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WILLINGNESS OF ACCEPTING MOBILE DATA POSITIONING TECHNOLOGY IN CHINESE MARKET

Master's thesis

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Allowed for defense on.....

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I have written this master's thesis independently. All viewpoints of other authors, literary sources and data from elsewhere used for writing this paper have been referenced.

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Content

Abstract

This research aims to study the willingness of accepting Mobile data positioning technology in tourism, traffic and population statistics in China. Despite big data is popular in different industries, the Chinese government is still conservative, using traditional methods for statistics, such as transportation, population, and tourism. For the time being, mobile phone selling market grows rapidly around the world. Billions people generate tons of data every second through their mobile phone. The big challenge is to get to know about those data. With the analyzing big data technology has a great improvement, it is a good opportunity to start analyzing mobile data positioning market in China. As the fastest-growing developing country in the world, China has a large potential market. At the same time, China's digitalization process has also developed rapidly, laying a good foundation for Mobile data positioning(MDP). As mobile data positioning technology mainly provides to the government, so in this study, it adopted questionnaire to 67 civil servants about their attitude to use MDP in their daily work. Meanwhile, this study using Structural Equation Modeling SEM, SPSS, technology acceptance model(TAM) model and smartpls to determine the model of their willingness to adopt this technology. The results show that perceived usefulness and perceived ease of use are direct and important predictors of positioning using mobile data whereas. The findings help as a guide for effective decision to any technology company who are interested in MDP in Chinese's market.

Key words: Mobile data positioning, Chinese's market, Technology acceptance model(TAM)

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Introduction

Mobile data positioning is a sub- branch of Location based services. The term location-based services is a recent concept that denotes applications integrating geographic location with the general notion of services. (Schiller and Voisard, 2004) With the development of mobile communication, these applications represent a novel challenge both conceptually and technically.

The development of location and mobile communication technology has made location-based service (LBS) applications increasingly popular.(Sun et al., 2017) Currently, in the past six years, all conventional and next-generation mobile networks have been able to determine the location of the basic level, a great deal of effort has been invested in developing precise positioning systems for mobile networks.(Clarke, 2014) There are many mature and reliable mobile positioning technologies, all of which are capable of capturing time and distance related information, It can be used to interpolate the whereabouts of mobile devices and their users. (SPINNEY, 2003)Although some mobile positioning technologies have limited accuracy, they are valuable for a variety of location-based applications.

Over the past decade, mobile telecommunications services have shown alarming penetration. Especially in developing countries, mobile phones have played a vital role in making cellular services available to a portion of the population who previously had no access to such services.(Meddour et al., 2011) Mobile phone users all over the world, have already become the essential part of human daily life. Based on the statistic, the number of sold smartphone during past five year has reached 1.4 billion.("Cell phone sales worldwide 2007-2020," n.d.) Under the huge amount of mobile phone selling, another new industry appeared. As for mobile phone positioning, currently not much companies are focusing on it. In the current research, the Estonian research company Positium applies mobile phone data positioning technology to actual scenarios. Positium has achieved good results in transportation, population mobility, and tourism through cooperation with local operators and through MDP technology.("Solutions," n.d.) With the rise of big data, Mobile phone data positioning is gradually recognized by people. At

present, Indonesia cooperates with Positium to use MDP technology in tourist statistics and COVID-19 statistics, and benefit from it.(Gao et al., 2019)

Being the largest developing country, China has undergone rapid economic development.(Zhang et al., 2013) The flows of population have drawn increasing attention across various academic fields as well as governments. The main reason is that the flows of population have not only reshaped the spatial distributions of the population but also affected the development of regional economy.(Weili Zhang et al., 2020) Meanwhile, big data and predictive analytics have huge potential to create value to the Location Based Services. Normally people use their mobile application to record their locations, like GPS, GSM networks. But in this technology, it adopts anonymous cellular network historical data provided by local phone operator.

The government has gradually realized the convenience brought by big data. For example, they use big data analysis to handle negative emotion during public emergencies(Wei Zhang et al., 2020), also in the COVID-19 infectious disease that hit the world economy this year, the Chinese government has also adopted the method of big data statistics to prevent the spread of the virus.(Zhou et al., 2020)

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Mobile phone positioning as a branch of LBS services, has great potential for the government's big data statistics. This paper will analyze the attitude of government personnel towards the adoption of mobile phone positioning technology. The first part is literature review, research of the previous researchers using the Technology Acceptance Model(TAM), and also stated the application of location-based services. The second part is to put forward hypotheses based on previous research, and collect data to verify the hypothesis.

At present, except for statistical companies similar to Positium, MDP technology has not been widely used and has a broad market. This is partly because the technology only serves government departments, and the government as a whole is conservative about adopting new technologies. At the same time, the technology needs to reach an agreement with local operators and comply with the relevant laws and regulations of the country. In this study, the focus is on China, and the government ’s attitude towards adopting this technology is obtained through a questionnaire survey of Chinese government staff. In this study, a total of 67 staff members in the tourism, transportation, and population departments of the Chinese government were used to analyze their attitudes and factors that influence the Chinese government's adoption of MDP technology.

1. Literature review

1.1The concept of Technology Acceptance Model

Generic studies on innovation adoption and diffusion have been widely applied to understand why and how organizations and individuals adopt new technology.(Lee et al., 2011) Technology Acceptance Model has been one of the most influential models of technology acceptance, with two primary factors influencing an individual’s intention to use new technology: perceived ease of use and perceived usefulness.(Davis, 1989) TAM models system usage intentions and behavior as a function of perceived usefulness and perceived ease of use. At present, TAM has become a cutting-edge subject in the fields of information systems, information management, and economic management. In TAM, the goal is to use the main determinants of use to accept or reject new tools. The intention to use is controlled by the individual personality of the particular tool used. Perceived usefulness (PU) and perceived ease of use (PEOU) influence people's mentality of using specific tools. Perceived usefulness (PU) is characterized by people trusting the use of certain tools to improve their task execution.(Hoong et al., 2017)

The original scales for measuring the TAM constructs have been confirmed to be reliable and valid in several replications and applications spanning a range of technologies and user populations.(Davis and Venkatesh, 1996) Especially the application of new technology, such as Mobile library applications(Rafique et al., 2020), telemedicine

services(Kamal et al., 2020), and Smartwatch adoption (Dutot et al., 2019).The choice of an individual to voluntarily accept new technology is known as technology acceptance.

For successful implementation and utilization of technology, users' willingness is a crucial factor.(Rafique et al., 2020) The TAM explains user motivation by means of 3 factors: Ease of use, usefulness, and attitude toward using. (Figure 1 Technology Acceptance Model(TAM) (Davis, Bagozzi & Warshaw 1989))Several studies have attempted to extend and modify the TAM by proposing additional variables that may contribute to acceptance of technological innovation.(Estriegana et al., 2019) Venkatesh and Davis developed and tested a theoretical extension of the TAM called TAM2, which explained perceived usefulness and intention to use in terms of social influence and cognitive instrumental processes.(Viswanath Venkatesh and Davis, 2000)

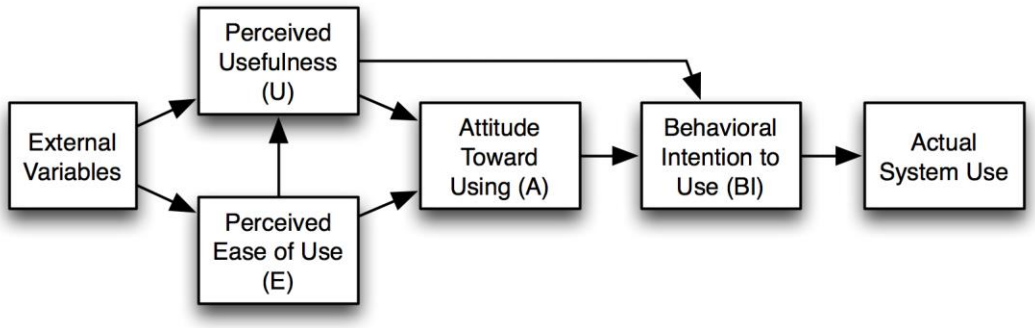

Figure 1 Technology Acceptance Model(TAM) (Davis, Bagozzi & Warshaw 1989)

In the past ten years, Internet technology has made great progress, and TAM has been accepted by more and more scholars, and its research has also shown a thriving scene.(Taiwo and Downe, 2005) Researchers have turned their attention to the technical acceptance of different target groups when facing various network information systems, but people soon discovered that the original TAM could not explain the complex situation of different target groups facing various network information systems.(Surry and Surry, 1997)

With the continuous advancement of information technology, scholars in many disciplines have compared theories such as Theory of Reasoned Action (TRA)(Venkatesh et al., 2003), Theory of Planned Behavior (TPB),(Notani, 1998) Diffusion of Innovations Theory (IDT) (Raynard, 2017), UTATU model(Venkatesh et al., 2003), with TAM in the past two decades. The combination has continuously improved the theoretical model of TAM; at the same time, the research object of TAM has gradually concentrated from the general population to a specific group, and the research direction has also shifted from the initial model framework to the study of external variables, so that the explanatory power of the model has continuously improved.

