhou) in their work routines?

3) How can the adoption of RFID technologies in a smart city transportation system be improved?

1.4 Topic Justification

The research is conducted among the managers of central intelligent transportation management departments in Hangzhou because it has taken the lead in the process of developing a smart transportation city in China. The application of RFID in actual transportation is minimal, including truck weight monitors, electronic control systems of toll stations, tire pressure detection systems. (Landt, 2001) However, these applications are just the tip of the iceberg, and they have a narrow range of applications in transportation systems. To address this, in 2006, the "Research Opportunities Radio Frequency Identification (RFID) Transportation Applications Conference" organized by the Transportation Research Council held a conference in Washington, which focused on discussing radio frequency identification technology for transportation applications and research blueprints for RFID applications, including Transportation operations, road management policies. (Infowars, 2005) According to a survey by the Eye of Transport Company (2006), there are significant amounts of companies adopted RFID solutions at that time. Retail and manufacturing remain the second-largest RFID users. However, RFID usage has been stagnant since the end of 2006. (Landt, 2001) Another survey showed that only 40% of industrial companies conduct a study on RFID activities, and 40% of companies still not installed RFID, for these companies apply REID, 60% of them do not have a plan to increase RFID investment further. (Eye for Transport, 2006) So, to sum up, the literature review on the application of RFID in transportation is still relatively small. It inspired my exploration of RFID in the field of transportation. The purpose of this research is to research existing and potential applications of RFID through interviews with relevant personnel in the intelligent traffic management department.

1.5 Scope & Limitations

This research mainly explores the application and influence of RFID in intelligent urban transportation based on interviews with managers of major Hangzhou intelligent transportation company. Since the research focus on the impact of RFID in the field of intelligent transportation, the application of RFID in other fields are not be involved. Besides, the main focus of this thesis is the impact of RFID on human traffic activities, with particular emphasis on the perspective of the managers. However, due to the limited time and economic conditions, this research is focus on one city in China, Hangzhou, and thus the findings cannot be
considered widely representative. Future researches focused on cities with different economic development levels are needed.

1.6 Thesis Outline

This research is divided into six chapters

Chapter 1 describes the Introduction and Research Setting, Purpose Statement and Research Questions, Topic Justification, Scope and Limitations, and Thesis Organization.

Chapter 2 deals with Literature. It explains the RFID concept and history, and there is also literature about smart transportation and RFID application in transportation.

Chapter 3 provides the research methodology adopted for the study to be carried out, including the tradition, approach, methods for data collection, and data analysis. Besides, there is also the reliability, validity, or similarity. Finally, ethical considerations are presented.

Chapter 4 provides details about the empirical findings.

Chapter 5 conducts discussions according to findings.

Chapter 6 overviews this thesis, give conclusions and contributions and provide directions for future researches in this field.
CHAPTER 2 Literature Review

2.1 Smart Transportation

Smart transportation has become an important driving force for economic development and plays an important role in the construction of smart cities. (Kyriazis et al., 2013) Smart cities take a transformative or incremental view of urban governance change. The legitimacy appeal of smart city governance is a better result or a more open process. In short, smart city governance is about using information technology to forge new forms of human cooperation to achieve better results and a more open governance process. (Albert, 2015) As smart cities move from concept to practice, smart transportation is also continually being explored and developed in practical construction. (Liu, 2018) The focus on intelligent transportation should also gradually shift from the field of engineering and technology to theoretical research. (Kain, 2018) Intelligent transportation is the integration of communication sensing technology and big data computing into the city’s integrated transportation system. (Bask et al., 2009) Based on the continuous improvement of the original transportation infrastructure, digital technology is widely used. The construction and development of smart transportation also causes a fundamental change in the form of public transportation organization, which is conducive to the integration of socially dispersed transportation systems to form integrated and interconnected coordinated transportation modes. The intelligent system can use technologies such as cloud computing and big data analysis to coordinate the demand and supply of the entire city’s transportation, implement data sharing, effective collaboration, and service integration, and complete the orderly arrangement of city personnel and materials at a lower cost. (Al Nuaimiet al, 2015)

2.1.1 Smart Transportation in Western Countries

Western countries have been involved in the research of intelligent transportation since the 1960s and 1970s. From the policy planning to the infrastructure construction, foreign cities give full play to the combination of technological advantages and the status quo of cities, showing different development characteristics. In the process of building intelligent transportation, western countries combine advanced technology to carry out traffic congestion management, collect massive data information required by big data platforms, provide humanized public services and city management, and government departments have played a vital role in this development process. The United States released it’s ITS strategic plan in 2015 and planned to complete the dual upgrade of networked and intelligent in 2019. In the development of driverless cars, the United States has issued a series of regulations to encourage and restrict the development of autonomous vehicles. When the "Guidelines for the Policy of Self-driving Cars" were issued in 2016, the legality of autonomous driving was affirmed and incorporated into federal law. The framework and strategic plan’s guidance and outlook from 1.0 to 3.0 encourage states to re-evaluate existing transportation laws and regulations, remove legal obstacles to the testing and deployment of autonomous driving technology across the United States, and implement the integration of this technology with the transportation mode of ground transportation systems. (Barbaresso et al., 2014)

The EU’s first legal primary document to coordinate the deployment of smart transportation is the "ITS Development Action Plan" formulated by the European Commission in 2010. It is the first legal primary document to coordinate the deployment of information technology systems (ITS) in the European Union (EU) model map, establishing the EU’s 2020 intelligent
transportation. The three primary goals of the system (ITS) are sustainable transportation, competitiveness, and energy-saving and emission reduction. After that, the European Union proposed strategic implementation plans mainly in the fields of electric vehicles, road safety, intelligent transportation systems, market access, and CO2 emissions, and planned to strengthen international scientific and technological cooperation in the field of transportation research in various countries. EU's current technical standards have not yet been finalized, and enterprises around the two major technical systems of WIFI technology and 5G technologies are currently in an ongoing dispute. (Uhlemann, 2018)

The Japanese government attaches great importance to the development of autonomous vehicles, connected cars, and intelligent transportation. As early as 2013, the Japanese Cabinet released the Japan Revival Plan, the "World's Leading IT Country Creation Manifesto", in which intelligent connected cars have become one of the core. Based on this model, the Japanese Cabinet formulated the National Science and Technology Innovation Project "SIP Strategic Innovation and Creation Project Plan" to upgrade the technological development of autonomous driving systems to a national strategic height. (West, 2016) It proposed a commercialization schedule for autonomous driving and the "ITS 2014-2030" The Technology Development Roadmap plans to build the world's safest road in 2020 and the world's safest and smoothest road in 2030. Japan is very concerned about the development plan for autonomous vehicles. Not only has the timetable for the advancement of technology in this field been established in the "2017 Government and Civil ITS Conception and Roadmap", but also the division of responsibilities and accidents for autonomous vehicles has been clearly defined through the "Autonomous Driving Related System Development Outline". (Uhlemann, 2018) The safety conditions for driving a car are specified. At present, an intelligent connected car ecosystem that has been developed in coordination with countries such as China, Japan, and South Korea has initially formed in the Asian region. (West, 2016)

From the perspective of the overall planning of smart transportation in Western countries, the United States, the European Union, Japan, and some other countries have different focuses on smart transportation development strategies. However, they attach great importance to the development of autonomous vehicles. The US Smart Transportation Development Plan is based on the country's strong technical support and talent training base and is unified by the state. (Uhlemann, 2018) It develops rapidly with sufficient human and financial input. Due to a large number of small people in Japan, Japan has begun to focus on self-driving cars under the existing electronic toll collection (ETC) technology. The EU emphasizes cooperation and standardization among countries, intelligentization of integrated transportation systems, and emphasis on communications and on-board equipment. (Dima, 2019)

2.1.2 Smart Transportation in China

In the early 1990s, China introduced the concept of smart transportation. After more than 30 years of development, most cities in China now have relatively complete intelligent traffic management systems, such as traffic flow collection systems, bus dispatching systems, and signal control systems. In the actual application process, these systems can be used not only independently but also in combination with each other. They have important practical significance for improving the quality of road traffic services and have provided significant help for the modernization of the city. (Ge et al., 2017) However, there are still some problems with the construction of smart transportation in our country. For example, the top-level design and the overall planning of the city are insufficient. With the development of the concept of integrated construction, urban traffic management departments will inevitably face the problem
of how to construct highly intelligent transportation capable of handling massive information
data. (Ge et al., 2017)

In China, since the government has led to the construction of smart transportation, the current
construction of intelligent transportation mainly covers two parts. (Luo& Chen, 2019) First, to
perform administrative supervision functions, government departments plan and construct
various integrated transportation subsystems based on the needs of macro transportation
organization and decision-making, transportation market supervision, transportation
organization and management, various types of transportation data statistics, and public
transportation services. The second is to support or help operation and management
organizations to build operating systems that are closely related to transportation production,
including intelligent transportation infrastructure, intelligent vehicles, intelligent operation
organization and management, and intelligent transportation service systems. The development
and construction of smart systems are also divided into centralized government construction
and market-oriented mechanism development and construction due to the different use of
objects. (Yang & Zhang, 2017)

As China shifts from a labor-intensive economy to a technology-intensive economy, increasing
the deployment of intelligent systems to improve population conditions is a priority. Tolling is
a significant problem; that is, manual tolling can significantly slow down traffic. As the number
of Chinese cars continues to grow significantly, this problem will surge. Recently, the Ministry
of Transport has vigorously promoted the ETC system as an intelligent transportation system
to improve the efficiency of China's toll system. In some cities, the government-subsidized 50%
of the ETC label cost when purchasing ETC labels for new users. In many cities, car owners
paying through the ETC system can also get a 3% discount on tolls (Liu, 2010).

