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Business Process Analysis and Optimization on Road Traffic Law Enforcement of the Beijing Intelligent Traffic Management

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Abstract

With the increase of motor vehicle ownership and the traffic demand in Beijing, the road traffic management is becoming more important and complex. To build the intelligent traffic management system using the information technology is an effective measure to improve the traffic system ability and service level, and the road traffic law enforcement business is one of the key link. With IDEF method, this paper builds the business process model of Beijing road traffic law enforcement, carries out the business process diagnosis and analysis combined with the actual situation. The paper puts forward the optimization idea of Beijing road traffic law enforcement business process, and builds the optimized business procedural model, which provides reference to develop the traffic law enforcement business of the Beijing intelligent traffic management system.

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Keywords: Intelligent Traffic Management; Road Traffic Law Enforcement; IDEF Method; Business Process Analysis; Business Process Optimization

1 Introduction

Beijing road traffic system will face a serious situation in the future for a long time that motor vehicle ownership and traffic flow continue to grow rapidly while urban road infrastructure construction continues to accelerate and traffic management scope continues to expand. In road traffic management, we need to extend the technology coverage scope, integrate the system resource and improve the comprehensive benefit. Through technological innovation, application innovation and management innovation, we can build intelligent traffic management system, accelerate the process of realizing scientific and modern road traffic management in the capital city. Road traffic law

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enforcement business is one of the most important and critical urban traffic management business. Back in 2009, the total number of law enforcement events carried out by Beijing Traffic Management Bureau reached more than 8 million, which brought great pressure to the traffic police's work. The urban traffic management situation is becoming even more complex and severe now. We need not only to build a uniform basic information application platform alongside with traffic management business application systems (Cheng, 2009), but also to analyze the policing response, law enforcement, incident disposal, violations disposition information feedback and other various work of the business process. The road traffic management department takes advantage of information technology to make related data sharing and uses the data synthetically, improves the management efficiency. It enhances the efficiency and ability of road traffic law enforcement, strengthens the law enforcement supervision, and improves the law enforcement level.

2 Business Process Analysis on Beijing Road Traffic Law Enforcement

2.1 Summary of Major Business Functions of Beijing Road Traffic Law Enforcement Management

Road traffic law enforcement business mainly includes on-site and off-site law enforcement. Currently, Beijing traffic police law enforcement tasks are getting heavier and heavier, and the requirements of law enforcement standardization of traffic administration are getting higher and higher. Therefore, on-site rapid enforcement and on-site law enforcement digitalized documents are the important trends in traffic management information construction (Yu, 2013).

On-site law enforcement Digital business mainly includes traffic law penalty management functions, such as violation penalty to the local and nonlocal drivers, general procedure penalty, subsequent penalty of off-site law enforcement, and driver's scorecard management, training examination management, paying penalty management and so on.

Off-site law enforcement means the traffic administrative department records the people's traffic violations by specific technology to form a particular image and video data, it is one of the law enforcement ways to penalize the illegal party after the event. Off-site law enforcement system broadens scope and time range of traffic management (Jia, & Qian, 2011). Off-site law enforcement rely on the information collected and recorded by the equipment. Humanized management becomes the main focus in off-site law enforcement. It is important to make the standard evidence obtaining public, improve the informing system and discuss nonlocal payment mechanism. The function of Beijing traffic off-site law enforcement management system mainly includes violation information collection and management, batch data processing, data supplemental collection and auditing, data aggregation and download and local query statistics. Among them, illegal parking information is collected by documents and digital camera, illegal operation information such as red light running and speeding is collected by the road monitoring equipment.