However, TAM original model has its own limitation. So Venkatesh and Davis came up a new model based on original TAM model. In 2000, Venkatesh and Davis (V. Venkatesh and Davis, 2000)selected 156 factory employees from four factory employees who actually used the workshop task diary system to conduct a questionnaire survey, and studied the impact factors of perceived usefulness in more detail. They introduced a series of Social Information to classic TAM: Subjective Norm, Voluntariness, Image, Experience, and deleted the influence of attitude on intention, and proposed TAM2. The perceived usefulness of TAM2 is affected by the combination of subjective norms, impressions, and Job Relevance, output quality and Result Demonstration) This model TAM2(Figure 2), added external factor, can evaluate the result in more accurate way.

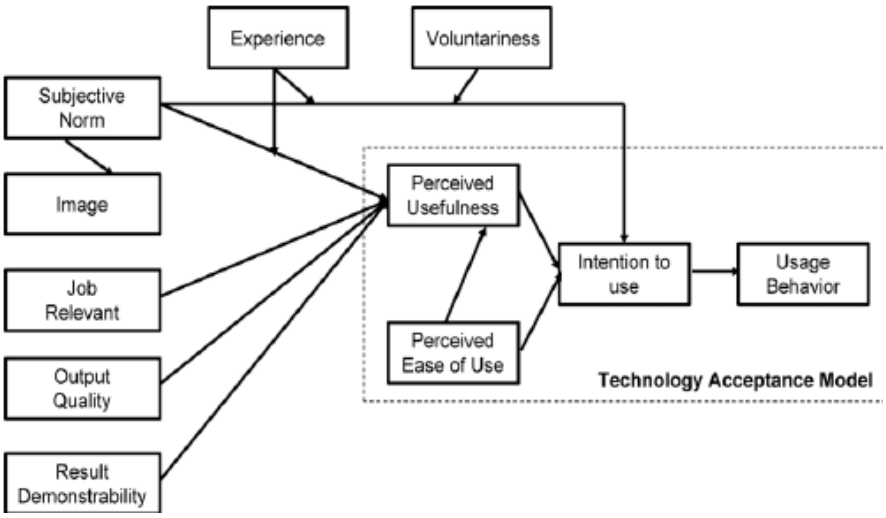

Figure 2 TAM 2 model.(V. Venkatesh and Davis, 2000)

With the vigorous development of technology acceptance models in academia, there are more and more relevant models and theories, and the variables designed in the process of technology acceptance are gradually increasing. The unified theory of acceptance and use of technology (UTAUT)framework and concepts(Figure 3), mainly developed from psychological and sociological theory, have been highly utilized to describe technology acceptance and use.(Venkatesh et al., 2003) Because the model has high prediction validity(Wang et al., 2020), UTAUT has been used to study various technologies and utilizes key concepts such as expected performance, expected workload, social influence, and convenience conditions that promote intent to use.(Kim and Hall, 2020) The UTAUT model is one of the most popular models and was validated by different empirical studies as a precise model that predicted the system acceptance and usage.(Isaac et al., 2019)

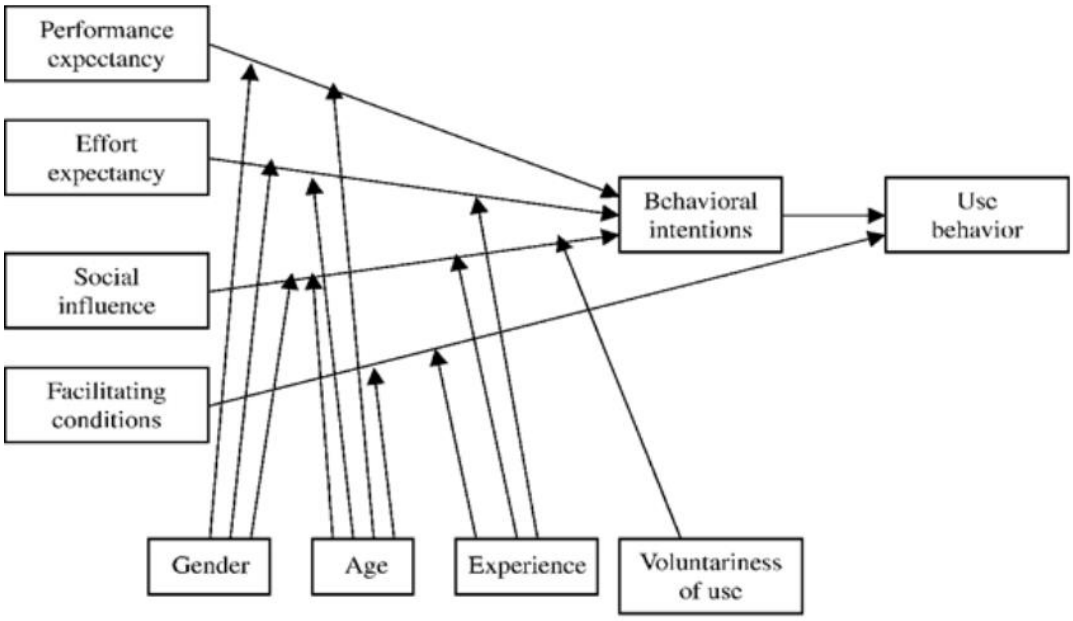

Figure 3. TUAUT model

This research model is derived from the widely accepted technology acceptance model (TAM), and based on a comprehensive review of a large number of literature, some elements of other theoretical models are introduced to form the initial acceptance model of information technology. Most of the recommended factors have a direct or indirect significant impact on the intention to use in the near future and the intention to use in the

long term. TAM uses a few simple concepts to explain people's acceptance of technology, which is very consistent with the simplicity of the theory. Therefore, it is very suitable as a theoretical basis and extended to other scientific and technological acceptance studies.

1.2 LBS and Mobile phone positioning industry

In today ’s market, there is a growing demand for mobile locations by consumers and government agencies. Location Based Services (LBS) uses location technology to provide a single user with the ability to always access network services on the move. (Xu and Gupta, 2009) Location-based applications are one of the most anticipated new segments of the mobile industry. (Schiller and Voisard, 2004) Location is a vital component in consumer services like social media, search, advertising and navigation.(Wang, 2015) Recent years have witnessed rapid advances in location-based services(LBS) with the continuous evolvement of mobile devices and communication technologies. LBS have become more and more popular not only in citywide outdoor environments, but also in shopping malls, museums and many other indoor environments. They have been applied for emergency services, tourism services, intelligent transport services, gaming, assistive services. Location-Based Services(LBS) have a huge blistering growing market, however, LBS market reports do not fully agree about the current market size, the exact number of LBS users, market growth rate, etc. Different market study reports describe LBS market size, number of LBS subscribers and frequent users, revenues and costs and most appreciate application types with different and sometimes extremely contrasting numbers and figures and this becomes more problematic when it comes to forecasting the future market of LBS.(Basiri et al., 2015)

The basic location of the device is determined by localization, which is based on the user's basic information, such as lifestyle, navigation data, shopping habits, social activities, and paths of public transportation usage habits. (Krumm et al., 2007)Mobile devices that support location include smartphones, tablets, and in-vehicle devices, as well as other smart devices. LBS provides useful information about current local activities,

shops and entertainment venues.(Mendelson, 2014) In addition, LBS has become an important part of marketing strategies and small business monitoring systems.

Table 1 Enabling technologies for precise LBS

Technology	Description	Precision
GPS	Satellite-based, global, uses latitude, longitude, altitude.	<= 10m
A-GPS	Performs positioning calculations beyond the mobile device.	1m-10m
Time-based	Depends on the time delay of an electromagnetic signal.	50m – 150m
wLAN	Cell ID, radio signal strength, location fingerprinting.	1.5m – 10m
Blue-tooth	Short – Range RF specification.	10cm – 10m
RFID	Allows for contactless reading of RF-enabled tags.	1cm- 1m

Source: compiled by the author based on Perusco and Michael (2005)(Perusco and Michael, 2005)

In current study, there are two main technological methods for location mobile phones from the infrastructure of MNOs(Mobile network operators): Active and passive mobile positioning. Active positioning locates the owner of the phone in real-time and requires the owner's consent. Passive mobile positing is extracting data representing information about historical locations of the phones from the log files of MNOs. (Ahas et al., 2014)

In Global Location-Based Services Market 2020, it illustrates that the Location-Based Services Market was valued as USD 20.53 billion and is expected to reach USD 133.08 billion by 2023. The location-based services market is observing a growth due to increasing analytical and business intelligence applications. The increasing importance of targeted marketing, globally, has led to high focus on marketing efforts. Location-based services allow the analysis of consumer behavior in commercial spaces, like malls and shops to understand the consumer preference to take advantage for marketing.