Smart transportation, including vehicle tags, driver smart cards, and rush-hour traffic control,
is an information system based on RFID, Global Positioning System (GPS), and other wireless
sensing technologies that have recently been widely deployed in China. RFID has made an
enormous contribution to reducing traffic congestion in transportation (Golob & Regan, 2001;
Holguin-Veras & Wang, 2011), providing safe travel, changing driving habits, and creating
business opportunities (Golob & Regan, 2001). Many countries and cities provide ETC
services. In some countries, such as China, its adoption rate remains low. However, China has
witnessed great development in smart transportation in recent years. Given that China has the
most significant number of kilometers of toll roads in the world, public service reforms caused
by the improvement of transportation system intelligence are correspondingly significant.
According to recent data released by the Zhejiang Provincial Department of Communications,
one of the wealthiest regions in China, the number of ETC users has increased dramatically,
reaching over 137,000 by 2012 (Wan, 2012). Zhejiang Province has installed 339 electronic toll
collection(ETC) lanes at 164 expressway toll stations, with a coverage rate of more than 52%.
The average number of times that vehicles supporting ETC pass through toll booths in a day
exceeds 48,000 (Wan, 2012).

2.2 RFID Concept

Radiofrequency identification (RFID) is a generic term describing a system that transmits the
identity of an object or person over radio waves (in the form of a unique serial number).
(Roberts, 2006) It is divided into a broad category of automatic identification technologies, with
corresponding standards and established protocols. Initially, it was used to identify enemy
aircraft during World War II. After the war, the main application of this technology was still in
the military field, but due to the high cost, it was not quickly popularized in the civilian field.
In the 1980s and 1990s, the improvement and popularization of chip and electronic technology brought new opportunities for the widespread use of RFID. For the first time in Europe, RFID technology has been applied to such civil areas as road toll collection. In the 21st century, RFID has also entered a period of rapid development. Countries around the world have begun to pay extensive attention to the value brought by RFID in the civil field. RFID has been widely used in western developed countries, such as bill security, production automation, access control, highway toll collection, parking lot management, identity identification, cargo tracking, and other fields, and its application scope is still expanding. The increase in attention to RFID comes from Wal-Mart, the largest supermarket chain. In January 2004, Wal-Mart agreed to require its major global suppliers to use RFID tags on pallets in January 2005. Before this, Metro had carried out RFID technology for nearly a year for the experiment. Sensitive IT vendors are moving in the wind, including SAP, Oracle, Microsoft, HP, TI, Philips, NEC, and many other well-known companies, covering chips, software, databases, supply chain management, overall solutions, and other IT industry chains. Nowadays, RFID is gradually being applied to all walks of life and is inseparable from all aspects of our lives. In various research fields of the information technology academia, there is a lot of researches on RFID, such as innovation management, project management, and e-commerce. For example, in the field of innovation management, Sheffi (2004) believes that RFID technology plays an important role in the innovation life cycle and speculates possible ways to adopt RFID in the future.

2.1.2 Challenges of RFID Adoption

Asif and Mandviwalla (2005) believe that the widespread adoption of RFID technology may be hindered by many technical and business challenges. First, the adoption of RFID lacks a universal standard for interoperability issues. Second, the cost of hardware and software associated with RFID technology is high, and the cost of integrating RFID technology with traditional systems is also high. Third, RFID has security issues related to data access, as well as privacy and legal issues. Fourth, the adoption of RFID requires the expertise to implement RFID. Wu et al. (2005) also made the same point of view; they studied the technical challenges of high introduction rate of new hardware and software when RFID technology, and raised the problem of the lack of a unified RFID standard, as well as the issue of RFID patent intellectual property rights. They also point out that the costs associated with RFID tags are high, and also involve system customization and configuration. In response to these issues, Bendavid and Bourgault (2005) added a project management challenge to effectively implement and use RFID in a multi-company environment, which requires inter-organizational collaboration between the participating company networks as a technology. These challenges became more and more loaded in subsequent developments. Because companies may adopt specific targets for RFID, they may conflict in the process. The inter-organizational system (IOS) must be adopted together; Yang and Jarvenpaa (2005) explored the importance of trust in the adoption of RFID.

2.1.3 Applications of RFID

As the most in-depth research area, RFID is considered the "next revolution" of supply chain management and warehouse (Srivastava, 2004). At a strategic level, Gunasekaran and Ngai (2005) suggested that RFID can take advantage of other information technologies such as the Internet, e-commerce and wireless technologies to implement a make-to-order supply chain
management strategy. Lefebvre et al. (2005) analyzes how to redesign the supply chain process when using RFID, and studies the impact of RFID on improvement through process integration, automation, cancellation, and the emergence of new "smart processes." By showing multiple case summaries, Angeles (2005) also illustrates the potential benefits of using RFID technology in a supply chain environment, such as the reliability of physical movement information, and better tracking of manufactured products through a hypothetical example. The authors suggest that RFID has the potential to generate process freedom and supply chain visibility. (Angeles 2005) Finally, Kärkkäinen (2003) analyzed the potential of RFID technology to improve efficiency in the short-life product supply chain. Through a case study, KaRkkalnin identified major store-level opportunities in (i), reducing inventory losses by improving inventory accuracy and better-controlling inventory turnover. (ii) Improving asset visibility to improve replenishment productivity.

Mathematical and simulation models can also assess the impact of RFID on supply chain dynamics. For example, Fleisch and Tellkamp (2005) demonstrated the potential advantages of RFID in a retail supply chain environment, which can reduce inventory inaccuracies, while also reducing supply chain costs and levels of stockouts. Gaulker (2005) also studied the improvement of inventory replenishment decisions, viewing information visibility as a vital dimension of the supply chain supporting RFID.

Kiritsis et al. (2003) proposed a model that uses RFID technology for information management and uses it in combination with intelligent embedded systems. Their model can capture data from any link in the supply chain, and use information and knowledge feedback from life cycle operations and life cycle termination operations to designers and producers to optimize life cycle operations.

Another area of research is information systems for e-commerce applications. Kärkkäinen et al. (2003) proposed a "product-centric approach" as a flexible information collection and sharing method for supply chain members. In this latter approach, information management is based on the way to centralize information into a single product, where software agents share information peer-to-peer: each unique object is assigned a unique identifier, that is, Internet’s Domain Name Service (DNS). Ngai et al. (2007) presented the results of a case study in which RFID (prototype) systems were integrated with mobile commerce technologies to improve management with container yards. Finally, there are still multiple research issues (Curtin et al., 2007), such as the development, adoption, and implementation of RFID technology, as well as its actual and potential uses and its development.

There have been many studies on RFID in the academic field of information management, especially the impact of RFID on the supply chain, logistics, and the retail industry. However, there is still a relatively large gap in studying the impact of RFID on smart transportation, as well as the influencing factors when implant RFID technology. Therefore, the purpose of this article is to systematically answer the following questions to fill the gap: how does RFID affect the construction of intelligent transportation, and what influence the implantation of RFID.

2.3 RFID Applications in Transportation

Public transportation is another popular area for RFID technology applications. RFID-based electronic charging technology is one of the oldest and most widely used RFID implementations (Ulatowski 2007). Once a car with embedded RFID tags arrives at a toll booth and RFID is read in the United States, electronic toll collection systems are considered an effective way to eliminate long-distance traffic at toll booths (Ulatowski 2007). RFID toll systems are also used in criminal cases because it enables prosecutors to identify the location of the offender's car
In South Korea, the South Korean government has established a credit card-linked electronic toll system called "Bypass", which is designed to pay transportation expenses quickly. If an RFID tag is embedded in their car, they can pass through the toll booth without having to stop the car because the RFID reader scans the data immediately and processes the entire payment process in 5 seconds (Kim 2008). Hong Kong launched a similar public transport toll system in 1997. "The system can handle 10 million transactions per day and includes all modes of public transport" (Kovavisaruch and Suntharasaj 2007). South Korea has established a credit card called" bypass". Associated Electronic Tolling In India, railways are the most widely used form of public transportation, and RFID technology is also used in Indian railway tolls. If RFID tags are embedded in their cars, drivers can pass through the toll station without having to stop Automotive, because RFID readers scan data immediately and process the entire payment process in 5 seconds (Jadhav et al., 2017). For example, the Mexican government runs "Creating Traffic Knowledge in Mexico: Applying RFID to Prevent Malicious Destruction", and the innovative project's One of the goals is to develop a traffic information system to obtain more detailed data needed for government decision-making (Prado et al. 2010). Similar to the situation in Mexico, the BRTA (Bangladesh Road Transport Authority), the technology used primarily to control and supervise road transport systems (Hossain, 2009). In India, the railway is the most widely used form of public transportation in the railway charges also uses RFID technology. According to Castro and Wamba (2007), RFID can identify targets through contactless data communication between readers and tags. RFID has the function of remote identification and is used for intelligent traffic and parking management. RFID technology has been gradually promoted and widely used in the field of transportation, achieving excellent results. (Mizuno and Shimizu, 2007) RFID is an advanced information collection and identification technology. (Luo and Chen, 2019) With its advantages such as long reading distance, high accuracy, strong anti-interference ability, and strong environmental adaptability, RFID is increasingly applied to the field of urban traffic management. (Zhang et al., 2019) The following focuses on the application of RFID in the field of urban intelligent traffic management.