2.2 Business Process Analysis on Beijing Road Traffic management based on IDEF method

IDEF method is used to describe the system function and the contact among them. It not only can describe a single activity, but also can reveal the relationship among activities by the concepts related to the activities. Beyond that, we can describe the system comprehensive using IDEF method, can distinguish the difference between function and reality clearly using functional model (Plaia, & Carrie, 1995). At present, this method has been applied to many practical problems, produced great influence and benefit on promoting the consistency of the communication and strengthening management. And it has been developed to series of technology (Shang, & Wang, 2004). This paper describes the relevant link of road traffic management business process with IDEF0 method first, then, it connects each link of the business process of Beijing road traffic law enforcement to process analysis and restructuring optimization with IDEF3 method. Now, Beijing road traffic law enforcement administration is one of the organs of Beijing Municipal Public Security Bureau, with detachments, brigades of each district and other different management layers.

2.2.1 Total Frame Model Figure

IDEFO model takes a top-down hierarchical method, analyse a complex process step by step to reduce the difficulty of analysis. According to the characteristics of the business process of road traffic management and the principle of IDEFO, the input, output, control and mechanism needed by the business process are described by graphical language. A top-level single graphics represents the whole process, so illustrative phrases in graph are abstract. Similarly, interface arrow represents external connector of the whole process. The first layer, also known as the A-0 level, is the overall frame work of the business process of road traffic management, the content is as follows:

Input: the road traffic information;

Output: traffic information classified by usage

Control: traffic management rules and regulations, system operation specification;

Mechanism: staff of traffic management, facilities and equipment

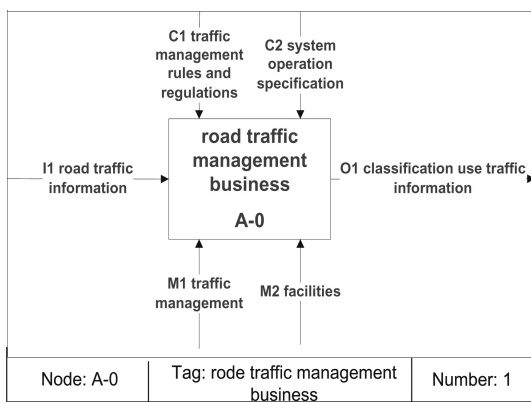


Fig.1. A-0: Road traffic management business IDEFO graphs (the first layer)

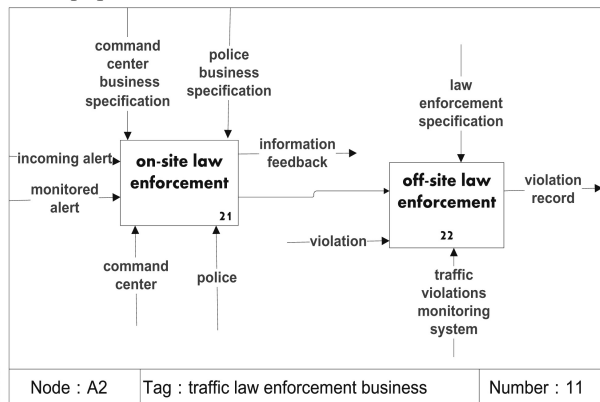


Fig.2. A2 Business process diagram of traffic law enforcement (the third layer)

The input, output, control and mechanism of the first layer are described as above. Then we decompose the A-0 layer into the second layer A0. In A0 layer, the whole business process is divided into traffic information release process and traffic law enforcement business process, which is the third layer. These two sub-processes can be represented as A1 and A2. This paper builds model of A2 and analyse the process detailed.

2.2.2 Business Process Model of Traffic Law Enforcement

As stated earlier, Beijing road traffic law enforcement operations include two modules at present: on-site law enforcement and off-site law enforcement.

2.2.2.1 Business Process Model of On-site Law Enforcement

On-site enforcement operations have two kinds of alarm information source: one is incoming alarm, the other is the system monitored alert. The business process of on-site law enforcement A21 is as shown in figure 3. The system records automatically when receiving incoming alarm. Then alarm office analyses, judges the alert and gives traffic police instruction to take action according to mobilizing police rules if the system

confirms the accuracy of the alarm. After traffic policeman’s on-site handling, the handling information needs to be reported to the traffic law enforcement centre. The centre assesses the disposal programs and uploads to information centre. The alerts what the system detected automatically mainly include fatal traffic events monitored by CCTV monitor system, traffic flow detection system, incident detection system and 122 alert in hot figure, emergency, road congestion and other important traffic events. A212 system took actions after monitoring alerts as shown in figure 4.