Additionally, increasing smart device sales has further fueled the market growth. Marketers believe that location-based advertising is a strong tool for mobile marketing and can elicit quick response from consumers. Thus, location data is gradually becoming a critical element for digital marketing of brands and enterprises. Developing self-driving cars technology relies heavily on location-based services for navigation and safe driving. But, the privacy of data is a major restrain to the market.(Czakon et al., 2020)

LBS applications under mobile phone positioning technology

Road traffic management

Traffic management is an important issue for local authorities who try to effectively manage all the information collected for traffic control. LBS plays an important role because it can immediately inform the driver of the current car's road conditions, dangerous points, etc.(Sadoun and Al-Bayari, 2007)

LBS plays an important role in traffic management. This is a method for determining a driving time of a vehicle on a road, wherein the vehicle is operable in a mobile communication network, including: collecting historical communication events of a mobile user to obtain a driving sample, wherein the historical communication event indicates when to move Device moves. (Corser et al., 2013)

The service provides information about traffic jams and determines faster routes to drivers. It considers a large part of the infrastructure and is always updated. It can also predict traffic that arrives at a specific location after a specific time and provides some instructions to avoid traffic congestion. It can estimate the total travel time, and in the case of traffic congestion, can suggest alternative routes for the remaining time. It is linked to police information, and if part of the road is closed, it is recommended to use the anointer route or other possible travel methods, such as trains.(Ragia and Deriaz, n.d.)

Population

The knowledge of the size, distribution and characteristics of current population is critical to deal with issues in urban planning.(Wu et al., 2020) Many existing studies defined the residents by the proportion of residence time in the study area with spatiotemporal

information contained in mobile phone data.(Wu et al., 2020) Compared with traditional census data, mobile positioning data are advantageous for analyzing human activity patterns due to large data volume and multitemporal characteristics. Similar large-scale human activity datasets such as satellite-derived nighttime light data, nationwide points of interests, and taxi trajectory data have all been utilized to study regional inequality in economic development.(Wang et al., 2019)

Tourism

Rapid advances in information and communications technology in recent decades have opened up several new possibilities for researchers and statisticians to understand the spatiotemporal behavior of tourists.(Saluveer et al., 2020)

The possibilities for Location Based Services on mobile go beyond consumer-facing apps like FourSquare. With over 770 million GPS-enabled smartphones, location data has begun to permeate the entire mobile space. It's powering advertisements, and many other services, from food deliver to travel apps.(Osterholm, n.d.) Location related services are an integral part of the mobile service landscape today. Detecting one's whereabouts and relating them to networked information offers benefits for users and businesses.(Breuer et al., 2015) Mobile phone positioning technic using passive mobile positioning data concerning the location of call activities or handovers in network cells that is automatically stored in the memory of service providers. (Ahas et al., 2010)

When it comes to mobile communication technology, China is the largest market in the world. Based on the statistics, till 2019, September, there are over 1595 million people subscribed to mobile services in China. As for the whole world the unique mobile subscribers number is around 5.1 billion people("GSMA," n.d.). It is not hard to say, China already accounted for a larger or mainly proportion of the mobile phone subscribers' market.

(in millions)

Figure 4 Number of mobile cell phone subscriptions in China (Source: https://www.statista.com/statistics/278204/china-mobile-users-by-month/)

As an important technical support for realizing smart cities and smart lives, LBS technology has brought many conveniences to people's lives. However, the sword has double fronts, and the security issues of user location privacy are becoming increasingly prominent. Location-based services (LBS) refer to those information services that deliver differentiated information based on the location from where a user issues the request.(Mascetti et al., 2007) Although LBSs useful and convenient, pose a serious threat to users' privacy as they are enticed to reveal their locations to LBS providers via their queries for location-based information.(Shin et al., 2012) In order to maximum extend protect users' information, study institution and different companies are paying more and more attentions on it. (Pingley et al., 2009)

2. Proposed model and hypothesis

Based on previous research, a theoretical model was developed using the TAM as a framework to understand the role of individual factors in government officers' acceptance of MDP technology.(Estriegana et al., 2019) this study extended TAM in MDP domain by including four external variables, i.e. Habit, and Institution trust. The dependent variable for this study is Attitude Toward Using, where perceived ease of use,

habit, institution trust, output quality, perceived usefulness, performance expectancy were the independent variables.

The proposed model included UTAUT, TAM,TAM2. According to the research aim, the variables were screened and the dependent variables were determined. Since mobile data positioning is mainly used for official data statistics, Habit, intuition trust, output quality, performance expectancy, and perceived security are selected as external independent variables. The traditional TAM variables used in the core are Perceived usefulness and received ease of use.

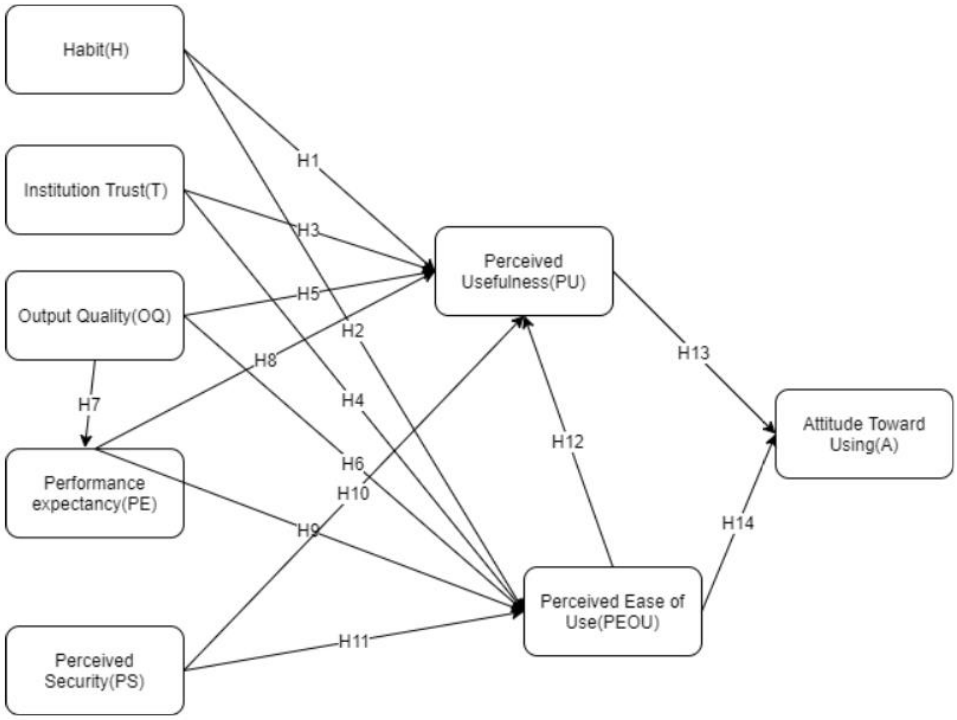

Figure 5 Research Model

Independent variable and hypothesis

Since the previous research did not have any relevant research on the attitude of acceptance of Mobile data positioning, in the selection of independent variables, after reading a large number of research articles on the attitude of TAM towards the adoption of new technologies, they following factors are chosen to build the model.((Hussein, 2017),(Chen and Chao, 2011),(Kamal et al., 2020),etc.)

Habit (H)

Frequency of past behavior then reflects habit strength and has a direct effect on future performance.(Ouellette and Wood, 1998) The more experienced a user is, the way better the user will use the internet and mobile applications for personal usage. It inferred that habit has more cognitive influence on behavior intention, as it helps in more intensive assessment of various cost advantages that are of more considered nature.(Rafique et al., 2020) In the meanwhile, in previously research, it has been proved that Habit has positive relationship to the core constructs of TAM.(Hubert et al., 2017) In many surveys of online web pages, Habit is a very popular independent variable, such as the study of online shoppers,(Gefen, 2003) and a survey of loyalty,(Liu-Thompkins and Tam, 2013)

The first hypothesis is

H1:

Habit is positively related to perceived usefulness of mobile data positioning technology.

H2:

Habit is positively related to perceived ease of use of mobile data positioning technology.

Institution Trust (T)

Trust is "firm belief in the reliability, truth, or ability of someone or something; acceptance of the truth of a statement without evidence or investigation; believing in the reliability, truth, or ability of; allowing someone to have.(Park, 2020) .Recent studies showed that the impact of distrust on an individual's behavior might exceed that of trust, depending on the specific context. (Strohmaier et al., 2019) Individuals, especially government personnel, trust in a technology is an important factor in whether they will adopt this technology. Hence, it can be inferred that Institution trust dose have an effect on the acceptance of technology.

H3:

Institution Trust is positively related to perceived usefulness of mobile data positioning technology.

H4:

Institution Trust is positively related to perceived ease of use of mobile data positioning technology.