2.3.1 Smart Bus

Smart buses can use RFID, sensing, and other technologies to understand the location of the bus in real-time, and realize functions such as curves and route reminders. At the same time, it can also combine the operating characteristics of buses to plan and dispatch lines and vehicles through an intelligent dispatch system to achieve intelligent scheduling. (Hamilton and Sankaranarayanan, 2013)

2.3.2 Electric Bicycle

Utilize RFID technology to strengthen the management of electric bicycles in the city, and realize the functions of the license, monitoring, anti-theft, insurance claims, and other functions of electric vehicles, to achieve the purpose of urban electric vehicle traffic management and the protection of owner benefits. (Farooq et al., 2014)

2.3.3 Car Networking

Using advanced sensors, RFID, cameras, and other equipment, it can collect information about the surroundings of the vehicle and the vehicle itself, and transmit the data to the on-board
system, thereby real-time monitoring of the vehicle's operating status, including fuel consumption, vehicle speed, tire pressure, and tire temperature. (Wen, 2010)

2.3.4 Smart Parking & High-Speed Charging
In the future, when vehicles with ETC equipment enter or leave the parking lot, they will not need to park and collect cards, swipe cards or pay cash. (Fraga-Lamas and Fernández-Caramés, 2017) The problem of "difficult parking and slow payment" will be alleviated. It means that in the future, ETC will allow consumers to extend the payment scene further.

2.3.5 Real-Time Monitoring & Management of Urban Traffic
The intelligent transportation integrated platform collects urban traffic data based on RFID technology, which can realize real-time monitoring of traffic flow, intelligent statistics of traffic information, traffic information mining, and big data processing functions, as well as congestion charging and congestion restriction by area and period. The traffic data processed by big data can be used as data support for predicting urban traffic congestion and formulating traffic plans. (Nellore and Hancke, 2016)

2.3.6 Monitoring of Vehicles
RFID Automotive electronic identification system based on RFID technology can monitor vehicle yellow-green label information and vehicle exhaust emissions in real-time and accurately and realize the electronic management of vehicle environmental-friendly yellow-green label information, vehicle exhaust emission monitoring, and over-limit vehicle area regulation (Nellore and Hancke, 2016).

2.3.7 Ensure the Safety of Cars
Automobile electronic identification based on RFID technology has formed a complete security system of anti-cloning, anti-counterfeiting, anti-tampering, and anti-illegal reading, ensuring the unique correspondence between motor vehicles and electronic automobile identification. It can be widely used in vehicle-related security management applications such as stealing vehicles, fake decks, and other illegal vehicles, including tracking and tracing of vehicle trajectories, and dynamic control of regional traffic. Improve vehicle identification capabilities to more accurately combat all types of vehicle-related crimes. (Fraga-Lamas and Fernández-Caramés, 2017)

2.3.8. Optimize Vehicle-Related Operations
Automotive electronic identification based on RFID technology can realize the qualification management of urban taxis and other operating vehicles, priority management of public transportation signals, and the electronic verification of various expenses such as road and bridge tolls. By reading the vehicle use information stored in the car's electronic identification, the traffic supervision department can implement targeted traffic operation management for vehicles of different uses such as buses, school buses, and operating vehicles. (Otondo et al., 2009) At the same time, the RFID-based automotive electronic identification system can accurately check vehicle payment information, realize electronic inspection of vehicle-related expenses, and improve the collection rate of various types of vehicle-related expenses.
2.4 Theoretical Framework

Taewoo and Theresa (2011) supported that smart cities embody innovation not only in technology, as is emphasized by the literature, but also in management and policy. Considering that innovation is “not just a new idea but a new practice” they defined the smart city as “ICT-enabled public sector innovation made in urban settings” (2011, p.186). Thus the unique context of each city shapes the way ICT was used by the policymakers to improve the residents’ quality of life. To provide a comprehensive view of their theory they introduced the Framework for Smart City Innovation. This framework presents the dimensions of innovation, the risks involved, and the way to success.

According to Taewoo and Theresa (2011), technological innovation refers to the mechanism of changing and upgrading technological tools. Technological innovation can improve services and create conditions for better use of these tools. Organizational innovation refers to the creation of management and organizational capabilities for the effective use of technical tools and conditions. Policy innovation is about solving institutional and non-technical urban problems and creates mechanisms that favor conditions for smart cities.

Technology, as a tool for innovation, should ensure system interoperability and integration of systems and infrastructures. However, efficient technical performance cannot be taken for granted as it should be based on efficient and effective management and cross-organizational interoperability enhanced by supportive and committed leadership. Regarding the policy dimension, Taewoo and Theresa (2011) proposed the need for policy integration between the plethora of policies that cities’ policymakers have to adapt to. Additionally, a marketing strategy is needed to publicize innovations. But above all that the innovation idea and process should be resident-centric and engage residents through collaboration and partnership. Finally, the contextual dimension should be taken into account not only from the physical dimension point of view but also from the perspective of the larger environmental and multi-jurisdictional context.

Therefore, innovation is a shift in policy and management practices to better meet the technological needs of cities. Given the complexity of implementing successful smart innovative practices and the different stakeholders’ perspectives involved, Taewoo and Theresa (2011) emphasized the risks which may occur from lack of knowledge, incompatibility between the systems, too much hope over technological feasibility, and security issues. The organizational risks include conflicts within the organization, employees’ resistance to change, and misalignment between organizational goals and projects’ objectives. From the political aspect, risks exist in political pressure, conflicts with other policies, and exclusion of the stakeholders involved during decision making.

Considering smart transportation as an aspect of the smart cities concept this research utilized the Framework for Smart City Innovation from the technological and organizational point of view, as it investigates the changes on the roles and responsibilities of the managers of the transportation system in HANGZHOU, China and the challenges they report. Further investigation taking into account the political and contextual dimensions among the residents and the policymakers would be beneficial for the specific project as it could provide useful feedback and a basis for the system’s improvement.
Figure 2: Framework Illustration for the Smart city innovation created by author own
CHAPTER 3 Methodology

3.1 Methodological Tradition

Three main epistemological positions have been used to investigate and examine social phenomena and/or subjects. i). Critical theory has a broad meaning in both philosophy and social sciences. The goal of critical theory is to identify, explain, and transform all circumstances/dimensions of humans in society. So, the critical theory provides simultaneously the descriptive, normative, practical, and self-reflective responses for social inquiries, which seek to increase the freedom in their forms. One of the most important features of critical theory is that it is not a theory with a definite reference limit, but a "group" of theories (Collis and Hussey, 2009. ii). Positivism seeks to identify scientific hypotheses that can be tested in order to discover the laws of the universe without acknowledging the subjective state of the individual. The testing process is done utilizing quantitative research methods and theoretical deduction (Briman and Bell, 2011). iii). As for the studies that need to understand the phenomena by investigating the social structure, interpretivism has a strong advantage. Interpretivism is a philosophy focusing on understanding rather than prediction, which makes it quite suitable for use in the field of theoretical development (Tahh, 2015). Interpretivism, associated with the social sciences, aims to understand human behavior from the participants’ frame of reference using qualitative research methods and inductive methods of theory (Collis and Hussey, 2009; Brightman and Bell, 2011). Deductive and inductive strategies are considered as trends rather than fixed distinctions (Bryman and Bell, 2011).

3.2 Methodological Approach

Qualitative research allows unquantifiable facts about participants to be obtained (Berg, 2009). Its main interest is to explore the meaning, perception, and understanding of participants (Horn, 2012). In contrast, quantitative research emphasizes the quantification of data collection and analysis (Bryman and Bell, 2011), which allows for larger samples to be investigated (Cameron and Price, 2009). If human beings are studied in a way that is symbolically simplified and statistically aggregated, there is a danger that a mathematically correct conclusion may be at odds with reality (Mills, 1959). When the purpose of the research is to understand the research situation, explanatory research is useful (Horn, 2012), which went beyond description and seek to analyze and explain the causes of the phenomenon (Collis and Hussey, 2009). In the
qualitative research strategy, the main purpose is to understand human behavior in a complex social environment. So qualitative research can help researchers understand how people behave in a certain cultural context. By exploring and describing the observed social background, researchers can further analyze and understand the system (Horn, 2012).

RFID has a wide range of applications in smart transportation and complex scenarios. RFID also has a primary and secondary distinction in different management practices of smart transportation. It is necessary to have a deep understanding of the impact of RFID on both the construction and management of smart transportation from the view of managers’ routine work. Theorizing can only be built accurately by working with existent subjective meanings in the human social world, specifically, researchers need to acknowledge the existence, to understand without distorting, and finally to be able to reconstruct. And this thesis aims to describe and analyze the impact of RFID mainly on the management of smart transportation and human behaviors. Therefore, it was an interpretive nature of the study, from the perspective of interpretivism to a theoretical approach.

In this thesis, interviewing, a qualitative method (Starks, 2007), was adopted to follow the interpretivism paradigm. When trying to determine a person's attitudes and values, interviews are useful but it is difficult for the questionnaire to find or accommodate these attitudes and values. The basic skill of interviewing is the ability to quickly establish successful relationships to obtain high-quality research (Berg, 2009). With more flexibility, adaptability, and interactivity of interviews, a higher level of depth and complexity can be achieved and meaning can be explored, especially when using open and flexible questions (Cameron and Price, 2009) during interviews. Besides, open-ended questions may receive more thoughtful answers and a better understanding of participants’ views and opinions (Byrne, 2004). In this study, the interviewees were asked open-ended questions in order to explore participants’ insights more deeply (Collis and Hussey, 2009).

3.3 Methods for Data Collection

3.3.1. Interviewee Recruiting

The purpose of in-depth interviews with managers in intelligent transportation systems is to understand the use of RFID in intelligent transportation and to explore how RFID affects the work of managers in the construction of intelligent transportation. Therefore, both the interviewer (i.e., the researcher) and the interviewees were expected to have the relevant knowledge of RFID and intelligent transportation and to master the interview skills.