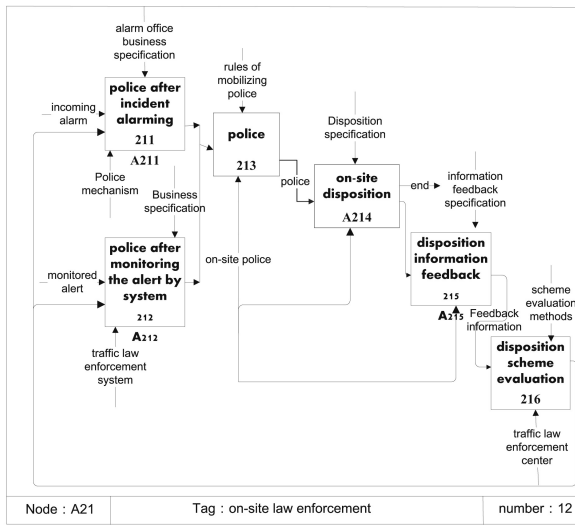


Fig.3. A21 Business sub-graph of on-site law (the fourth layer)

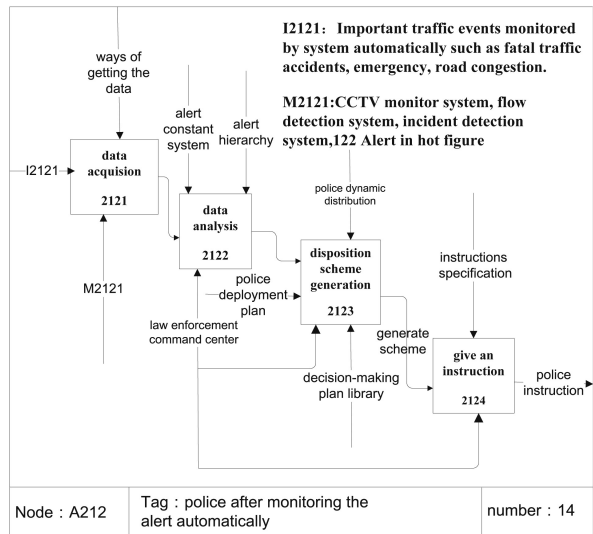


Fig.4. A212 Process diagram of policing enforcement automatically (the fifth layer)

There are two ways of delivery for paying fine when the traffic police are onsite: the first one, the parties pay fine by debit card using policeman’s wireless enforcement terminal such as POS equipment; the other one, the traffic police give the penalty tickets, the parties go to the law enforcement centre to accept the penalty. The process of on-site disposition is as shown in figure 5. After on-site disposition, the information will be uploaded to the law enforcement squadron, then the detachment, further the information centre. At the same time, the fine information will be uploaded to the law enforcement squadron by law enforcement station or bank after the fine is paid. The feedback process of disposition information A215 is as shown in figure 6.

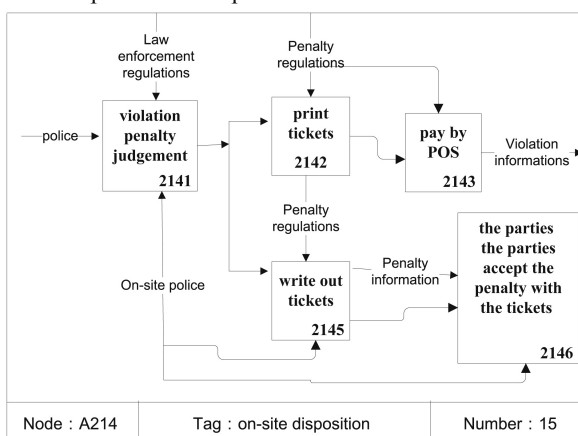


Fig.5. A214 Process diagram of on-site disposition (the fifth layer)