Output quality (OQ)

In Mobile data positioning technology(MDP), government personnel will be very interested in Output quality. In many studies of new technologies, Output quality is adopted as an independent variable of a model. For example, in A Study of Web 2.0 Website Usage Behavior, Output quality is adopted as an independent variable of inquiry behavior,(Wu et al., 2008), at the same time, in the study of accepting community tourism models, output quality is also used as one of the independent variables(Noor et al., 2005). Especially in this technological innovation. Meanwhile, Output quality will affect Performance expectancy. As the technology adopted by the government, people pay more attention to what they can get from the software.

H5:

The output quality of Mobile phone positioning technology is positively related to usefulness.

H6:

The output quality of Mobile phone positioning technology is positively related to perceived ease of use.

H7:

The output quality of Mobile phone positioning technology is positively related to performance expectancy.

Performance expectancy (PE)

Performance expectancy (PE) is the degree to which an individual believes that using a system will help him or her to attain gains in job performance. This measures how much people realize that a system such as the Internet or a mobile technology is useful in carrying out their tasks in day-to-day work.(Venkatesh et al., 2003) In developing

countries, the process of dealing with organizations and receiving services in a traditional face to face manner is time consuming. (Sepasgozar et al., 2019) Many of the previous research have established positive association between PE and BI in variety of contexts, such as mobile payment(Oliveira et al., 2016). Performance expectancy has implications for the use of mobile data positioning. This is simply because MDP provides better solutions than before, and MDP can also enhance their working ability. Moreover, they are likely to be interested of the comparison about MDP and traditional methods especially on statistics.

H8:

The performance expectancy of Mobile phone positioning technology is positively related to perceived usefulness.

H9:

The performance expectancy of Mobile phone positioning technology is positively related to performance expectancy.

Perceived Security (PS)

Perceived security often uses in online shopping, in order to increase the online users' confidence in the security of their data.(Mekovec and Hutinski, 2012) Research suggests that users in developing countries have a strong desire to feel secure when using a new technology.(Rahman et al., 2017) In this case, users also want to have a high degree of confidence in the security of the technology before accepting it.(Sepasgozar et al., 2019) MDP technology using Passive Mobile Positioning to trach the location coordinates of mobile phones, it requires close cooperation with local mobile phone operators. Passive mobile positioning is data which is automatically stored in memory or log files of mobile operators.(Ahas et al., 2010) As the most credible department, the government needs the government to believe in the safety of technology so that the people can accept the technology.

H10:

The perceived security of Mobile phone positioning technology is positively related to perceived usefulness.

H11:

The perceived security of Mobile phone positioning technology is positively related to performance expectancy.

Perceived usefulness (PU)

PU is defined as the "degree to which a person trusts that using a specific system would improve their job performance"(Davis and Venkatesh, 1996) TAM2 also theorizes that people employ a mental representation for assessing the match between important task goals and the resultant consequences as a basis for forming judgements about the user-performance contingency.(V. Venkatesh and Davis, 2000)

H12:

Perceived usefulness is positively related to attitude toward using mobile data positioning technology.

Perceived ease of use (PEOU)

Defined as the "degree to which a person thinks that using a specific system would be effort-free"(Davis and Venkatesh, 1996) Much previous research has established that perceived ease of use is an important factor influencing user acceptance and usage behavior of information technologies.(Venkatesh, 2000)

H13:

Perceived ease of use is positively related to the attitude toward using of mobile data positioning technology.

H14:

Perceived ease of use is positively related to the perceived usefulness of mobile data positioning technology.

3. Method

Questionnaire

The validity and reliability of a questionnaire in the quantitative study have its own importance. Therefore, to ensure the reliability and validity of the questionnaire, every construct is supported with the measurement items which were selected from appropriate literature.(Rafique et al., 2020) However, due to geographical factors, the particularity of Chinese government departments, and the current status of the new coronaviruses in the world, two investigation methods were used in this study. Because MDP is mainly used for transportation, tourism, and demographic statistics, we took a telephone questionnaire survey to call different government departments to collect data. At the same time, a mobile phone questionnaire survey was also conducted with the local statistical bureau. It should be emphasized here that the questions in the questionnaire are the same, whether it is a telephone questionnaire or a mobile questionnaire.(Questions are presented in Appendix A.)Since some local civil servants require anonymity, only national government departments are listed here, and local government departments are not disclosed in the paper. At the same time, due to different languages, I translated English into Chinese as much as possible and translated the questionnaire questions. In Table2, the interview organizations, departments, and the number and time and date of interviews in each department are listed.

Table 2 Study sample and interviews

Institution	Department	Number of People	Duration	Interview time
Ministry of Culture and Tourism of The People's Republic of China	Industry Development Division	2	Avg 14mins	23.04.2020
Ministry of Culture and Tourism of The		2	17mins	23.04.2020

People's Republic of China	Public service department			
Ministry of Culture and Tourism of The People's Republic of China	Market Management Division	2	Avg 15mins	23.04.2020
National Bureau of Statistics	-	3	Avg 15mins	27.04.2020
China Tourism Academy	-	2	Avg 17mins	28.04.2020
Ministry of Transport of the People's Republic of China	-	2	Avg 13mins	30.04.2020
Local government agencies.	-	54	Avg 7mins	Gathering questionnaire until 30.04.2020

In the end, 13 telephone questionnaires from relevant national institutions and 54 mobile phone questionnaires were harvested. In the telephone questionnaire, it will explain what MDP is, how it works, and the resources needed. Usually everyone would quickly understand and start answering questions. In the mobile questionnaire, there are detailed explanations to facilitate understanding.

At the same time, in order to facilitate the quantitative questionnaire, the question will be 0, completely disagree, 1, disagree, 2, somewhat disagree, 3, some agree, 4, a largely part agree, 5, fully agree to digitize the questionnaire answer.

In this study, data statistics and analysis comprehensively used structural equation models, using partial least squares (PLS), and selected SmartPLS3.0 software as a data analysis tool for descriptive statistics, reliability testing, and a series of work, etc. As a validity test, model fitting test and research hypothesis verification, so as to verify the hypothesis of this study.

Structural Equation Modeling (SEM) is developed based on the statistical theory proposed in the 1970s. Comprehensive utilization and improvement of statistical methods. It has been widely used in research fields such as psychology, sociology, economics, and education.

PLS is a data processing method popular among scholars in recent years. Using it to construct structural equations to process data has many advantages: First, PLS can minimize the residual differences of endogenous variables and clarify multiple Complex relationships between variables. Second, compared with the maximum likelihood method based on covariance, the data to be processed is normally distributed. PLS has no strict requirements for data distribution, so its application range is wider. Third, PLS can be used for complex model testing, and is more suitable for the case where there are multiple core variables in the structural model, and the sample size is not high. Therefore, this study chose to use PLS to establish a structural equation model for empirical verification.

SmartPLS3.0 software is the latest software in the SmartPLS series, and is currently the most widely used software for solving structural square product models with PLS, and its estimation accuracy and stability are relatively higher than other algorithms, and the SmartPLS3.0 software application interface is simple The operation steps are simple and the data processing speed is fast. Because of its obvious advantages, the software has been used by many scholars to process and analyze data in recent years. Therefore, this study uses the above methods and tools to do empirical research, making the empirical research results more accurate and credible.

4.Data analysis

After collecting the data, the next step is to process the data. The first step is to determine whether the data meets the statistical requirements.

Error! Reference source not found. is the descriptive statistics of each item. The average value of each variable is between 1.912-2.618. It can be preliminarily interpreted that the respondents' knowledge and recognition of MDP technology is low; The data is required to conform to a normal distribution or approximate normal distribution. According to scholar Kline: when the absolute value of the skewness of the sample data is less than 3 and the absolute value of the kurtosis is less than 10, the sample basically follows the normal distribution. It can be seen from the table below that the maximum absolute value of the skewness of each variable is 0.765, and the maximum absolute value of the kurtosis is 0.996, both of which are within the range of critical values. Corresponding statistical methods can be used for further data analysis.

Table 3 Descriptive statistics

Items	M	SD	Kurtosis	Skewness
PE1	2.000	0.857	0.789	0.716
PE2	2.132	0.784	0.500	0.694
PE3	1.912	0.762	0.722	0.765
H1	2.397	0.910	-0.775	0.074
H2	2.618	1.099	-0.480	0.340
T1	2.338	0.885	0.073	0.312
T2	2.221	0.905	0.014	0.394
T3	2.191	0.845	-0.367	0.367
T4	2.088	1.039	-0.718	0.462
PU1	2.191	0.974	-0.284	0.480
PU2	2.353	0.982	0.098	0.566
PU3	2.441	1.049	-0.860	0.120
PU4	2.162	0.917	-0.684	0.369
OQ1	2.456	0.914	-0.221	0.133
OQ2	2.515	1.157	-0.209	0.342
OQ3	2.353	1.026	0.172	0.575
PEOU1	2.132	0.999	-0.876	0.452
PEOU2	2.294	0.956	-0.996	0.094
PEOU3	2.309	0.959	-0.316	0.360
PS1	2.044	1.091	-0.609	0.676

PS2	2.250	0.991	-0.346	0.493

Factor loadings

According to statistics-related knowledge, regarding the factor load (FL), its evaluation standard value is generally required to be greater than 0.50, and ideally required to be 0.7 or more. It can be seen from Table 4 that the factor load (FL) value of each item in the formal questionnaire of this study is between -1.00 and +1.00, and all are higher than 0.7, indicating that the effect of measuring the convergence of each facet is good.