The researcher contacted managers of China's intelligent traffic management department and only those who agreed to join this study were involved. To ensure the comprehensiveness and rationality of the study, the contacted interviewees were made sure to cover all-level management personnel including basic management personnel, middle management personnel, and senior management personnel of major intelligent transportation companies. In the end, a total of six people agreed to join the interview, including two senior managers and four middle managers. Their ages ranged from 35 to 60 years old. All the participants gave their written and oral permission for the recording.

3.3.2. Interview Procedure
This study went through the following schedule to obtain in-depth interviews:

One week before the interview, the initial contact with target managers was made to determine the possibility and interests of being interviewed. The specific appointment plans were formulated subsequently. Three days before the formal interviews, the time and the place of the interview with the interviewees were determined, the interview outline was constructed, and the interview questions were arranged reasonably. One day before the interview, the interview time was reconfirmed, the interview process was simulated, and the researcher i.e., the interviewer, familiarized oneself with the interview protocol. One day after the interview day, interview recordings were organized and the validated data were extracted. All interview records were kept on file and follow-up visits were thereby arranged.

During the interview, the interviewees were first introduced the subject of the interview and were ensured about the protection of their privacy and anonymity. The duration of each interview is about 30-40 minutes. Due to the longitudinal nature of this study, all interviews were conducted in person and via Skype for the follow-up interviews. Skype provides a synchronized interaction between the researcher and the interviewees, and both parties were able to maintain a neutral and personalized position throughout the process (Hanna, 2012). Therefore, it is possible to overcome criticisms related to the loss of interactive visual and interpersonal relationships (Evans et al., 2008).

The interview questions were designed mainly based on the main performance characteristics of RFID in the use of intelligent transportation and ask questions about the management process. Specifically, the interview questions were created following the goal of answering the proposed research questions of this thesis study (please refer to Appendix A for the whole question list). Thereby, effective information was able to be obtained from the interviewed middle and senior management personnel. (Interview questions for smart transportation managers can be found in appendix A) The interview protocol was carried out consistently, with similar/same questions for all participants while retaining the flexibility of emerging topics and questions raised by participants (Bryman and Bell, 2011). For obtaining the good data quality, the interviewer (i.e., the researcher) hardly repeated the question due to that repeatedly asking questions might cause the managers’ discomfort and resistance, which directly affect the quality of subsequent interviews. Different forms of confirmation utterances were noted and marked for all the managers throughout all interviews. Generally, this study allowed them to state their refined opinions as responses to the researcher’s questions.

While recording the conversation, the interviewer carefully comprehended the utterances of the interviewed managers, refined or rephrased the keywords to lead the conversation topic as planned. The interviewer preferentially tried to extract the key information from the managers’ utterances. The subjective opinions of the interviewees were kept with annotation. The interviewer maintained to be skeptical about the results of the first interviews as well as the opinions they have extracted. In subsequent interviews, thereby, the interviewer freely asked the related questions for further clarification from interviewees if applicable.

Since the interviewees are all managers of China’s intelligent traffic management department, the interview language was all in Chinese and so were the recordings. The coding book (shown in Appendix B) was translated into English by the researcher. All the recordings were later destroyed after the researcher’s analysis.

Due to the inevitable occurrence of some human interference factors in the interview, specific errors or deviations occur during the interview survey, mainly including recording errors and interpretation errors.
Recording errors are errors that occur when the interviewer records the content of the interview. In interview surveys, when the interviewer needs to record a verbatim response, rather than merely writing down a number or letter, the error is more likely. Additionally, the more interviewers need to write, the more the occurrence of recording errors are. Because interviewers need to make relevant records, they tend to simplify their verbal responses.

Interpretation errors mean that the interviewer misunderstood a particular behavior or speech of the interviewee, which distorted the interview content. During the interview, the interviewer needs to examine the interviewee's language or behavioral response and record it with own understanding, which inevitably be affected by the interviewee's opinion and judgment. This error is more likely to occur in an online/virtual interview environment because of the loss of non-verbal information.

Therefore, the researcher proposed to control the error of this study through the following two aspects:

1) Monitor the interview process. The entire interview processes were examined immediately after it was done in order to avoid the sloppy even wrong execution of the interview protocol. Advanced recording and audio equipment were used to accurately record the interviews and avoid the wording problem.

2) Exclude subjective factors for distracting and/or obscuring the content. The interviewer would ask again to get clear and accurate answers and accurate when the interviewees’ responses were ambiguous. Moreover, the interviewer would restrain oneself from speaking much during the interview to avoid interrupting the interviewee's thinking and responding.

3.4 Data analysis method

The analysis aims to excavate the core content of RFID's impact provide the impact of RFID on the people and especially on the managers, providing a basis for further concept definition. Thematic analysis, due to its flexibility, has been widely used as a qualitative analysis method (Roulston, 2001; Braun and Clarke, 2006). Coding is the classic means to do the thematic analysis. One advantage of coding is that it provides a "powerful concept grid" (Atkinson, 1992, p. 459) because it is based on a given set of categories. Coding was always done in the entity of the original data. Because coding involves searching data content for topics, then dividing the data into units, and organizing and summarizing the units to topics (Fisher, 2007). The process of coding is doing content comprehension and induction. Induction means that the identified subject is closely related to the data itself (Patton, 1990), rather than trying to adapt it to the other existing coding framework (Braun and Clarke, 2006) which might not be a good fit. Thereby the obtained recording and full transcripts were analyzed to reduce the perceptual selectivity (Cameron and Price, 2009).

Following the "three Cs" method (code, category, concept) described by (Lichtman, 2009), this research analyzed the raw data (transcripts) obtained from the interviews in the following steps:

1. Code/annotate the original interview transcripts.

In this step, all obtained transcripts were read and annotated with summarization notes by the research i.e., the author for the first pass. Useful codes (i.e., annotation notes) were either extracted from the original utterances of interviewed managers or derived from the author’s comprehension with contexts. The transcripts were obtained by first using the automatic video transcribing software then the author manually examined all transcripts to correct word error or other transcribing problems if any.
This very first pass was laborious and time-consuming but quite crucial for the whole research study. It set the base and prepared for the subsequent analysis.

2. Categorize annotations into codes.

In this step, the author carried out the second pass to finalize the codes with previous annotations. The annotations obtained from the first pass were carefully examined and referred to the source contexts when necessary to make sure its validity. The products of the examination were the refined annotation and topics/themes. The author tried the best to make the annotation as accurate and tidy as possible. The resultant annotations became the finalized codes of this study. Codes are detailed in the codebook table of Appendix B.

3. Reorganize codes to derive themes.

A theme is usually defined as a pattern in a dataset that is related to and would give insight into the research problem. Therefore, finding themes is at the core of the content analysis and helps answer the research question.

In this step, the author derived the themes, whose final number is five, by i). the semantics of the codes, ii). the co-occurrences of codes, and iii). most importantly, the relatedness to the research questions of this research study. Reasonable inferences were made when the author tried to group and abstract the very specific codes. Once tentative themes were derived, the author would evaluate the possibility of combining any two of them. The aforementioned process would repeat until no theme could be revised. The themes were only determined by then.

After the author eventually coded the materials and finalized the themes, the annotations and themes were sent to the interviewees for review because they are the experts in the domain of intelligent transportation as well as the research participants. With the review feedback from those experts, the author then revised the corresponding codes and themes for correctness and accuracy.

3.5 Reliability and Validity Test

The concepts of reliability and validity (Carmines and Zeller, 1979) are derived from the research on the reliability and validity of tests in psychological tests. Reliability and validity (Kirk and Miller, 1986) are usually used as two technical indicators when constructing and evaluating measurements. The validity test (Kirk and Miller, 1986) of interview design quality refers to the validity analysis of interview measurement results. The validity test is a test of the extent to which the measured results of interviews can reflect the objective reality. To be specific, the validity test must collect data from different aspects according to its specific purpose function, and scope of application.

Therefore, this qualitative research applied the reliability and validity analysis of the interview to evaluate the quality of the interview design. After the researcher designed a specific interview outline, the researcher’s supervisor was invited to make an evaluation. The outline was adopted after the evaluation was qualified. For the data collection, this study extracted data from the materials of six interviewees, thereby, being compared with the one-sample study, the validity of this study was higher. As for the data coding, construct extraction was carried out based on the original data of six interviewees, and this study has a strong reference basis.
3.6 Ethical Considerations

In consideration of the possible ethical issues arising from this study, the following methods were used for interviews. First of all, participants who are invited to interview were invited by emails stating the purpose, invitation, schedule, and content arrangement of the interview to ensure that all participants were fully aware of the study and made decisions of attending freely and voluntarily. Secondly, the interested participants signed a written consent before the interview for contributing his or her knowledge and opinions to the research as well as for agreeing with the author to releasing the study findings to the research community. Thirdly, all participants were remained anonymous throughout the interview recording process and in the recording transcripts so that participants’ privacy was protected. The identity information of all participants was destroyed after the research study was over.
CHAPTER 4 Empirical findings

In this chapter, the empirical findings are presented. After thematic data analysis, twenty-nine codes (please refer to Appendix B for reference) were finalized in total after the coding. Five themes thereby emerged out of the content analysis of all interview transcripts, and they are the following:

1. Benefits of RFID on people
2. Demand of keeping information system updated
3. Importance of integrating systems and funding
4. Need for employees’ awareness-raising and training
5. Need for management level’s awareness

Theme 1: Benefits of RFID on people
For this theme, the specific codes with a frequency of over 30%, according to the frequency from high to low, are “innovation”, “management”, “intelligence”, and “information technology”, “resources”, “services”, “(a better) life” and “(improved) sustainability”. These eight codes summarized the benefits brought by the advent of RFID in the intelligent traffic management.