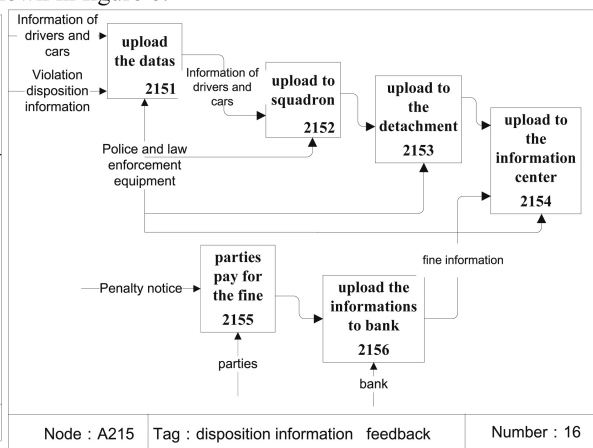


Fig.6. A215 Feedback process diagram of disposition information (the fifth layer)

2.2.2.2 Business Process Model of Off-site Law Enforcement

According to the description of the main functions of off-site law enforcement mentioned above, the business process model A22 is built as shown in figure 7. Off-site enforcement business mainly include three sub-processes: violations information acquisition and upload process named A221, information disposition process named A222 and violations disposition process named A223. Off-site enforcement system monitors related violations information through the road violations monitoring equipment. What they monitored mainly include: red light running, speeding, illegal use of bus lanes, the emergency lane, one-way street, driving without a license plate and other road traffic offence (He, King, & Watson, 2013). The detailed model of the sub-processes A222 is as shown in figure 8.

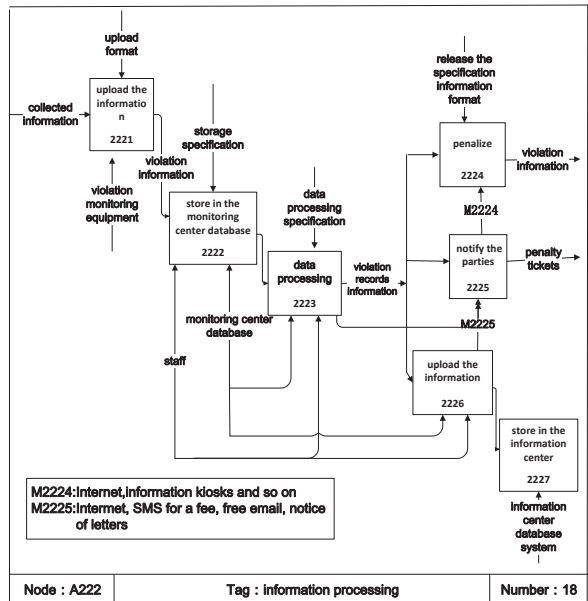
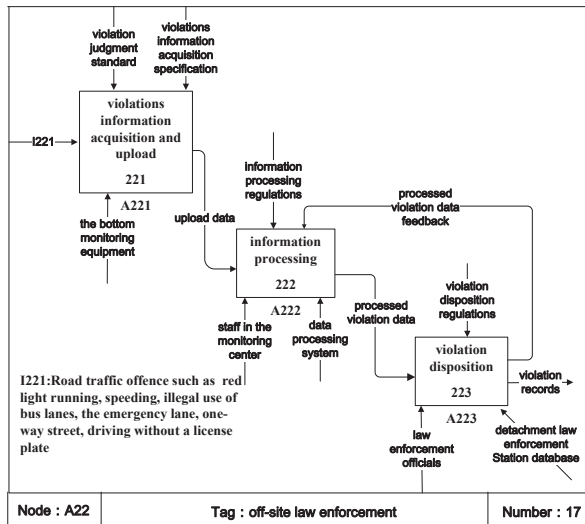


Fig.7. A22 Process diagram of off-site law enforcement (the fourth layer)