Table 4 The factor load of each item on its related construct.

Items	**Measure**	**Loading**
PE1	I think MDP technology can make my job easier	0.863
PE2	I think MDP technology can get better analysis results	0.911
PE3	I think using MDP can improve my work efficiency	0.909
PU1	I think MDP can provide valuable services	0.945
PU2	I think MDP can simplify my workflow	0.936
PU3	Using MDP can make me more confident in my job	0.916
PU4	Using MDP allows me to better understand the data	0.909
H1	I think the statistical method of MDP is better than the traditional statistical method	0.888
H2	I think MDP can completely replace traditional statistical methods	0.750
T1	I can believe the statistical results of MDP	0.879
T2	I can believe the statistical method of MDP	0.907
T3	I believe the MDP data is guaranteed	0.837
T4	I believe MDP's analysis process is trustworthy	0.819
OQ1	MDP analysis results are guaranteed quality	0.873
OQ2	The quality of MDP analysis is consistent	0.866
OQ3	MDP analysis is accurate	0.807
PEOU1	Reading the MDP analysis report should be simple for me	0.887
PEOU2	MDP analysis results will be more acceptable than traditional results	0.819
PEOU3	The analysis report using MDP is simple for me	0.874
PS1	I think MDP complies with all relevant laws	0.905

PS2	I think MDP is safe	0.900

Cronbach's Alpha*、*CR and AVE

Table 5 Results of the three criteria of Cronbach's alpha, AVE and CR for all constructs

Construct	Cronbach's Alpha	CR	AVE
PE	0.877	0.923	0.800
PU	0.883	0.920	0.741
H	0.870	0.939	0.885
T	0.890	0.924	0.754
OQ	0.807	0.886	0.722
PEOU	0.824	0.895	0.740
PS	0.773	0.898	0.815

The Cronbach's Alpha coefficients of all measurement facets in this study are greater than 0.7, indicating that the data investigated in this study is reliable and has reached a good level of reliability. The combined reliability (CR) of each facet in this study has reached more than 0.8, exceeding the critical value of 0.7, indicating that the measurement variables of the data are highly correlated, that is, the degree of isomorphism between each facet index is high, And the extraction variation (AVE) of each facet is 0.722-0.885. The criterion for this value is that the value is greater than 0.50. The larger the value, the greater the percentage of the variables measured by the model explained by the latent variables. Therefore, combining the results of the above two measurement indicators, it can be concluded that the data of each facet of this survey questionnaire has good reliability and convergence validity.

Discriminant validity

Discriminate validity is the degree to which the measures of different concepts are distinct. Discriminate validity can be examined by comparing the squared correlations between constructs and variance extracted for a construct. (Zhu et al., 2012)Mainly by testing the size of the AVE value of the latent variable and comparing the correlation coefficient of the square root of the AVE of the latent variable and other latent variables.

That is, when the square root of the average variance extraction (AVE) is greater than the correlation coefficient with other factor variables, it indicates that the measured data has good discriminant validity. This study uses the PLS algorithm in SmartPLS software to calculate the AVE square root of the measured data and the factor correlation coefficient values shown in Table 5. It can be seen from the table that the square root of the AVE of each facet in this study is greater than the correlation coefficient between the latent variable and other variables, so the measurement model has good discriminant validity.

Table 6 Discriminant validity based on Fornell-Larcker criteria

Construct	H	OQ	PE	PEOU	PS	PU	T
H	(0.941)						
OQ	0.698	(0.849)					
PE	0.559	0.635	(0.895)				
PEOU	0.751	0.762	0.687	(0.86)			
PS	0.723	0.723	0.647	0.797	(0.903)		
PU	0.759	0.749	0.741	0.832	0.808	(0.861)	
T	0.700	0.777	0.697	0.728	0.715	0.775	(0.869)

NB: The internal value of () is the square root of AVE

5. Result and Conclusion

There is very limited research on Mobile data positioning technology acceptance, so in this study, the acceptance of MDP technology in the Chinese government. After analyzing the collected data with good statistical characteristics, a path test was conducted to determine whether our previous hypothesis test was true.

Statistical hypothesis testing

Table 7 Results of the tested hypotheses including path coefficient, significance index and explained variance

Hs	Path relationship	Std beta	Standardized path coefficient（β）	Path significance index (t-value)	P-level	Decision	f^2	R^2	VIF

H1	H -> PU	0.106	0.166	1.571	0.116	Not Supported	0.052	0.028	2.795
H2	H -> PEOU	0.105	0.245	2.33	0.020	Supported	0.100	0.060	2.433
H3	T -> PU	0.105	0.139	1.327	0.185	Not Supported	0.029	0.019	3.417
H4	OQ -> PU	0.097	0.036	0.373	0.709	Not Supported	0.002	0.001	3.321
H5	OQ -> PEOU	0.118	0.233	1.977	0.048	Supported	0.084	0.054	2.622
H6	OQ -> PE	0.068	0.635	9.371	0.000	Supported	0.675	0.403	1.000
H7	PE -> PU	0.089	0.207	2.343	0.019	Supported	0.043	0.043	2.290
H8	PE -> PEOU	0.092	0.189	2.061	0.039	Supported	0.098	0.036	1.921
H9	PEOU -> PU	0.126	0.26	2.062	0.039	Supported	0.087	0.068	4.057
H10	PS -> PEOU	0.125	0.329	2.626	0.009	Supported	0.153	0.108	2.857
H11	PS -> PU	0.099	0.221	2.238	0.025	Supported	0.076	0.049	2.241
H12	PU -> Attitude	0.148	0.316	2.143	0.032	Supported	0.062	0.100	3.243
H13	PEOU -> Attitude	0.145	0.42	2.901	0.004	Supported	0.109	0.176	3.243

The results of the model test are shown in the above table. From the table, it can be found that the H-to-PU standardized path coefficient is 0.166 (t = 1.571, P = 0.116> 0.05), indicating that H does not have a significant impact on the PU; In previous research, habits have a positive effect on the Institute(Taherdoost, 2018). But by analyzing the research results, it can be seen that habits have no effect on the final result. This is because there are few sample data, on the other hand, because the interviewees are all grassroots staff.

H has a PEOU standardized path The coefficient is 0.245 (t = 2.33, P = 0.020 <0.05), indicating that H has a significant positive effect on PEOU; In the results of habit on received ease of use, Habit has a significant impact. This shows that in the received ease of use, the user's habits should be fully considered.

T has a standardized path coefficient of 0.139 for PU (t = 1.327, P = 0.185> 0.05), indicating that T has a significant impact on PU No significant effect; Trust ’s research on perceived usefulness shows that Trust has no significant effect on perceived usefulness.

OQ on PU standardized path coefficient is 0.036 (t = 0.373, P = 0.709> 0.05), indicating that OQ has no significant effect on PU; the research results of output quality on perceived usefulness show that output quality has no significant effect on perceived usefulness.

OQ on PEOU standardized path coefficient is 0.233 (t = 1.977, P = 0.048 <0.05), indicating that OQ has a significant positive effect on PEOU; the output quality of PEOU research results show that OQ has significant support for PEOU, which can indicate that for MDP technology, OQ should be strengthened.

The standardized path coefficient of OQ on PE is 0.635 (t = 9.371, P = 0.000 <0.05), indicating that OQ has a significant positive effect on PE; For the PE factor, OQ showed support in the results. Therefore, people generally have high expectations for OQ. Related companies should focus on demonstrating the OQ of their products.

PE The PU normalized path coefficient is 0.207 (t = 2.343, P = 0.019 <0.05), indicating that PE has a significant positive effect on PU; PE is also a supporting factor for PU. In government departments, people want more practical tools.

The standardized path coefficient of PE to PEOU is 0.189 (t = 2.061, P = 0.039 <0.05), indicating that PE has a significant positive effect on PEOU; At the same time, PE also presented the results of support to PEOU. This is also reasonable.

The standardized path coefficient of PEOU to PU is 0.260 (t = 2.062, P = 0.039 <0.05), Indicating that PEOU has a significant positive effect on PU; This result supports most of the research, and once again validates TAM's model theory.(Raynard, 2017)

PS has a standardized path coefficient of 0.221 for PU (t = 2.238, P = 0.025 <0.05), indicating that PS has a significant positive effect on PU; For government departments or

large enterprises, system security is an indispensable consideration. It was also verified in the results.