The code “innovation” appears most often from all interviewees. Apparently, the adaptation and application of the advanced research technology to human world was deemed as new and novel by the public. As the frontline staff, the interviewees witnessed and appreciated use of RFID in the city transportation. They believed the city transportation management workflow become more “intelligence”, more efficient, and convenient. They felt that the lifestyle for people living in Hangzhou was updated and upgraded accordingly. The RFID-powered “management” realizes the dream that they can manage and operate the city transportation multi-dimensionally, which improve the efficiency of workflow and the public service capabilities have been further improved.

Moreover, the nature of RFID, “information technology”, has made it feasible to connect/link with other information technology, mainly including the Internet of Things, cloud computing, big data, etc. With the synchronized technology facilities, the mutual support and enhancement not only make the city transportation to be optimized at the maximum level but also powered the other facilities to be more convenient for the urban public “service”, thus improve the quality of life of residents. Specifically, according to the managers, the use of RFID technology has helped them optimize and integrate various “resources” to achieve resource conservation, reduce resource and energy consumption, promote sustainable urban development (“(improved) sustainability”), and provide new solutions to various urban problems (“(a better) life”). The interviewees gave the following explanation: “The use of RFID technology is convenient and beneficial to the people, creating a better life for Hangzhou residents”, “Improving the quality of life of residents”, "The use of RFID technology can promote residents to create and prosper the city”.

Theme 2: Demand of Keeping Information System Updated
Information system was another theme in interviews and its update concerns the interviewees very much. The construction of information systems plays a very important role in promoting the development of RFID technology. Information systems are the top priority of urban
transportation management. If information systems are not updated in time, it hinders the development of smart transportation in Hangzhou.

From the coding analysis: it was reported that the reasons for poorly updated information systems mainly included: i). less resource sharing and different sources of resources; ii). less integration of information resources; iii). less information resource packages; iv). poor matching of information resources; v). incomplete information resources; vi). the resources are not updated in time. Among them, Hangzhou’s information resources were few and only got updated from one source. One interviewer mentioned the reasons for the lack of information resources in Hangzhou three times in the interview, which is quoted as below:

“The version of the information management system we use is relatively old. The current era has been changing and has been innovating. Many companies will now choose some innovative systems. They are integrated systems in some areas. Besides, due to the different platforms between the various departments, we share much fewer resources”

Other interviewee also agreed that the information system hardly match the actual needs and demanding in work:

“After all, the information management system is a big one, and it is not necessarily suitable for every subdivision. It will be adjusted according to this, which is what we require.”

“If some systems are not updated in time, they may feel that the use effect is not good.”

“Less resource sharing”

All in all, the poorly information system in Hangzhou is that employees in the traffic management department were still used to relying on traditional work methods, unaware of the convenience of information systems. Senior management staff neglected the idea of popularizing information resources among frontline staff. The root cause for the outdated information resources is that information management agencies would only promote and maintain the information resources based on the demands of the majority rather than the minority i.e. the subdivided frontline departments. On the one hand, the information resources used by different subdivision departments are the property of the companies which cannot be shared, therefore, building a unified resource platform is not realistic.

Theme 3: Importance of Integrating the Systems and Funding

The funding problem included i). insufficient funds and ii). confined funder. Most managers believed that the infrastructure of smart transportation in Hangzhou was not fully equipped because of insufficient funds, and the funds were provided by the Chinese government. One of the managers said: “We are all invested by the government” Another one confirmed: “The capital investment is all allocated by the superior department” Some managers also pointed out that “The introduction of private capital is still relatively limited”

It shows that in the process of promoting RFID, the source of funds is relatively confined. A single source of funds might lead to suffer from a shortage of money flow, which causes urgent cases when the RFID technology was in great need but cannot meet the need due to insufficient funds. According to one of the managers: “In some departments, hardware and software are insufficient, and funds are few. After all, living standards are limited; our funds are relatively few, and the infrastructure that can use RFID technology within the jurisdiction is limited”.

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That is, an inability to implement information construction. It can be seen that the amount and source of funds invested in the promotion and development of RFID technology have critical impacts, it is related to the first step of urban traffic information construction.

Theme 4: Need for Employees’ Awareness-Raising and Training

Frontline staff are crucial in the development of RFID because they are the persons who use existing information technology in work routines. If they cannot effectively and efficiently make good use of the RFID, then the efficacy of RFID would remain untapped. Yet, the employees of transportation department showed lack of the awareness of self-learning and the interest for new technology.

One of the managers pointed out that employees' self-learning awareness is not strong enough. He said: “Some employees may not have a strong sense of learning by themselves” He also points out that: “There is no online training.” Another manager also said: “This piece can improve the part, but the actual improvement of the employees is not too big. One is that the employees are busy and do not advocate it. They can escape if they can”. Another concern is that employees were not familiar with information resources. One of the managers said: “After the system is in place, employees can only get a rough idea and become familiar with it.” Some managers thought that the inability of using RFID effectively was due to that employees' educational level or the learning abilities were not enough. That is, employees did not know how to apply information technology to work. “The level of our grassroots employees is limited, and this effect cannot be achieved.” One manager said: “It can only be said that employees will grope for some simple, elementary things, and if they want to perfect these things, they need professional staff to guide them.” Another also pointed out that: “Employees lack professionalism in this area”.

It can be seen that the internal factors of employees mainly include employees’ learning awareness and learning ability, employees’ unfamiliarity with information resources, employees' insufficient education background, inadequate interest on new technology, and employees' ignorance of how to search for information. Among them, the limited professional skill of employees was mentioned eleven times in the interview by four interviewees. “Employee's self-learning awareness was not strong” mentioned from two interviewers and a total of six times in the interview. “Employees were not familiar with information resources” and “employees did not know how to apply information technology to their work” were also pointed by one manager. All in all, the key factors were “the limited professional skill of employees” and “the staff’s ability to learn information is not strong”. The factors that lead to the employees’ inability to learn were mainly due to the employees’ lack of self-learning awareness and the training was not what they wanted to learn and/or was irrelevant to actual work routines.

Through content analysis, it can be seen that the external causes of employees mainly include the work pressure of grassroots employees, the mobility of employees, and the low wages. The factor of high employee pressure comes from four interviewers. One manager said: “employees will be more tired” Another mentioned: “Network training has little effect on employees” The factor of high employee mobility comes from two managers. One of them said: “Although we are a public system, the grassroots employees have no establishment and no fixed positions. Some work for one year, some work for two years, and some work for more than three years”. He also said: “Many grassroots employees have more mobility now”. Another manager said: “Almost all of us send employees to study, but every year we train many excellent employees, and after the training is gone, we have lost.” The factor of the low salary of grassroots
employees comes from one manager. He said: “Grass-roots employees are treated poorly” It can be seen the most influential external factors of employees was the working pressure.

Training is a common way to promote employees’ proficiency and make employees onboard. It taught the basic knowledge of information technology of a company or an organization. The awareness and the ability of grassroots employees in the application of information technology could only be introduced through the onboard training. Therefore, the content and organization of the onboard training must have enough attention of the employers and the managers.

Actually, according to transcript annotation (i.e. the coding results), there indeed were many problems about the onboard training: “little training or insufficient training”, “the training content is not comprehensive”, and “does not meet the real needs of employees”, “software training is not in place”, and “lack of strict training assessment”. “Little training and insufficient training” were mentioned by four managers. One of them said: “There is no special training” Another said: “The content of the training is relatively simple” Another thought the same: “The training is not enough” It is also mentioned by another manager: “Very little training in informatization”, “Employees lack training in this area”, “There is no special training in this area”. “The training content is not comprehensive and did not suit the employees’ real needs” came from two managers. One of them pointed out that: “Course content training is not in place” “The training is not too detailed”. “Software training was not in the place” mentioned by three managers. According to them, the training was “Just simple conceptual training, but no training on software systems”. The lack of strict training assessment came from two managers. One of the managers said: “Employees are busy and do not advocate, can escape if they can” Another also mentioned: “Without supervision, it will not work. Some online training, let them watch at home, but they did not watch at all”.

It can be seen that the most influential is little training, insufficient training and incomplete training content, and failure to meet the actual needs of employees. Looking at the coding results, we can see that the factors that lead to less training and insufficient training were mainly that many managers did not realize the importance of onboard training of information technology due to various reasons, such as time. The reason for the ‘useless’ training and the failure to meet the needs of employees was mainly that before the training, the trainers did not analyze the needs of employees in advance, resulting in the content of the training was little, not systematic nor comprehensive, and the training time was short.

Theme 5: Need for Management Level’s Awareness

According to the coding results, this theme contains i). the national policy implementation is not strong; ii). the management personnel's information awareness is not strong, iii). the management is insufficient; iv). the management personnel has less communication and sharing.

Among aforementioned entries, “management personnel’s information awareness is not strong” and “insufficient management” were mentioned by two managers. One said: “The national policy is still very good if it can be implemented” Another also has the same opinion: “The policy above is very good, there are some deviations below, some over-interpretation, and some are across the board”. “Less communication between managers” was from three managers. According to one of the three, “There is not much communication between the major R&D companies”. Another also said: “No communication. We still have very few personnel exchanges with municipal transportation systems in other provincial” “The leading direction of the senior management staff was wrong” mentioned by one manager. He said:
“The reason for the entire system not working very well is that the senior management staff did not lead properly” “The national policy implementation is not strong” from the manager. He said: “There is a special unified standard, which is what we lack, and we need to increase the ability of information management” “Management sometimes recognizes this problem; there is no special good solution” He also pointed out that: “Our management may not have paid much attention to it from the beginning. For the grassroots employees to use the information system, they only feel that it is enough to train the employees”.