Fig.8. A222 Process diagram of data processing (the fifth layer)

Off-site law enforcement system uploads the related violation information and images to the monitoring centre automatically through the road violations monitoring equipment, and stores them in the monitoring central database. The data processing system analyses, compares, stores and records the violations, such as red light running and speeding automatically. The parties are informed of related disposition information through internet, telephone query and sending notice to the owner of vehicle termly. At the same time, the related disposition information is uploaded to the information centre to be convenient to invoke as the gist of law enforcement (Li, & Liu, 2003). The driver has the right of verifying the information in the traffic detachment law enforcement station, if the information is right, he should accept the penalty, or he can appeal to eliminate illegal record.

2.3 Business Process Analysis on Road Traffic Law Enforcement with IDEF3 method

2.3.1 Business Process Model IDEF3 of on-site Law Enforcement

The process of on-site law enforcement is: accident alarming→alarm receiving→policing→violations penalty decision→on-site penalty→uploading violations record, the process model is as shown in figure 9. On-site law enforcement also includes seizing violations on the spot. Using POS equipment on the spot and going to the law enforcement department to accept the penalty with the penalty tickets are the two ways of on-site penalty. The detailed description of node J1 is as shown in figure 10.

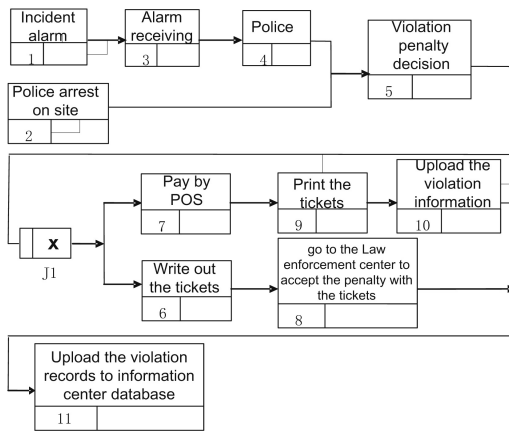


Fig.9. On-site law enforcement IDEF3

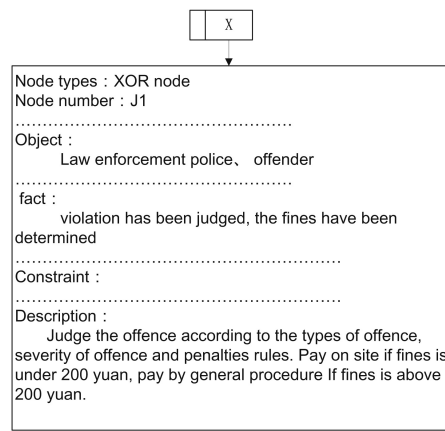


Fig.10. Detailed instructions to node J1

2.3.2 Business Process Model IDEF3 of off-site Law Enforcement

The information of off-site law enforcement is derived from the system or manual work. After recording and uploading the data, the business processing is: data processing → data review → data aggregation → generating the violation record information → violation information release → the driver get the notice → the driver accept the penalty or declare for reconsideration → upload information after accepting penalty, the process model is as shown in figure 11. There are two ways for the driver to get the penalty notice and to pay fine pattern. Generating the violation record information UOB7, going to law enforcement station to verify the violation information UOB13, and the detailed description of node J2 and J5 are shown in figure 12.