PS has a standardized path coefficient for PEOU 0.329 ($t = 2.626$, $P = 0.009 < 0.05$), indicating that PS has a significant positive effect on PEOU; At the same time, PS's support for PEOU further proves this point.

PU has a standardized path coefficient of 0.316 for Attitude ($t = 2.143$, $P = 0.032 < 0.05$), indicating that PU has an impact on Attitude Significant positive effect; PU's support for the final result of the Attitude is also validated by previous research(Rahman et al., 2017).

PEOU's standardized path coefficient for Attitude is 0.420 ($t = 2.901$, $P = 0.004 < 0.05$), indicating that PEOU has a significant positive effect on Attitude; PEOU's support for the final results of the Institute also confirms the previous research(Isaac et al., 2019).

Therefore, except for H1, H3, and H4, the rest of the assumptions are supported And from the perspective of the fitting effect of the model, each path f2 has a range of 0.002-0.675, R^2 has a range of 0.001-0.403, and R^2 of endogenous variables PE, PU, PEOU, and PS are 0.403, 0.809, 0.753, and 0.498, respectively. Explain that the model's interpretation of endogenous variables is acceptable. And from the collinearity test, the VIF value is between 1.000-4.057, which is less than 5, indicating that there is no serious collinearity between the variables of the model, and again that the fitting effect of the model is acceptable. The final structural model of this study is as follows:

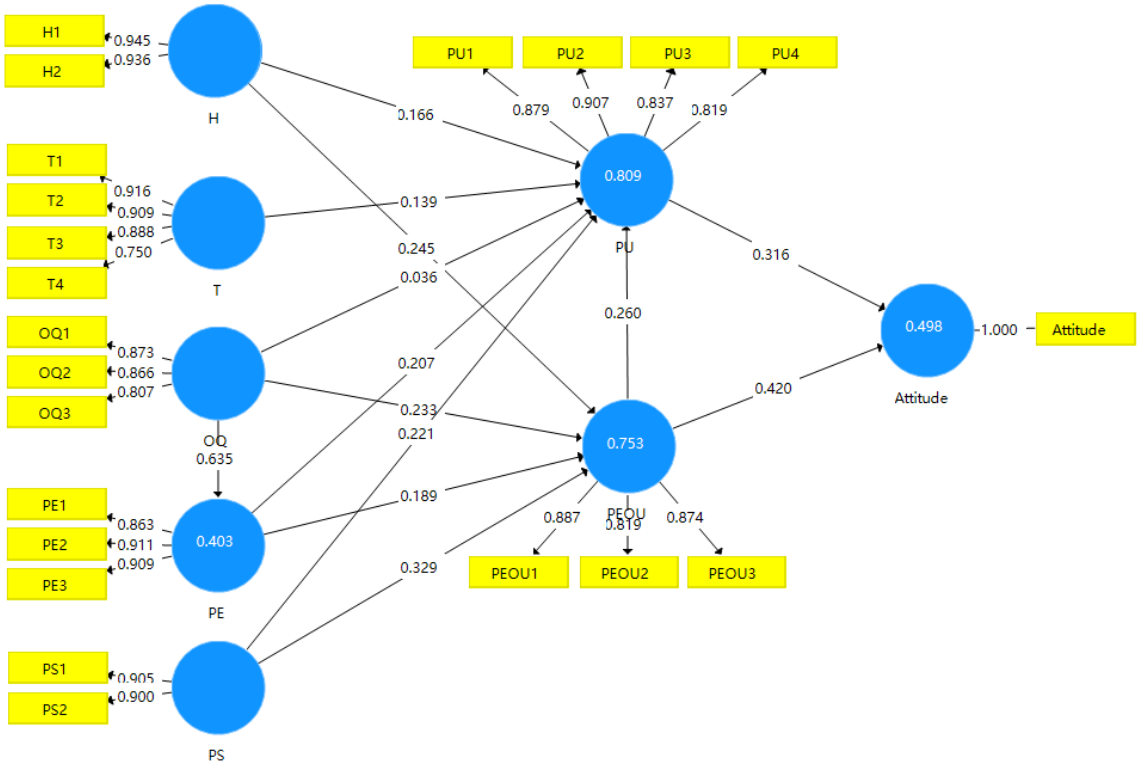

Figure 6 Results of the analysis.

This study aims to investigate the determinants of willingness to use Mobile data positioning technology in Chinese government agencies. In this research model, we can initially judge the government's attitude and interest in adopting MDP technology. The research results provide preliminary evidence for answering research questions and sub-research questions. The intention to use mobile data positioning is affected by specific factors. It can be seen from the table that most of the hypotheses passed the hypothesis test, but the assumptions of habits, institution Trust, and output quality for perceived usefulness were rejected. It can be seen that habits, trust and output quality are not the decisive factors for the received usefulness. This is also related to the sample size. At the same time, PU and PEOU have a significant impact on Attitude,

In this study, both PU and PEOU have a significant influence on attitudes. Among the external variables, PE and PS support the attitude. For enterprises, in order to obtain support, it is necessary to promote the product's Performance expectancy and Perceived Security. And they are very important for the entire model, which also validates the TAM model and previous research.(Hussein, 2017) (Vahdat et al., 2020) This study explores the use of MDP technology by

the Chinese government in tourism, transportation, and demographics. However, due to time and the impact of the epidemic, the data collected is very limited, but the results can initially reflect the positive attitude of the Chinese government. However, factors such as China's national conditions must also be considered. Today, all governments in the world are aware of the importance of reform and innovation. As a developing country, China still has a certain gap from developed countries. The Chinese government has also taken a positive attitude towards new technologies in recent years. However, for a government, especially for a country as large as China, the functional departments should not only consider the convenience brought by technology, but more about the entire national security system.

This study also provides meaningful insights for LBS statistics related agencies. For example, the Estonian company Positium. This research initially shows the attitude of developing countries to new technologies, which has fully researched the related technology companies to open the Asian market. How to display related technologies and gain the trust of government agencies is the most important issue. Because governments in developing countries are usually more conservative. However, driven by big data technology, more and more people are aware of the benefits behind big data.

At the same time, for data analysis and research companies similar to Positium, how to communicate with the government and reach cooperation is also a challenge. As the results of this study, not all hypotheses can pass the test. On the one hand, the sample data is small, on the other hand, it can also reflect that the government functional departments are not interested in new products. For example, habit, trust, and output quality. In the enterprise's research on a market, it is necessary to fully display the products so that the audience can better understand what benefits the products can bring. Although the model reflects the Chinese government ’s interest in MDP technology in tourism, transportation, and demographics, most of the respondents are grassroots, not senior government officials, so the results are certain limitations. But it is not difficult to see that the Chinese government's attitude towards accepting new technology is positive, and it can also be inferred that their innovation and reform are positive. China's economy is developing rapidly, it is not difficult to see that the future government will be more technological and innovative. At the same time, as more young people join the government team, I believe that in the future, more advanced technologies such as MDP will become more popular in the Chinese market.

Limitations and further research

Since the world has been in an emergency during the past few months, especially China, this has affected the data collection and quality of collection to a certain extent. Normally, government employees do not spend much time to understand this technology, although I try to explain the MDP technology in both the telephone questionnaire and the mobile questionnaire. This will result in the respondents' understanding of MDP technology being one-sided and incomplete. In future research, video interviews and other methods can be used to allow respondents to fully understand the new technology. At the same time, due to time constraints, the sample of the survey is limited, and some government personnel are not willing to participate in the survey. So in the results, we can see that some hypotheses have not passed the hypothesis test, which is contrary to the previous research. In future research, more samples can be selected to make the results more reliable.

Appendix A.

Questionnaire questions

Items	Question
PE1	I think MDP technology can make my job easier
PE2	I think MDP technology can get better analysis results
PE3	I think using MDP can improve my work efficiency
PU1	I think MDP can provide valuable services
PU2	I think MDP can simplify my workflow
PU3	Using MDP can make me more confident in my job
PU4	Using MDP allows me to better understand the data
H1	I think the statistical method of MDP is better than the traditional statistical method
H2	I think MDP can completely replace traditional statistical methods
T1	I can believe the statistical results of MDP
T2	I can believe the statistical method of MDP
T3	I believe the MDP data is guaranteed
T4	I believe MDP's analysis process is trustworthy
OQ1	MDP analysis results are guaranteed quality
OQ2	The quality of MDP analysis is consistent
OQ3	MDP analysis is accurate
PEOU1	Reading the MDP analysis report should be simple for me
PEOU2	MDP analysis results will be more acceptable than traditional results
PEOU3	The analysis report using MDP is simple for me
PS1	I think MDP complies with all relevant laws
PS2	I think MDP is safe

Reference

Ahas, R., Silm, S., Järv, O., Saluveer, E., Tiru, M., 2010. Using Mobile Positioning Data to Model Locations Meaningful to Users of Mobile Phones. J. Urban Technol. 17, 3–27. https://doi.org/10.1080/10630731003597306

Breuer, J., Buchinger, U., Ranaivoson, H., Ballon, P., 2015. Control & Value Trade-Offs in Handling User-Data: The Example of Location-Based-Services, in: Obaidat, M.S., Holzinger, A., Filipe, J. (Eds.), E-Business and Telecommunications, Communications in Computer and Information Science. Springer International Publishing, Cham, pp. 96–111. https://doi.org/10.1007/978-3-319-25915-4_6

Cell phone sales worldwide 2007-2020 [WWW Document], n.d. . Statista. URL https://www.statista.com/statistics/263437/global-smartphone-sales-to-end-users-since-2007/ (accessed 3.5.20).