Overall, the most influential factor was “the lack of information awareness of senior management” and ‘insufficient management’, and the least impactful ones were “the wrong direction of senior management” and “the implementation of national policies”.

The interview indicated that the awareness of senior management was not strong. The insufficient management was mainly due to that some senior management personnel did not have the awareness of learning the new technology to improve work routines. Although some managers were aware of information management, they were not professional in information management. There was currently no good solution to the problems encountered in the implementation process, resulting in inadequate information management.

In the process of promoting the development of smart city transportation, the senior management personnel are responsible, their ideological awareness and management abilities determine the direction and success of information development. Senior management personnel needs to pay enough attention to understand policies, information knowledge, and other related content by viewing various documents, training, and then do their best to promote intellectual development and strengthen departmental information management in their work and supervise the development of RFID information activities.
CHAPTER 5 Discussions

In this thesis study, the interview was adopted to study the influences of RFID brought in the work routine of intelligent traffic department in the point view of management level. The challenges encountered in the promotion of RFID are also expected to be found. This chapter summarizes the research results and their relevance to the research question.

This study has three research questions:

1. What changes did the adoption of RFID technologies bring to the urban life of Hangzhou according to the employees of central intelligent transportation departments?

2. What are the challenges of the adoption of RFID technologies in the smart city transportation system for the managers (and other employees) of the central intelligent transportation departments (in Hangzhou) in their work routines?

3. How can the adoption of RFID technologies in a smart city transportation system be improved?

Therefore, the following three subsections explain and try to give answer for each of the aforementioned three research questions one by one.

5.1 Benefits of RFID on People

Based on the findings, this research found that RFID can be combined with other information technology in urban development for the public good. The influence of RFID on the intelligent traffic management department i). improves the innovation of smart transportation; ii). makes the transportation regulation more efficient; iii). provides management with more intelligence and optional solutions for the transportation and urban life problems; iv). increasing other information technologies’ efficacy and efficiency thus maximally powering the prospect of smart city; v). helping managers optimize and integrate various resources; vi). helping provide Hangzhou residents with faster and more convenient public transportation services; vii). improving the life quality of residents in Hangzhou and making the best use of limited city resources; viii) promoting and practicing sustainable development for the smart transportation system and smart city.

5.1.1 Power of Innovation

Previous studies have shown that the adoption of RFID can bring innovation and boost for the smart transportation. (Bunduchi, Weisshaar, and Smart, 2011) The finding in this research also confirmed it. From the technical point of view, the joint development and innovative application of RFID with the new generation of information technologies such as the Internet of Things, the Internet, and big data, etc. made the unified enhancement. From the urban governance point of view, the innovation applied in RFID technology has helped managers and staff of smart transportation department engage in a both participatory and open model with typical characteristics such as intelligence. From the urban development point of view, the use of RFID required the management level to focus on the integration of technology, management, standards, and other departments, emphasizing the development concept of sharing, security, and collaboration.
5.1.2 Management Enhancemen

Through the adoption of RFID technology, management can focus on multi-dimensional management of city operations, take the problem-oriented and sustainable development as the goal, fully integrate with information and communication technologies to further optimize the allocation of urban resources, improve the urban public, manage service capabilities, and enhance the overall operation of the city. This finding is consistent with the previous study. (Zhu, Mukhopadhyay and Kurata, 2012)

5.1.3 Intelligence

The findings suggested that applying RFID information technology to the operation and management of cities can make them more intelligent and provide new solutions to urban problems. RFID intelligent technology helps to improve the efficiency of urban transportation, to improve the service level of urban infrastructure, and to promote sustainable urban development by reducing energy and resource consumption, which is consistent with the previous study. (Zhu, Mukhopadhyay and Kurata, 2012)

5.1.4 Information Technology

RFID can be used in conjunction with other city information technologies, mainly including the Internet of Things, cloud computing, big data, and other technologies. First, the information technology is an important part of building a smart city; second, its application provides key technical support for effectively innovating city management and operation models and solving urban problems; finally, the integration of RFID and other information technologies help the construction of a network-based smart city information platform and function implementation provides new ways for different participants to take part in the construction of smart transportation.

5.1.5 Resources

The sample interview emphasizes that the use of RFID technology can help optimize and integrate various resources, use fewer resources to create more value, achieve resource conservation, and promote sustainable urban development. Besides, it also involves reasonable joint use with other information resources, through the integration of information technology, building an open network information platform to achieve collaborative sharing of information resources.

5.1.6 Service

The use of RFID technology combines information technology with an urban service supply to make public services more intelligent and user-friendly. (Zhu, Mukhopadhyay and Kurata, 2012) The findings also showed that the continuous improvement of the level of intelligent services makes the city operate more efficiently and quickly; it provides residents with more equal and convenient urban public services, and their service capabilities have been further improved.
5.1.7 Life
Lots of researches showed that RFID can benefit people’s lives in different sectors (Washiro, 2012; Zhu, 2005; Amendola et al., 2014) The findings show to some extent that through the use of RFID in intelligent transportation, Hangzhou’s transportation construction can improve the quality of life of residents and promote the construction of a better city.

5.1.8 Sustainable Development
RFID has great effects on the sustainable development of the supply chain. (Yan et al., 2015) The finding in this study also reveals that sustainable development is another effect of using RFID in the construction of intelligent transportation, which was showed and proved in the coordinated development of economic, social, and environmental dimensions. Smart transportation is a combination of urban development and technological progress. The continuous improvement and continuous optimization of urban transportation methods through RFID technology can reduce resource and energy consumption due to economic and social development and reduce the negative effects of development on the environment, then realize the sustainable development of the city.

5.2 Challenges of RFID Implementation
Findings of this study have suggested that to promote the use of RFID in intelligent transportation in any dimension, especially in infrastructure and soft environment, a lot of financial support is required. (Nam and Pardo, 2010) The funding problem is the bottleneck restricting the development of RFID. If the capital is short, it causes problems in other dimensions. (Madhani, 2008) The research found that there are still many problems in the construction of infrastructure and the soft environment in Hangzhou. It is still the problem caused by funds in the final analysis, which is consistent with previous studies. From the findings of challenges, the reasons for funds have a greater impact on the development of Hangzhou’s intelligent transportation. Therefore, capital investment in intelligent transportation construction should be increased to reduce the economic burden of transportation management departments.

Besides, the findings show that the current funding for the main management departments of intelligent transportation comes merely from government funding. It thus indicated that in the process of promoting urban transportation informatization, the management department, however, only had one single source of funding. For this problem, the management department needs to think about increasing the investment of funds is not enough to rely on government investment. Multi-channel investment should be tried. Multi-channel investment can not only ensure that the management department has sufficient capital investment, but also have multiple parties to participate and supervise, which can achieve better results. It can fundamentally solve the main factors of the development of urban transportation informatization, beneficial for the overall development of intelligent transportation.

The information literacy of employees is related to the quality of the application of RFID technology in smart transportation and the effect of the application of RFID. (Smith, 2005) Taewoo and Theresa (2011) also emphasized the risks which may occur from lack of knowledge, incompatibility between the systems. This research found the same risks consistent with Taewoo and Theresa’s study. From the challenges at the employees' level, it was found that the employees' awareness of self-learning is not strong. They were not familiar with information resources and the information literacy was low. They did not know how to apply...
information technology to their work routines, and there was a lack of doing research or self-learning on information technology. All these problems directly or indirectly caused by the management level cannot make use RFID in smart transportation smoothly. According to Taewoo and Theresa (2011), organizational risks include conflicts within the organization, employees’ resistance to change, and misalignment between organizational goals and the projects’ objectives. In this research, from the training aspect, there were certain problems in terms of training content and organization which supported Taewoo and Theresa’s study. The reasons for these problems were lack of onboard training, insufficient training intensity, lack of strict training assessment, inadequate software training, and incomplete training content. At present, the management departments of most enterprises would let employees carry out information learning through training (Gallivan, Spitler and Koufaris, 2005), but from the results, the training was hardly ideal although onboard training is currently a popular way for employees to familiarize themselves with information technology. The staffs were still lack of awareness.

Taewoo and Theresa (2011) claimed that from the political aspect, risks exist in political pressure, conflicts with other policies, and exclusion of the stakeholders involved during decision making. They also claimed that efficient technical performance cannot be taken for granted as it should be based on efficient and effective management and cross-organizational interoperability enhanced by supportive and committed leadership. Regarding the policy dimension, Taewoo and Theresa (2011) proposed the need for policy integration between the plethora of policies that cities’ policymakers have to adapt to. Additionally, a marketing strategy is needed to publicize innovations. This research also found that there were challenges at the management level when using the RFID. It was learned that the middle and senior management staff still failed in the information management, such as insufficient management, wrong direction, and poor implementation of national policies. The results of this study were also consistent with the previous study conducted by Zhu, Sarkis, and Geng (2005). Their study has shown that although Hangzhou’s smart transportation was already in a leading position in China and the city’s technology infrastructure was also in an advanced position, and the management department had built many information platforms (Argyriou, 2016), the information management situation was not very satisfactory. In the specific management process, there was still a lack of corresponding information management, and much information equipment in Hangzhou had not been fully applied. Some senior managers still haven't applied information technology to daily management, and even some managers’ concepts were outdated and need to be changed. The reason was that the management personnel of the information management of urban transportation did not keep themselves updated and take the responsibility seriously enough.