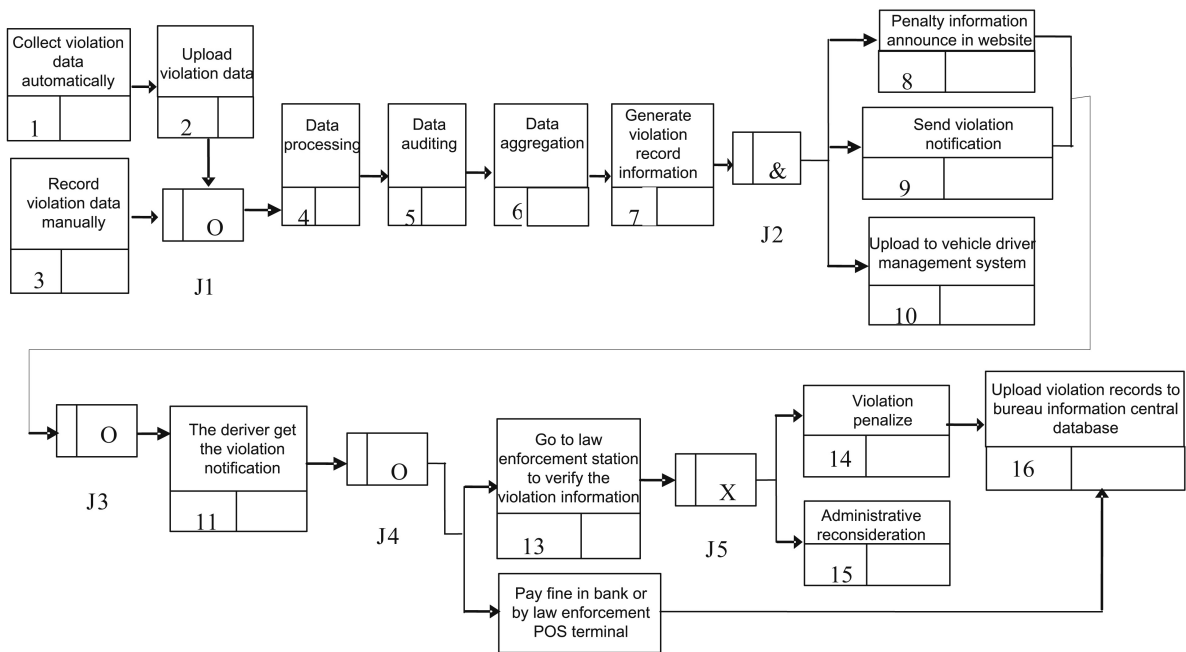


Fig.11. Off-site law enforcement business process IDEF3

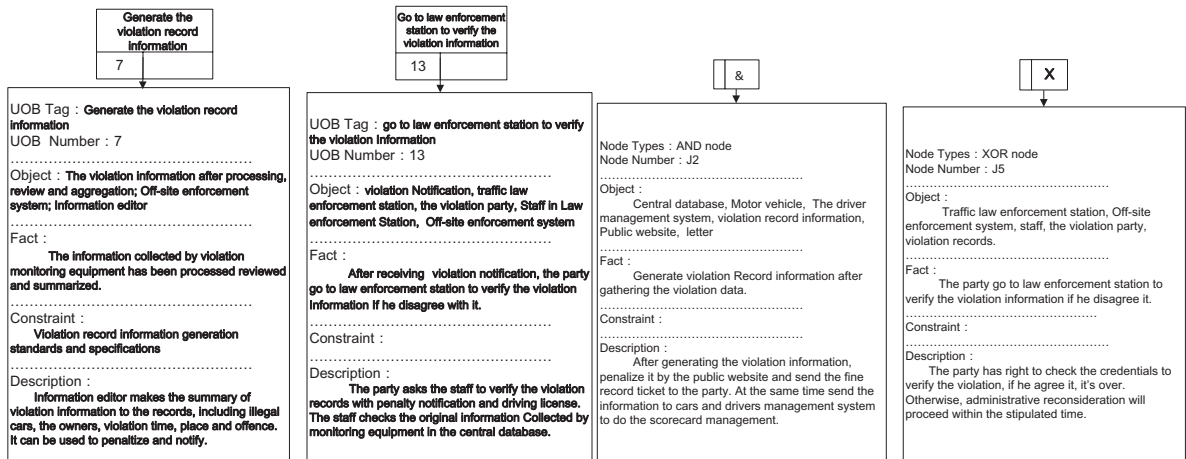


Fig.12. Detailed instructions to part of nodes of business process model of off-site law enforcement

3 Business Process Analysis on Beijing Road Traffic Law Enforcement

By analysing Beijing road traffic enforcement IDEF process model diagram, we draw a conclusion that on-site law enforcement business mainly includes 11 segments, among which traffic police catching illegal drivers on the spot and executing penalty through summary procedure is the critical on-site law enforcement business, it is also the key way to the process chart, which has 6 segments. Off-site law enforcement mainly include 16 segments, among which collecting violations by road violation monitoring equipment, notifying the parties through letters or the internet and letting the parties use self-service law enforcement terminals or banks to pay fine are major business of off-site law enforcement, and it is also the critical path to the process chart, which has a total number of 8 business segments. During the process of off-site law enforcement business, there are only two segments that involve the participation of the staff of Traffic Management Bureau, which is violation information dissemination and penalty in law enforcement station. Compared with on-site law enforcement, these two aspects save a lot of time and human resources, thus improving the enforcement efficiency.

The analysis of IDEF process chart shows that actual convergence of most aspects of current traffic enforcement process go smoothly in recent years through building the intelligent traffic management system in Beijing. Meanwhile the business flow and information flow are in coordination, the business flow relies on the information flow and similar business are mainly implemented in the same department and position. Existing business processes have been able to adapt to the current Intelligent Transportation System well together with higher efficiency of the intelligent transportation system and better internal integration. But with the increasing number of law enforcement events in Beijing Traffic Management Bureau and the increasing amount of traffic duty year by year, the average intensity of each front-line traffic police work will continue to increase. In the next few years, the number of the local traffic police could impossible increase sharply, but the number of vehicle and drivers will continue to grow. The situation of traffic management is severe, and the heavy task are in urgent need for further use of science and technology and management techniques to improve traffic management and control efficiency and service levels.

4. Business Process Optimization on Beijing Road Traffic Law Enforcement

4.1 Ideas of Business Process Optimization

Beijing road traffic enforcement business system should make further efforts to accelerate the expansion of information technology and the application of new equipment, upgrade existing traffic management integrated

business applications system, combine vehicle administration, law enforcement, legal institutions, accident disposition, safety supervision and other related businesses more closely together, and integrate traffic law enforcement business with other business through optimization and reorganization of traffic management business process, form a management business chain to achieve the linking management among all the business. Other business implementation involving traffic violation penalty can use record linkage system to deliver relevant information to the off-site law enforcement system for off-site traffic offense penalties. With the expansion usage of road violations monitoring equipment and the upgrade of digital law enforcement terminal (Wen, 2010), we can achieve the transformation from on-site law enforcement to off-site one, and reduce the police work intensity effectively.

4.2 Optimization on Traffic Law Enforcement Business Process

According to the former analysis, Beijing road traffic enforcement business can be improved in the following aspects.

- (1)When the traffic police go road patrolling and are on duty, if they find suspicious vehicles and people (mainly aiming at stolen cars, hit and run cars, fake license plate cars, fugitives, etc.), they are supposed to intercept the car and report the illegal information to the relevant departments.
- (2)When traffic violations is found in accident disposition, security check, vehicle management, road charging and other aspects, the traffic police should collect video footage of violation through law enforcement terminal, deliver the information to the bureau central database, and execute penalty using off-site penalty system.
- (3)When traffic police catch violations, he can choose the proper way between on-site and off-site law enforcement according to the situation. If choosing off-site enforcement way, he can collect videography evidence through handheld terminals, and upload the information to the bureau central database. If choosing on-site law enforcement way, he can turn on the law enforcement terminal, record the entire law enforcement process, and upload the disposition information to the bureau central database.

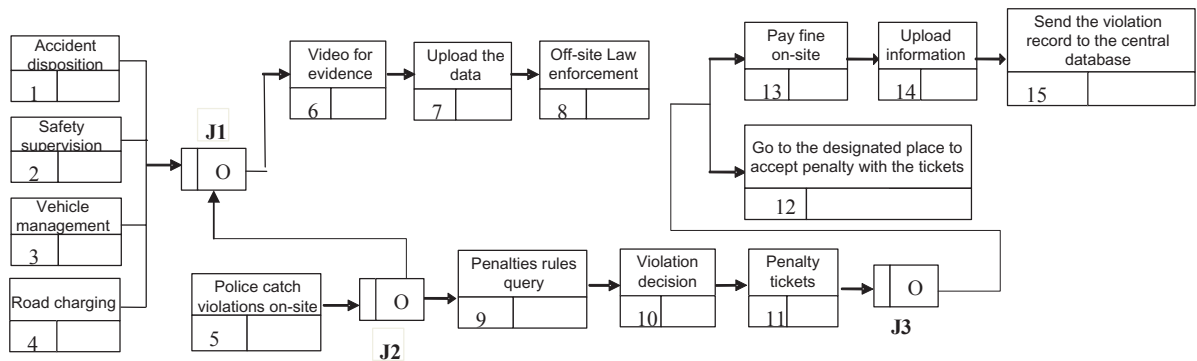


Fig.13. Rode traffic law enforcement figure IDEF3 after optimization

Traffic law enforcement business process after the restructuring is as shown in figure 13. Off-site law enforcement UOB8, penalty regulations query UOB9, the detailed description of node J1 and J3 are as shown in figure 14. The new business process pays more attention to using new type of intelligent terminal equipment, improving the mechanism of informing announcing in traffic law enforcement process (Zhou, & Zhang, 2010), setting humanizing violation recording system, promoting the data sharing and business integration with other

department. The new business process improves the road traffic law enforcement level and service capability by the analysis and early warning of traffic law enforcement.

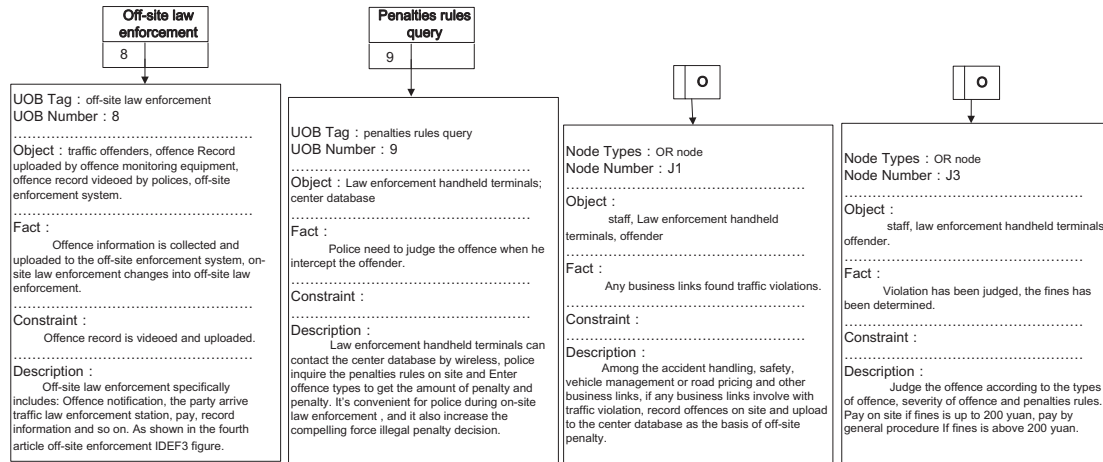


Fig.14. Detailed instructions to nodes after business process optimization

5 Conclusions

The development and wide application of intelligent traffic technology provides the basic conditions of building Beijing road intelligent traffic management system, and it is especially apparent and important in the road traffic law enforcement area. With the increase of motor vehicle ownership and resident travel demand, the contradiction among the people, vehicle and road becomes prominent. It has important practical significance to analyse and optimize the business process on Beijing road traffic law enforcement by the reasonable application of intelligent traffic management technology and method. It strengthens the road traffic law enforcement ability and improves the service level of traffic management department .

Acknowledgements

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