Chen, C.-F., Chao, W.-H., 2011. Habitual or reasoned? Using the theory of planned behavior, technology acceptance model, and habit to examine switching intentions toward public transit. Transp. Res. Part F Traffic Psychol. Behav. 14, 128–137. https://doi.org/10.1016/j.trf.2010.11.006

Clarke, R.N., 2014. Expanding mobile wireless capacity: The challenges presented by technology and economics. Telecommun. Policy, Special issue on Moving Forward with Future Technologies: Opening a Platform for All 38, 693–708. https://doi.org/10.1016/j.telpol.2013.11.006

Corser, G., Fu, H., Shu, T., D'Errico, P., Ma, W., 2013. Endpoint protection zone (EPZ): Protecting LBS user location privacy against deanonymization and collusion in vehicular networks, in: 2013 International Conference on Connected Vehicles and Expo (ICCVE). Presented at the 2013 International Conference on Connected Vehicles and Expo (ICCVE), pp. 369–374. https://doi.org/10.1109/ICCVE.2013.6799822

Czakon, W., Niemand, T., Gast, J., Kraus, S., Frühstück, L., 2020. Designing coopetition for radical innovation: An experimental study of managers' preferences for developing self-driving electric cars. Technol. Forecast. Soc. Change 155, 119992. https://doi.org/10.1016/j.techfore.2020.119992

Davis, F.D., 1989. Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. MIS Q. 13, 319–340. https://doi.org/10.2307/249008

Davis, F.D., Venkatesh, V., 1996. A critical assessment of potential measurement biases in the technology acceptance model: three experiments. Int. J. Hum.-Comput. Stud. 45, 19–45. https://doi.org/10.1006/ijhc.1996.0040

Dutot, V., Bhatiasevi, V., Bellallahom, N., 2019. Applying the technology acceptance model in a three-countries study of smartwatch adoption. J. High Technol. Manag. Res. 30, 1–14. https://doi.org/10.1016/j.hitech.2019.02.001

Estriegana, R., Medina-Merodio, J.-A., Barchino, R., 2019. Student acceptance of virtual laboratory and practical work: An extension of the technology acceptance model. Comput. Educ. 135, 1–14. https://doi.org/10.1016/j.compedu.2019.02.010

Gao, Z., Cui, X., Du, B., Zhou, S., Yuan, C., Li, A., 2019. Collection scheme of location data based on local differential privacy. Qinghua Daxue XuebaoJournal Tsinghua Univ. 59, 23–27. https://doi.org/10.16511/j.cnki.qhdxxb.2018.22.058

Gefen, D., 2003. TAM or Just Plain Habit: A Look at Experienced Online Shoppers [WWW Document]. J. Organ. End User Comput. JOEUC. URL www.igi-global.com/article/tam-just-plain-habit/3769 (accessed 5.5.20).

GSMA [WWW Document], n.d. . GSMA. URL https://www.gsma.com/ (accessed 4.8.20).

Hubert, M., Blut, M., Brock, C., Backhaus, C., Eberhardt, T., 2017. Acceptance of Smartphone-Based Mobile Shopping: Mobile Benefits, Customer Characteristics, Perceived Risks, and the Impact of Application Context. Psychol. Mark. 34, 175–194. https://doi.org/10.1002/mar.20982

Hussein, Z., 2017. Leading to Intention: The Role of Attitude in Relation to Technology Acceptance Model in E-Learning. Procedia Comput. Sci., 2016 IEEE International Symposium on Robotics and Intelligent Sensors, IRIS 2016, 17-20 December 2016, Tokyo, Japan 105, 159–164. https://doi.org/10.1016/j.procs.2017.01.196

Isaac, O., Abdullah, Z., Aldholay, A.H., Abdulbaqi Ameen, A., 2019. Antecedents and outcomes of internet usage within organisations in Yemen: An extension of the Unified Theory of Acceptance and Use of Technology (UTAUT) model. Asia Pac. Manag. Rev. 24, 335–354. https://doi.org/10.1016/j.apmrv.2018.12.003

Kamal, S.A., Shafiq, M., Kakria, P., 2020. Investigating acceptance of telemedicine services through an extended technology acceptance model (TAM). Technol. Soc. 60, 101212. https://doi.org/10.1016/j.techsoc.2019.101212

Kim, M.J., Hall, C.M., 2020. What drives visitor economy crowdfunding? The effect of digital storytelling on unified theory of acceptance and use of technology. Tour. Manag. Perspect. 34, 100638. https://doi.org/10.1016/j.tmp.2020.100638

Krumm, J.C., Cermak, G.F., Horvitz, E.J., Miller, E.C., Youssef, A.A.A., 2007. Utilization of the approximate location of a device determined from ambient signals. US7202816B2.

Lee, J., Kim, H.J., Ahn, M.J., 2011. The willingness of e-Government service adoption by business users: The role of offline service quality and trust in technology. Gov. Inf. Q. 28, 222–230. https://doi.org/10.1016/j.giq.2010.07.007

Liu-Thompkins, Y., Tam, L., 2013. Not All Repeat Customers Are the Same: Designing Effective Cross-Selling Promotion on the Basis of Attitudinal Loyalty and Habit. J. Mark. 77, 21–36. https://doi.org/10.1509/jm.11.0508

Mascetti, S., Bettini, C., Freni, D., Wang, X.S., 2007. Spatial generalisation algorithms for LBS privacy preservation. J. Locat. Based Serv. 1, 179–207. https://doi.org/10.1080/17489720801941789

Meddour, D.-E., Rasheed, T., Gourhant, Y., 2011. On the role of infrastructure sharing for mobile network operators in emerging markets. Comput. Netw., Recent Advances in Network Convergence 55, 1576–1591. https://doi.org/10.1016/j.comnet.2011.01.023

Mekovec, R., Hutinski, Ž., 2012. The role of perceived privacy and perceived security in online market, in: 2012 Proceedings of the 35th International Convention MIPRO. Presented at the 2012 Proceedings of the 35th International Convention MIPRO, pp. 1549–1554.

Mendelson, E., 2014. System and method for providing indoor navigation and special local base service application for malls stores shopping centers and buildings utilize RF beacons. US8866673B2.

Noor, N.L., Hashim, M., Haron, H., Aiffin, S., 2005. Community Acceptance of Knowledge Sharing System in the Travel and Tourism Websites: An Application of an Extension of TAM. ECIS 2005 Proc.

Notani, A.S., 1998. Moderators of Perceived Behavioral Control's Predictiveness in the Theory of Planned Behavior: A Meta-Analysis. J. Consum. Psychol. 7, 247–271. https://doi.org/10.1207/s15327663jcp0703_02

Oliveira, T., Thomas, M., Baptista, G., Campos, F., 2016. Mobile payment: Understanding the determinants of customer adoption and intention to recommend the technology. Comput. Hum. Behav. 61, 404–414. https://doi.org/10.1016/j.chb.2016.03.030

Osterholm, J., n.d. How Mobile Location-Based Data Improves Consumer Experience With Recommended Reward Apps To Try 3.

Ouellette, J.A., Wood, W., 1998. Habit and intention in everyday life: The multiple processes by which past behavior predicts future behavior. Psychol. Bull. 124, 54–74. https://doi.org/10.1037/0033-2909.124.1.54

Park, N.Y., 2020. Trust and trusting behavior in financial institutions: Evidence from South Korea. Int. Rev. Econ. Finance 67, 408–419. https://doi.org/10.1016/j.iref.2020.02.007

Perusco, L., Michael, K., 2005. Humancentric applications of precise location based services, in: IEEE International Conference on E-Business Engineering (ICEBE'05). Presented at the IEEE International Conference on e-Business Engineering (ICEBE'05), pp. 409–418. https://doi.org/10.1109/ICEBE.2005.71

Pingley, A., Yu, W., Zhang, N., Fu, X., Zhao, W., 2009. CAP: A Context-Aware Privacy Protection System for Location-Based Services, in: 2009 29th IEEE International Conference on Distributed Computing Systems. Presented at the 2009 29th IEEE International Conference on Distributed Computing Systems, pp. 49–57. https://doi.org/10.1109/ICDCS.2009.62

Rafique, H., Almagrabi, A.O., Shamim, A., Anwar, F., Bashir, A.K., 2020. Investigating the Acceptance of Mobile Library Applications with an Extended Technology Acceptance Model (TAM). Comput. Educ. 145, 103732. https://doi.org/10.1016/j.compedu.2019.103732

Ragia, L., Deriaz, M., n.d. Location Based Services for Traffic Management 10.

Rahman, S.A., Taghizadeh, S.K., Ramayah, T., Alam, M.M.D., 2017. Technology acceptance among micro-entrepreneurs in marginalized social strata: The case of social innovation in Bangladesh. Technol. Forecast. Soc. Change 118, 236–245. https://doi.org/10.1016/j.techfore.2017.01.027

Raynard, M., 2017. Understanding Academic E-books Through the Diffusion of Innovations Theory as a Basis for Developing Effective Marketing and Educational Strategies. J. Acad. Librariansh. 43, 82–86. https://doi.org/10.1016/j.acalib.2016.08.011

Sadoun, B., Al-Bayari, O., 2007. LBS and GIS Technology Combination and Applications, in: 2007 IEEE/ACS International Conference on Computer Systems and Applications. Presented at the 2007 IEEE/ACS International Conference on Computer Systems and Applications, pp. 578–583. https://doi.org/10.1109/AICCSA.2007.370940

Saluveer, E., Raun, J., Tiru, M., Altin, L., Kroon, J., Snitsarenko, T., Aasa, A., Silm, S., 2020. Methodological framework for producing national tourism statistics from mobile positioning data. Ann. Tour. Res. 81, 102895. https://doi.org/10.1016/j.annals.2020.102895

Schiller, J., Voisard, A., 2004. Location-Based Services. Elsevier.

Sepasgozar, S.M.E., Hawken, S., Sargolzaei, S., Foroozanfa, M., 2019. Implementing citizen centric technology in developing smart cities: A model for predicting the acceptance of urban technologies. Technol. Forecast. Soc. Change, Understanding Smart Cities: Innovation ecosystems, technological advancements, and societal challenges 142, 105–116. https://doi.org/10.1016/j.techfore.2018.09.012

Shin, K.G., Ju, X., Chen, Z., Hu, X., 2012. Privacy protection for users of location-based services. IEEE Wirel. Commun. 19, 30–39. https://doi.org/10.1109/MWC.2012.6155874

Solutions [WWW Document], n.d. . Positium. URL https://positium.com/solutions (accessed 5.18.20).

SPINNEY, J.E., 2003. Mobile Positioning and LBS Applications. Geography 88, 256–265.

Strohmaier, D., Zeng, J., Hafeez, M., 2019. Trust, distrust, and crowdfunding: A study on perceptions of institutional mechanisms. Telemat. Inform. 43, 101252. https://doi.org/10.1016/j.tele.2019.101252

Sun, G., Liao, D., Li, H., Yu, H., Chang, V., 2017. L2P2: A location-label based approach for privacy preserving in LBS. Future Gener. Comput. Syst. 74, 375–384. https://doi.org/10.1016/j.future.2016.08.023

Surry, D.W., Surry, D., 1997. Diffusion Theory and Instructional Technology [WWW Document]. undefined. URL https://www.semanticscholar.org/paper/Diffusion-Theory-and-Instructional-Technology-Surry-Surry/2c66c1b5143588b026665a088c759f16fc81dfee (accessed 5.18.20).

Taherdoost, H., 2018. A review of technology acceptance and adoption models and theories. Procedia Manuf., 11th International Conference Interdisciplinarity in Engineering, INTER-ENG

2017, 5-6 October 2017, Tirgu Mures, Romania 22, 960–967. https://doi.org/10.1016/j.promfg.2018.03.137

Taiwo, A.A., Downe, A.G., 2005. THE THEORY OF USER ACCEPTANCE AND USE OF TECHNOLOGY (UTAUT): A META-ANALYTIC REVIEW OF EMPIRICAL FINDINGS. . Vol. 49, 11.

Vahdat, A., Alizadeh, A., Quach, S., Hamelin, N., 2020. Would you like to shop via mobile app technology? The technology acceptance model, social factors and purchase intention. Australas. Mark. J. AMJ. https://doi.org/10.1016/j.ausmj.2020.01.002

Venkatesh, Morris, Davis, Davis, 2003. User Acceptance of Information Technology: Toward a Unified View. MIS Q. 27, 425. https://doi.org/10.2307/30036540

Venkatesh, V., 2000. Determinants of Perceived Ease of Use: Integrating Control, Intrinsic Motivation, and Emotion into the Technology Acceptance Model. Inf. Syst. Res. 11, 342–365. https://doi.org/10.1287/isre.11.4.342.11872

Venkatesh, Viswanath, Davis, F.D., 2000. A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. Manag. Sci. 46, 186–204. https://doi.org/10.1287/mnsc.46.2.186.11926

Venkatesh, V., Davis, F.D., 2000. Theoretical extension of the Technology Acceptance Model: Four longitudinal field studies. Manag. Sci. 46, 186–204. https://doi.org/10.1287/mnsc.46.2.186.11926

Wang, H., Tao, D., Yu, N., Qu, X., 2020. Understanding consumer acceptance of healthcare wearable devices: An integrated model of UTAUT and TTF. Int. J. Med. Inf. 139, 104156. https://doi.org/10.1016/j.ijmedinf.2020.104156

Wang, W., 2015. Using Location-Based Social Media for Ranking Individual Familiarity with Places: A Case Study with Foursquare Check-in Data, in: Gartner, G., Huang, H. (Eds.), Progress in Location-Based Services 2014, Lecture Notes in Geoinformation and Cartography. Springer International Publishing, Cham, pp. 171–183. https://doi.org/10.1007/978-3-319-11879-6_12

Wang, Y., Dong, L., Liu, Ye, Huang, Z., Liu, Yu, 2019. Migration patterns in China extracted from mobile positioning data. Habitat Int. 86, 71–80. https://doi.org/10.1016/j.habitatint.2019.03.002

Wu, M.-Y., Chou, H.-P., Weng, Y.-C., Huang, Y.-H., 2008. A Study of Web 2.0 Website Usage Behavior Using TAM 2, in: 2008 IEEE Asia-Pacific Services Computing Conference. Presented at the 2008 IEEE Asia-Pacific Services Computing Conference, pp. 1477–1482. https://doi.org/10.1109/APSCC.2008.92

Wu, Y., Wang, L., Fan, L., Yang, M., Zhang, Y., Feng, Y., 2020. Comparison of the spatiotemporal mobility patterns among typical subgroups of the actual population with mobile phone data: A case study of Beijing. Cities 100, 102670. https://doi.org/10.1016/j.cities.2020.102670

Wu, Y., Zhang, W., Shen, J., Mo, Z., Peng, Y., 2018. Smart city with Chinese characteristics against the background of big data: Idea, action and risk. J. Clean. Prod., Sustainable urban transformations towards smarter, healthier cities: theories, agendas and pathways 173, 60–66. https://doi.org/10.1016/j.jclepro.2017.01.047

Xu, H., Gupta, S., 2009. The effects of privacy concerns and personal innovativeness on potential and experienced customers' adoption of location-based services. Electron. Mark. 19, 137–149. https://doi.org/10.1007/s12525-009-0012-4

Zhang, B., Yang, S., Bi, J., 2013. Enterprises' willingness to adopt/develop cleaner production technologies: an empirical study in Changshu, China. J. Clean. Prod., Special Volume: Sustainable consumption and production for Asia: Sustainability through green design and practice 40, 62–70. https://doi.org/10.1016/j.jclepro.2010.12.009

Zhang, Weili, Chong, Z., Li, X., Nie, G., 2020. Spatial patterns and determinant factors of population flow networks in China: Analysis on Tencent Location Big Data. Cities 99, 102640. https://doi.org/10.1016/j.cities.2020.102640

Zhang, Wei, Wang, M., Zhu, Y., 2020. Does government information release really matter in regulating contagion-evolution of negative emotion during public emergencies? From the perspective of cognitive big data analytics. Int. J. Inf. Manag. 50, 498–514. https://doi.org/10.1016/j.ijinfomgt.2019.04.001

Zhou, C., Su, F., Pei, T., Zhang, A., Du, Y., Luo, B., Cao, Z., Wang, J., Yuan, W., Zhu, Y., Song, C., Chen, J., Xu, J., Li, F., Ma, T., Jiang, L., Yan, F., Yi, J., Hu, Y., Liao, Y., Xiao, H., 2020. COVID-19: Challenges to GIS with Big Data. Geogr. Sustain. https://doi.org/10.1016/j.geosus.2020.03.005

Zhu, D.-S., Lin, T.C.-T., Hsu, Y.-C., 2012. Using the technology acceptance model to evaluate user attitude and intention of use for online games. Total Qual. Manag. Bus. Excell. 23, 965–980. https://doi.org/10.1080/14783363.2012.704269

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