In conclusion, although the role of RFID in the field of intelligent transportation is somewhat complex, this study presents a relatively simplified picture. As new information technology, RFID plays a positive role in the management of intelligent traffic. Research shows that in the process of promoting RFID technology, there are still big challenges. The study has identified four different factors that explain these challenges. Further studies can be conducted to determine if the same challenges exist in other cities in China, and then measures can be taken to address different challenges. This may lead to more effective promotion of RFID in the future, thus achieving more sustainable development of intelligent transportation.

5.3 Suggestions for Developing RFID

Based on the analysis of the challenges of the implementation of Hangzhou RFID in the intelligent transportation system, combined with the current status of the development of smart
transportation in Hangzhou, this research put forward the following targeted countermeasures and suggestions for the development of RFID in the intelligent transportation system from three dimensions, which is technological, organizational and political dimensions.

5.3.1 Technological Dimensions

According to Taewoo and Theresa (2011), technological innovation refers to the mechanism of changing and upgrading technological tools. Technological innovation can improve services and create conditions for better use of these tools. Technology, as a tool for innovation, should ensure system interoperability and integration of systems and infrastructures. The information system construction is the key and cannot be ignored. In particular, there are imbalances in information system construction in various regions of China, which has a great relationship with the investment in smart transportation in different cities.

5.3.1.1 Increase Financial Investment

First, more applications can be made to the relevant departments and the government to increase capital investment and subsidies for intelligent transportation infrastructure.

Second, the Management department can cooperate with some companies and enterprises to increase investment in intelligent transportation management through enterprise investment. Since the enterprise is a profitable unit, there are sufficient funds to ensure the construction of all aspects of intelligent transportation and allow enterprises to invest in transportation facilities. Not only can make enterprises profit from it, but also can urge the management department to improve management efficiency and achieve a win-win effect.

Third, the management department can negotiate with financial institutions. BOT or financial leasing can be used for the construction of RFID systems in intelligent transportation. For example, using leasing and other methods invested by banks, establishing a highway toll collection management system based on RFID technology in a certain area, the transportation management department can save huge management costs. Using the saved funds to pay for equipment rental and maintenance costs which does not increase the cost of users, and it is easy to obtain user support. The electronic tags on the car can be distributed to the car owners free of charge by the bank. The bank can provide financial services to these car owners and digest the cost of the electronic tags to form a virtuous circular development model of RFID technology business operations.

5.3.1.2 Build Information Resource Database Systems

Using information resources to assist the effective use of RFID is a new way to promote intelligent transportation. Information resources are important factors for building intelligent transportation and effective use of RFID technology. If the information resources are lacking, the effective use of RFID technology will not be made. Given the above situation, this research gives recommendations to the management department from the following aspects:

First, build a smart transportation information system. The new type of intelligent transportation is a complex system, following the rules of system construction, using system engineering methods to build an open architecture system composed of the Internet of Things infrastructure and other information technology, which not only accommodates the current functional data but also provides a platform for future development and space.
Second, establish a city-level shared service platform. Integrate general functions into a large functional platform, and derive various applications of specific organizations on the platform to unify the functions of society and cities. At the same time, centering on the platform unified scheduling of information resources and data optimization.

Third, build common infrastructure network access. In a situation where a network protocol cannot be achieved today, there should be smart devices compatible with mainstream network transmission protocols to achieve multi-protocol conversion and multi-standard adaptation.

Fourth, establish a unified data center. Formulate a unified data format standard and define and explain data in a unified manner to promote the interaction, integration, and integration of data in various fields, industries. At the same time, build a big data analysis system to support applications in the smart field.

5.3.2 Organizational Dimensions

5.3.2.1 Improve the Information Literacy of Employees

Taewoo and Theresa (2011) claimed that organizational innovation refers to the creation of management and organizational capabilities for the effective use of technical tools and conditions. Efficient technical performance cannot be taken for granted as it should be based on efficient and effective management and cross-organizational interoperability enhanced by supportive and committed leadership. Therefore, innovation is a shift in policy and management practices to better meet the technological needs of cities. According to this study, the management level should enhance the consciousness of information-based learning among employees and increase their initiative in information-based learning. Senior management personnel should popularize knowledge of informatization to employees through various channels so that employees have a comprehensive understanding of informatization management in smart transportation and realize the importance of informatization management and its advantages.

Second, effective information training should be added to improve the information literacy of employees. To improve the information literacy of grassroots employees, senior management should increase informatization training, send employees out for training or invite experts to coach employees, and organize employees to learn information technology which can deepen employees' understanding of information technology and strengthen information technology at work Application.

5.3.2.2 Improve the Pertinence of Information Training

First, management should understand the training needs of various grass-roots positions. To improve the training effect, in addition to analyzing the content of the training, the trainer can also understand the real needs of the grass-roots employees through questionnaires, interviews, and other methods. It is understood that many employees believe that the training is not in place and the training content is incomplete in the face, it reduces the interest of employees in information technology. It can be seen that blind training does not understand the learning needs of employees, and the effectiveness of training is reduced. To improve the effectiveness and pertinence of information-based training, analysis of needs before training is very important.
Second, the training content should be modified according to the employee’s training needs analysis. Trainers should proceed from the real needs of employees and modify the training content appropriately.

Third, training times should be increased. The survey found that managers believe that training is not sufficient. Managers can join universities and the excellent local information technology R & D department to set up informatization training courses and informatization skills demonstration activities for grassroots employees. It is possible to propose to the training department to conduct more lectures, theoretical and practical studies. Also, online training is more convenient to conduct training for employees. But it is worth noting that each grass-roots position should carry out effective and specific training according to the actual situation of the position to improve training efficiency.

Fourth, a strict training and evaluation system should be established. It is understood that much corporate training is only simple training. Some online training does not have a strict evaluation system. Due to the busywork, employees do not study seriously, but only conduct corresponding evaluations after the completion of the study, which cannot be truly reflected in training results.

Fifth, establish a follow-up service platform. In the current training, the students are directly evaluated after the training, and there is no follow-up after the training. The grass-roots employees reported to the managers that they could not fully absorb the training content, and such problems in the actual work after training could not be resolved in time. It can be seen that establishing a follow-up service platform and providing timely guidance to grassroots employees after training not only improve the effectiveness of training but also further stimulate and enhance the enthusiasm of employees.

5.3.3 Political Dimensions

Taewoo and Theresa (2011) raised that policy innovation is about solving institutional and non-technical urban problems and create mechanisms that favor conditions for smart cities. Regarding the policy dimension, Taewoo and Theresa (2011) proposed the need for policy integration between the plethoras of policies that cities’ policymakers have to adapt to. Additionally, a marketing strategy is needed to publicize innovations. They also thought that all the innovative ideas and processes should be resident-centric and engage residents through collaboration and partnership.

5.3.3.1 Improve the Information Leadership of Senior Management

To achieve policy innovations, managers must change their concept, establish a correct concept of information management, and encourage more employees to participate in technology research projects and related training, teach employees the idea of informatization, and provide more training opportunities for department employees, so that they can learn more about relevant aspects, such as listening to lectures, studying in excellent companies that develop intelligent transportation systems. At the same time, Middle and senior management personnel should also improve their information literacy and enhance information leadership Ability. Secondly, as a leader, senior management should pay more attention to the policies promulgated by the state and local governments, understand the current national policy direction, lead the urban transportation construction in the right direction, and actively promote the city effectively under the guidance of the policy with the rapid development of transportation information.
5.3.3.2 Form Information Management Team

Due to limited time and energy, as the management personnel of the traffic management department, senior management personnel cannot take care of all aspects of the application of RFID in transportation. Besides, from the external level of employees, it can be seen that the grassroots employees have high work pressure and high mobility. Therefore, the transportation management department and the main responsible enterprise should establish an information management team within the management department to strengthen its management efforts and have fully applied the functions of the city's intelligent platform. At the same time, it can reduce the work pressure of the grassroots staff.

5.3.3.3 Adjust the Assessment for Management Systems

From the external reasons of employees, it can be seen that due to the low salary of grassroots staff, they are reluctant to spend more time and energy on updating information in the field of information. There are very few employees who often undergo training. Therefore, senior management personnel should adjust the assessment management system of employees according to the actual situation of the department, formulate more incentive measures, and take information training as part of performance assessment. On the one hand, it gives employees great spiritual encouragement; on the other hand, they can also urge employees to use information technology in their work routines and activities.

5.4 Limitations

The main criticism of qualitative research is the subjective level of the researchers' personal opinions and motivations (Bryman and Bell, 2011). Objectivity depends on the method used by the researcher to express clearly, the field of research, and the ability to express by means. (Berg, 2009) It's obvious that qualitative research is limited and cannot provide generalizations. But it provides in-depth information about the insights of the participants (Bryman and Bell, 2011; Bryman and Burgess, 1994).

Another common criticism is that the scope of qualitative results is limited. When conducting interviews with a small sample, it can be said that it is impossible to generalize the survey results to other occasions (Bryman and Bell, 2011). This study uses a sample of six different levels of managers and may be criticized for the sample for being too small thus limiting the universality and the validity of the research results to only this article. The researcher admits that not all managers in Hangzhou participated in the study, but given the author's time limit and the scale of the research project, the researcher believes that six participants were sufficient to investigate this topic.
CHAPTER 6 Conclusions & Future Work

6.1 Conclusions

This thesis has proposed three research questions:

1. What changes did the adoption of RFID technologies bring to the urban life of Hangzhou according to the employees of central intelligent transportation departments?

2. What are the challenges of the adoption of RFID technologies in the smart city transportation system for the managers (and other employees) of the central intelligent transportation departments (in Hangzhou) in their work routines?

3. How can the adoption of RFID technologies in a smart city transportation system be improved?

In order to achieve the purpose of this research and answer the questions mentioned, a literature review has been conducted to understand the latest situation of smart transportation known by the knowledge system, and to construct the theoretical framework used in the research process. The review identified a large number of issues in many areas of interest.

The empirical research is based on qualitative methods. Interviews were conducted during the research process. Using the coding method, the collected data was analyzed through thematic analysis. The following five themes have been identified using this method:

Theme 1: The impact of RFID on people

Theme 2: Importance of keeping information system updates

Theme 3: Importance of integration of the systems and funding

Theme 4: Need for employee awareness-raising and training

Theme 5: Need for Management awareness

Data analysis shows that the most influential factor is the lack of information awareness of senior management and insufficient management, and the lesser impact is the wrong direction of senior management and the implementation of national policies. It can be seen from the coding results that the awareness of senior management is not strong. The factors of insufficient management are mainly some senior management personnel still lack the awareness, and do not correctly lead this aspect of information system. Some managers are aware of this aspect of information management, but their capabilities in information management are lacking. There are no good solutions to the problems encountered during the implementation process, resulting in inadequate information management.

The influence of RFID on the daily work of managers of intelligent traffic management department firstly improves the innovation of smart transportation; secondly, make the management more efficacy; thirdly providing management with more intelligence plan to solve transportation problems; fourthly increasing other information technologies’ efficiency to maximize the effect of the information system; fifthly helping managers optimize and integrate various resources; sixthly help managers provide citizens with better public transportation services; seventhly improving the life quality of people in Hangzhou; lastly creating sustainable development for the smart transportation system.
According to the current situation and constraints, the following several targeted countermeasures and suggestions are proposed, mainly including:

(1) Attach importance to infrastructure construction, such as: increase financial input through multiple channels, strengthen the construction of information resource library, and increase the rate of resource sharing and utilization rate;

(2) Improve the information literacy of grassroots employees and strengthen informatization training, such as: effectively improve the information literacy of grassroots employees and improve the relevance of informatization training;

(3) Increase the intensity of transportation information management in Hangzhou, Such as: improving the management's informatization leadership, forming an informatization management team, and adjusting the assessment management system.

6.2 Contribution

Although there have been a lot of researches on RFID and smart transportation in recent years, there are relatively few analyses on the current status and influencing factors of RFID development in Hangzhou. Through this research, people can understand the current status of Hangzhou's RFID technology development in smart transportation, and the impact of RFID on smart transportation management. This study also analyzes the development problems. This study uses qualitative research to understand the development of Hangzhou's RFID and its influencing factors, identifying the importance of influencing factors; and putting forward reasonable countermeasures and suggestions to promote its development, providing a theoretical basis for promoting the development of RFID in Hangzhou, providing support for accelerating the construction of smart transportation in Hangzhou. It also gives an idea about how to use RFID to promote the sustainable development of smart transportation, providing reference strategies and suggestions to promote the overall development of Hangzhou's smart city.

6.3 Future Work

Due to limited personal abilities and time, this study has the following shortcomings, as follows:

1) Due to the limitation of time and objective conditions, the sample size of this study is slightly insufficient;
2) When analyzing the status quo and influencing factors, it only grasps the status quo and influencing factors from the perspective of managers, and does not from other perspectives.

This research is from the perspective of intelligent transportation system managers, to study the current status and influencing factors of the development of RFID in the Hangzhou intelligent transportation system. In future research, researchers can study the cities and rural areas of China separately to find the factors that affect the development of smart transportation in cities and rural areas. Further researches can also study the current status and influencing factors of smart transportation from a broader perspective. Third, to further understand the development of smart transportation in China and continue to promote the role of RFID in smart transportation, future research can conduct empirical research on the four influencing factors proposed in this thesis, testing these four factors through a large sample and the degree of influence of the information development of smart transportation in other cities. Fourth, in future research, researchers can strive for the opportunity to practice for the above-mentioned targeted promotion strategy, and provide timely feedback on the results of the practice. The
specific suggestions are revised in time to provide the most meaningful reference for the use of RFID in smart transportation in China.
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Appendixes

Appendix A

Questions of Interview Protocol:

1. Please tell me first which traffic management area you are responsible for?
2. What do you think is the reason for popularizing RFID technology in intelligent transportation systems?
3. How the application was communicated among the employees?
4. How the implementation of RFID technology affected your everyday working life?
5. What are the problems in the development process of implanting RFID? What are your suggestions on encounter them?
6. Which do you think are the reasons and how these problems could be prevented?
7. Many cities in China have also carried out the construction of intelligent transportation, and are also vigorously promoting the use of RFID technology. What feedback did you get from these managers?
8. What improvement measures are needed to promote the further popularization of RFID technology?
Appendix B

Coding book for both RFID's influence on the manager’s work routine and problems using RFID in smart transportation:

<table>
<thead>
<tr>
<th>Code</th>
<th>Category</th>
<th>Theme</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Innovations in Service and City Management</td>
<td>Innovation</td>
</tr>
<tr>
<td>2</td>
<td>Realizing the Intelligent Operation of The City</td>
<td>Intelligence</td>
</tr>
<tr>
<td>3</td>
<td>Synergy with the New Generation of Mobile Communications, Internet of Things</td>
<td>Information Technology</td>
</tr>
<tr>
<td>4</td>
<td>Integrating Resources Such as Nature and Information</td>
<td>Resources</td>
</tr>
<tr>
<td>5</td>
<td>Improvement of Resident Services</td>
<td>Services</td>
</tr>
<tr>
<td>6</td>
<td>Enriching Social Life and Bringing A Better Living Environment</td>
<td>Life</td>
</tr>
<tr>
<td>7</td>
<td>Sustainable Development of Cities</td>
<td>Sustainability</td>
</tr>
<tr>
<td>8</td>
<td>Informatization Resources Are Not Comprehensive;</td>
<td>Technological Problems</td>
</tr>
<tr>
<td>9</td>
<td>Low Integration of Informatization Resources</td>
<td>Technological Problems</td>
</tr>
<tr>
<td>10</td>
<td>Informatization Resources Match in The Low Degree</td>
<td>Technological Problems</td>
</tr>
<tr>
<td>11</td>
<td>Informatization Resources Are Not Updated in Time</td>
<td>Technological Problems</td>
</tr>
<tr>
<td>12</td>
<td>Insufficient Funds</td>
<td>Funding Problems</td>
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<tr>
<td>13</td>
<td>Single Source of Funding Input</td>
<td>Funding Problems</td>
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<tr>
<td>14</td>
<td>Employees 'Informatization Awareness and Learning Ability</td>
<td>Low Employee Awareness</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Problem Type</td>
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<tr>
<td>---</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------------------------------------</td>
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<tr>
<td>15</td>
<td>Employees' Unfamiliarity with Informatization Resources</td>
<td>Low Employee Ability</td>
</tr>
<tr>
<td>16</td>
<td>Employees' Low Professional Abilities</td>
<td>Low Employee Ability</td>
</tr>
<tr>
<td>17</td>
<td>Inadequate Research on Informatization</td>
<td>Low Employee Ability</td>
</tr>
<tr>
<td>18</td>
<td>Employees' Ignorance of How to Integrate Information</td>
<td>Low Employee Awareness</td>
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<td>19</td>
<td>Work Pressure of Employees</td>
<td>Organization Problems</td>
</tr>
<tr>
<td>20</td>
<td>Mobility of Employees</td>
<td>Organization Problems</td>
</tr>
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<td>21</td>
<td>Low Wages</td>
<td>Organization Problems</td>
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<tr>
<td>22</td>
<td>The Training Content Is Not Comprehensive and Does Not Meet the Needs of Employees</td>
<td>Training Problems</td>
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<tr>
<td>23</td>
<td>Less Training and Insufficient Training</td>
<td>Training Problems</td>
</tr>
<tr>
<td>24</td>
<td>Software Training Is Not in Place</td>
<td>Training Problems</td>
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<tr>
<td>25</td>
<td>Lack of Strict Training Assessment</td>
<td>Training Problems</td>
</tr>
<tr>
<td>26</td>
<td>The National Policy Implementation Is Not Strong</td>
<td>Policy Problems</td>
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<tr>
<td>27</td>
<td>The Management Personnel's Information Awareness Is Not Strong</td>
<td>Management Problems</td>
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<tr>
<td>28</td>
<td>The Management Is Insufficient</td>
<td>Management Problems</td>
</tr>
<tr>
<td>29</td>
<td>The Management Personnel Have Less Communication and Sharing</td>
<td>Management Problems</td>
</tr>
</tbody>
</table>
Appendix C

Consent form

Title of research: The impact of the RFID on the construction of smart transportation
Researcher: LIU JINXIN
Email: jl224me@student.lnu.se

Supervisor: Konstantina Pentarhou
Email: Konstantina.Pentarhou.extern@lnu.se

Aim
This research aims to investigate The impact of the RFID on the construction of smart transportation.

Procedure
Your participation in this research includes an interview which will last for up to an hour. The interview will be recorded under your permission.

Dangers
The participation in this research does not include any danger while the material of the interviews will be used exclusively from the researcher for the purposes of his research.

Confidentiality
The information you are going to give will be held safe and confidential by the researcher. Only the research will have access to the research data. All the data of the research will be held until its completion and will be deleted afterwards. Your name will not be revealed and it will be linked with any of the findings.

Voluntary participation and the right of withdrawal
Your participation in this research is voluntary. You can refuse to participate or to withdraw at any time, even during the interview.

Right to ask questions
You have the right to ask any questions by contacting with the researcher before, during and/or after the interview.

Consent
I agree to take part in the research:” The impact of the RFID on the construction of smart transportation” conducted by LIU JINXIN

I agree to be audio-recorded.

Yes No

Data: Participant: Researcher: