A Management and Operation Method of Internet of Things using the Material Supply Model

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***Abstract* — The paper proposes a new management and operation method of Internet of Things, IoTs, using the material supply model. The method aims to improve the efficiency and accuracy of management and operation for IoTs. We consider the application of Internet of Things to aviation material supply to make the support environment more transparent, the support resources more timely and the overall support more efficient within the Information Technology framework for information development and construction of logistics modernization.**

Keywords - management and operation method; Internet of things; material supply model; logistics modernization

I. INTRODUCTION

The concept "Internet of Things" was coined by Kevin Ashton of Massachusetts Institute of Technology (MIT) in 1999, and is defined as follows: all things are connected to the Internet via sensing devices such as Radio Frequency Identification (RFID) to achieve intelligent identification and management. Early in 1995, the book The Power to Predict first described application scenarios of the Internet of Things.

In recent times, the Internet of Things has developed rapidly and globally due to increasing government and enterprise investment in projects in regions such as the USA, Europe, Japan, and South Korea. IBM's Smarter Planet initiative will see an investment of 3 million dollars made in smart grid and digital healthcare projects. The EU has proposed an 2010 policy framework that aims to enhance economic efficiency and promote the development of Information and Communication Technologies (ICT) through widespread use of these technologies. In Japan, the i-Japan strategy is based on E-Japan and U-Japan. South Korea has also proposed a new project for the Internet of Things[1]. In China, Prime Minister Wen Jiabao presented the concept of "Experiencing China" in August 2009. Driven by the Chinese Government, the Internet of Things industry has developed rapidly in China. First, the development of the Internet of Things conforms to the trend of using information technologies to better serve society[2]. On the one hand, modern society suffers development bottlenecks in the fields of energy, transport, logistics and financing. On the other, people have direct demands in health, and medical treatment and services[3]. With a general belief that information technologies make for smarter terminals, wider networks, and better services than other technologies they are naturally chosen to solve problems encountered in social and economic development as well as to enhance standards of living. Second, the Internet of Things is regarded as a new source of economic growth by many governments.

The Information Super highway Plan implemented by the Clinton administration brought 10 years of rapid economic development to the USA. Now, the Obama administration has put forward "Smarter Earth," which probably has relations with the Information Superhighway Plan. In China, the Internet of Things is regarded as the practice of using information technologies to promote industrialization. In regions such as Europe, Japan, and South Korea, government plays an important role in Internet of Things planning. Third, with its businesses reaching saturation point, the telecom industry also regards the Internet of Things as a new breakthrough. In many European countries, mobile phone penetration rate has reached 100%. As a result, person-to-thing and thing-to-thing communication has been placed high on the agenda. The Internet of Things therefore represents a new stage in the development of the telecom industry[4-6].

Despite these strong driving forces, the Internet of Things faces challenges. First, inter-industry barriers are an important factor affecting the development of the Internet of Things. Currently, telecom service providers are the main promoters of the Internet of Things, and have made (or are making) ambitious plans for its development. However, there are technical barriers among industries, and different industries have their own industry chains, which are sometimes difficult to penetrate.

Second, several technological issues are difficult to overcome. Vast differences in applications make it difficult to work out a uniform service provision platform. Terminals and services vary dramatically in relation to industries and applications. Third, the question still remains whether the scale of the Internet of Things industry can support the entire industry chain. At present, interest from industries that may benefit from Internet of Things service is far from strong[7-8].

II. THE FRAMEWORK OF MATERIAL SUPPLY MODEL

As we all know that aviation material supply is very important in the high-tech brushfire war. So a new aviation material supply model based on the "Internet of things" which can fit the modern war has been built. In recent years,

with the development of the information technology and network, the field of aviation material supply has gone through drastic changes. The information collection, exchange and transmittal for aviation material supply have become faster and more efficient. Numerous airline companies and air force in various nations have undertaken major initiatives such as recombining efforts and investment in Information Technology (IT) to better manage their storehouse and reduce inefficiencies in their supply chain. However, little information showed that one challenge in all aviation material supply is an efficient management of inventory in a complex network of facilities and products with random demand, random supply and high inventory and transportation costs, which have baffled the better management purpose in aviation material supply chain. This requires us to start with information management of the aviation material and to change the supply model. The appearance of the "Internet of Things (IOT)" makes it possible to come true.

The emergence of the Internet of Things has its specific historical background, the economic weakness of the western developed countries and growth worry in developing countries is the internal demand of the Internet of Things, the sub-prime mortgage crisis originated in the United States in 2008 is the fire cable of the rapid growth of the Internet of Things. In order to promote the development of the Internet of Things, some developed countries carry scientific strategic layout on it based on its national interests. Research on the Internet of Things of our country is late, because we have launched a series of resource mobilization activities and local industrial layout on the background of not grasping accurately connotation and epitaxial of the Internet of Things, growth process, the development directions, this is not conducive to the healthy development of the Internet of Things industry in China. Based on these, it will be helpful to improve the progress of the theory of the Things on Internet industry, and also be conducive to the manager's scientific decision to making of the Internet of Things industry in China, to study systematically domestic and foreign related base theory of the Internet of Things and base theory of industry growth, to analyze the growth mechanism of the Internet of Things industry, to explore the growth law of it. The Internet of Things is a product of IT and Internet's development to a certain stage, and is a new emerging modern information industry. However, from the content, the Internet of Things is different from the general information industry, it includes not only a sensor identification equipment, network communications equipment, application system equipment and so on other physical products manufacturing industry, but also belong to the providing communication channels, software development, system integration, professional services and so on other service industries, or the spirit of industry; it not only has some new creation, newly added products "narrow" industrial part of the Things of Internet technology itself, but also has some newly added "fusion" industrial part by application extending to other industries.

It is well known that Internet is the interpersonal communication by network, "Internet of things" is a kind of network which links all things together with the use of sensor equipment such as radio frequency identification technology(RFID), infrared inductor, global orientation system, laser scanner and so on), and makes communication expanded from "any time", "any place" and "any person" to "human to thing" and "thing to thing". And an intelligent supply system which can long-distance detect and control the material will be built based on the "Internet of Things". As a result, in this paper an aviation material supply model is built on the base of "Internet of Things".

III. THE TREND OF AVIATION MATERIAL SUPPLY MODEL BASED ON "INTERNET OF THINGS"

In the future war, the core and soul of aviation material supply will contain three steps: information resource, command and controlling, and survivability, which are decided directly by the content of information application and intellectualization. Firstly, information is the most important and invisible resource in aviation material supply, which can guide the whole process of material supply including preparation, planning, organization and implementing. Aviation material supply needs cooperation with logistics and information streams to bring supportability. Secondly, intellectualization is the core of aviation support's command, controlling and correspondence. In the data battlefield of future, aviation support could realize the intellectualization and network of command and correspondent by "internet of things" system, which transmits the aviation material information such as storage, transportation, fuel loading and consumption with current data and images to every visible system, and the commander can control material states such as production, storage, transportation and supplement etc. directly and give orders precisely. IOT information platform has provided with the commander with great support. With the support, the commander could intellectualize the control and commanding of aviation material by mastering the consumption of aviation material, the amount of time, space, species and quantity that aviation material needs, proper dispatching, automated selecting secured routes, automated deciding a solution plan .etc.

High-speed and high efficiency are a must to a decisive and efficient aviation support in modern wars. One reason is that only the high-speed support can adapt to the rhythm of the information development war, and with the improvement of support speed and efficiency to a high extent, the supplement of aviation material can be in proper time and place. The other reason is that a quick reaction achieves high efficiency. The extensive application of "internet of things" technology will make the foundation for high speed and high efficiency of aviation support. At the same time each factor of the aviation materials support will change absolutely; on the facet of the transmission and disposal of support information, data communication and automatic command system will achieve the transmission and disposal; on the fact of organizing and command, computer simulation technology can predict the amount of the demand and make support plan quickly according to the factors like model,

scale and geography of the battle-field, which cuts down the time for command and decision largely; on the facet of aviation material storage, it can adjust according to environment and the missions.

The unity and integration of modern war gets the aviation material supply to develop towards omnidirectional and integration. On one hand, the front side and depth of aviation material supply will be larger and larger with the development of warfare ability, mode and means, and plane linear style would be replaced by solid network. Only if we have an omnidirectional aviation material supply, can we adapt to the information battlefield. On the other hand, the information war is a kind of united warfare with multi-service joint operation, and the information command and warfare system will combine all kinds of multi-service battle effectiveness together into one unit. We will not meet the needs of united warfare without the integrated support. Therefore, the aviation material supply system has to break the borders of army services, integrate all kinds of organizations as one, and optimize the deployment of aviation material resource in general. The appearance of "internet of things" will realize the integration and digitalization of aviation material supply, combine the support powers of all army services into one unit, and also combine storage support forces of front-line and back-line, which could provide conditions for integrative aviation material supply.

IV. THE DESIGN OF THE AVIATION MATERIAL SUPPLY MODEL BASED ON "INTERNET OF THINGS"

The management doctrine of the USA United Air Lines is “the right parts, to the right aircraft, at the right time, with the lowest cost possibly.” This doctrine explains the relationship between aviation material cost and support effectiveness incisively: the lowest cost and provision assuring the supply of aviation materials. The key steps below should be grasped as aviation materials support skills: whole support for aviation materials, planned stock-pile, cycling period controlling, and quality assurance, continual cleaning up of remainder, making real-time disposal and decision on support information. As a result, a support model is based on “Internet of things" should build up an efficient information platform (fig. 1) for aviation material supply at first. According to characteristics and requirements of data transmission in support system, making use of this information platform and, acquire, identity, dispose, transit, transmit, memorize, make use of and control support information effectively, then transform into energy to make a great benefit quickly.

As every step during support is in the condition of motive or uncompact, the information and direction always shift with actual actions in time and space, which would affect the availability, sharing, instantaneity and accuracy of the information. Aviation material supply system is based on “Internet of Things”, which could solve these problems effectively. It could use the information platform to widely use “Internet of things" in many occasions, such as storehouse management, transport management, production management, material track, means of delivery and shelf identification. It is shown in Fig. 2.

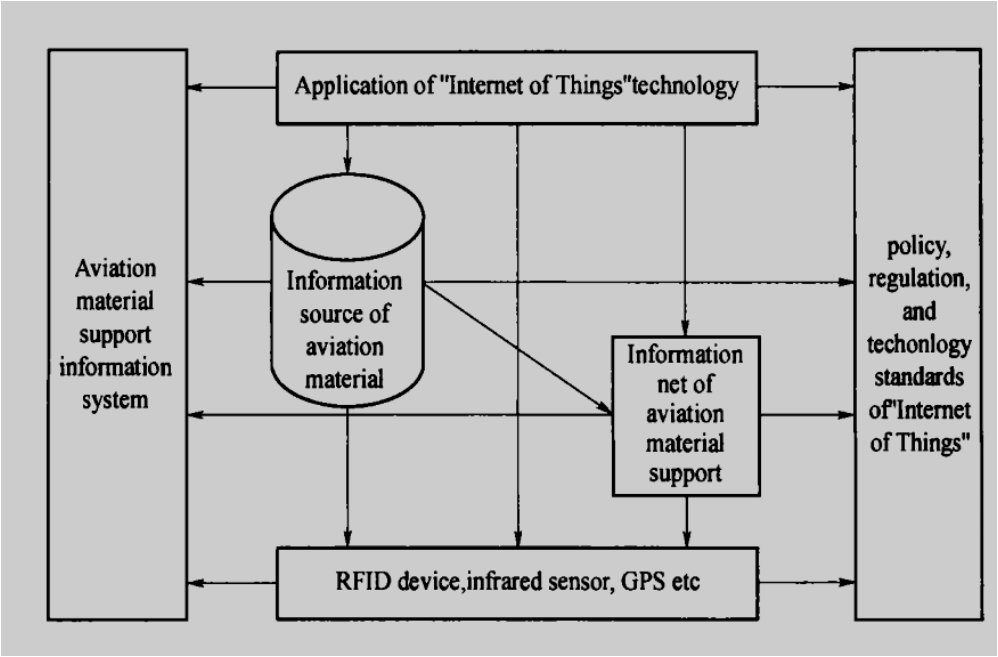

Figure 1. Aviation material supply information platform based on "Internet of Things".

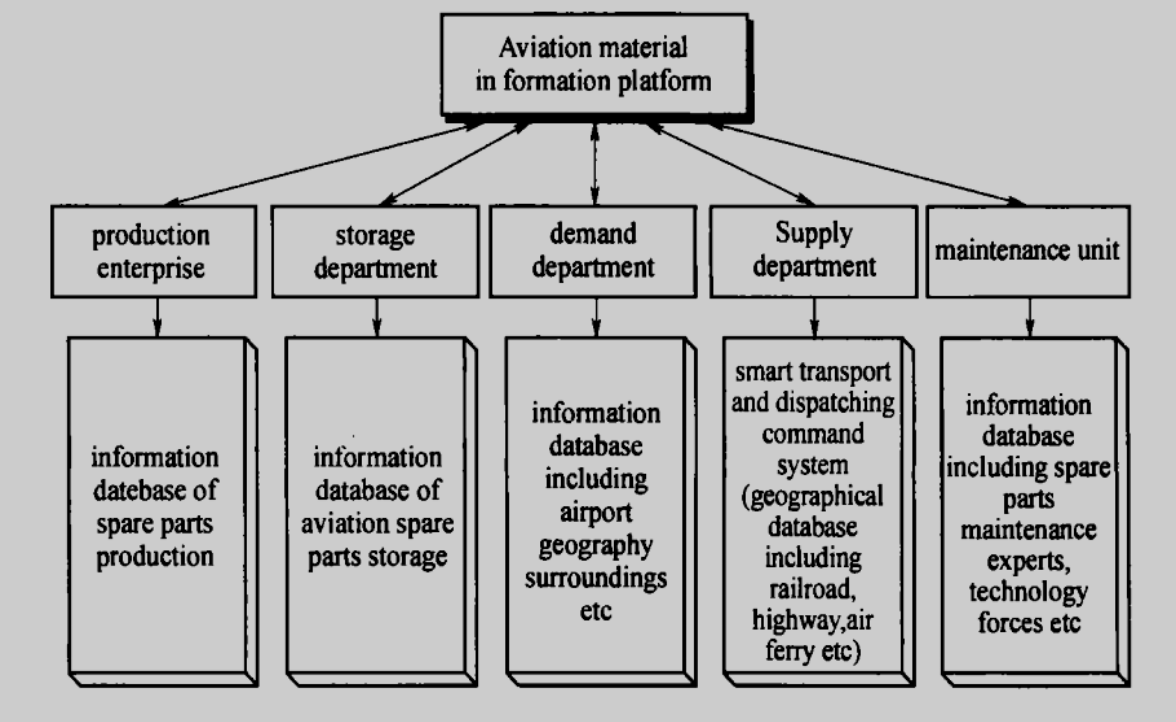

Figure 2. Sketch map of aviation material supply system network.

(1) Spare parts production enterprises of aviation material. The platform will display spare parts production factories, enterprise network charts according to requirement, and locking the factory of a certain spare part, and show its location, which provides information for material collecting leaders in the warfare, and meets requirements of aviation material.

(2) Spare parts storage enterprises of aviation material. The system will switch to network chart of spare parts storage automatically according to requirement information, and present optimal storage information of spare parts based on "handy principle". Then display the distance from storage point to requirement point.

(3) Demand department of aviation material .Providing the airport information such as location, characteristics, plane modes and the number etc.

(4) Supply department of aviation material. After the storage point and the requirement point are confirmed, the system will create provision route network chart to fix optimal transport plan.

(5) Maintenance units. If there is no storage of spare part and material, the system will provide reference information about maintenance department, maintenance expert and maintenance capacity, to help management leaders make decision of organizing repairing of aviation material rapidly.

The aviation material supply would not only provide material and money to support objective, but also meet its demand using information support technology, means and method. With adoption of advanced information technology, an information system for equipment support should be founded due to the profound principium of aviation equipment, its complicated structure, and its changeable support means and content. Then it can improve the efficiency and effectiveness of equipment support. As a result, the idea and the technology of "Internet of Things" will make an immeasurable influence on the command, the process and the technology method of the information development. Aimed at the characteristics of supply chains we could design a model as shown in Fig. 3.

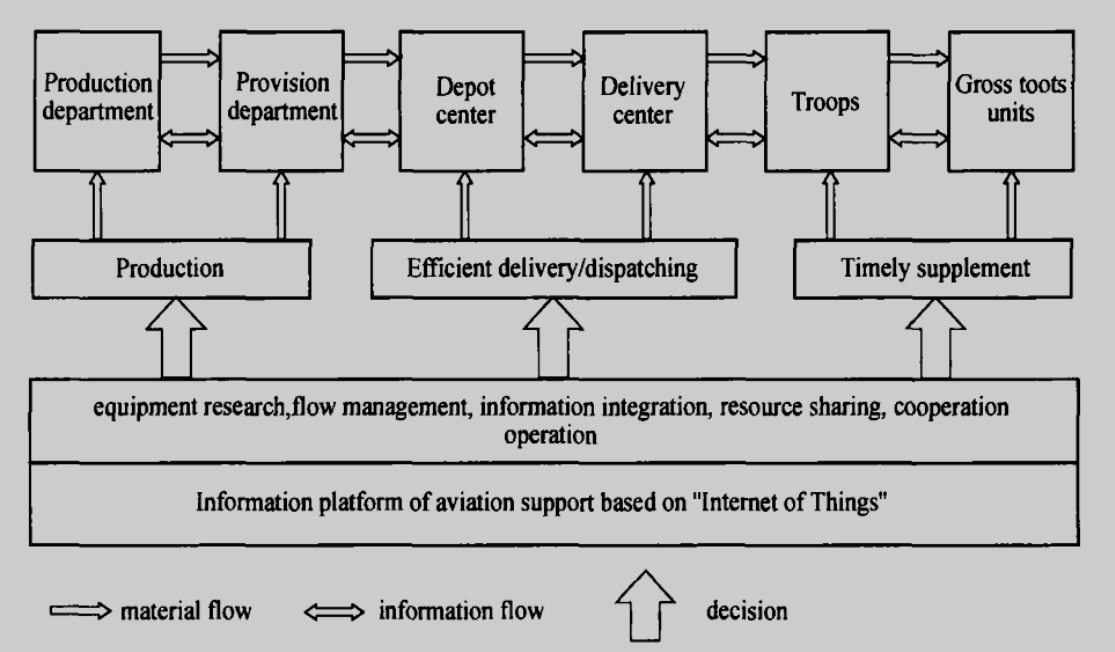

Figure 3. Real-time integrative aviation material supply.

The value of integrative aviation material model is that we can extract the information we need from data by “Internet of Things” including information based on geographical space and place, information on product attribute, production flow condition, supply chain key indices and data flow speed etc. The "intelligence" supply chain of “Internet of Things” age could meet the need of information aviation material supply, enhancing its efficiency (e. g. dynamic supply and demand balance, detection and solving of predict accidents, aimed at reducing stockpile level and product position visualization etc.) and also reduce conserving pressure of supply chain (e.g. reducing the consumption of energy and resource, reducing the pollution of exhaust emission. Right now the factors such as prolix and low effective infrastructures, high stockpile cost and low load efficiency have severely affected the function of supply chain network. The "intelligent" supply chain of aviation material would optimize the supplying model from raw and processed material to product through powerful analysis and simulated engine. This would assist factory to make sure of the product facility location, optimize material storage place, and set stockpile distribution strategy. Furthermore, a “Internet of things" would make the real seamless, end to end supply chain come true, it will reduce capital and cost(transport, storage and stockpile cost), at the same time, heighten control capacity of aviation material supply.

The Internet of Things, like other industry, has also an evolutionary process on industry growth, only it show some differences in growth background, power source, the growth process and so on. The value creation of the Internet of Things is the innovative way of communication between humans and things, to get real raw data, to promote transparency of the management process, and reduce the communication transaction costs, mainly show of its value creation process is to promote simplistic data access, promote the automation of production processes and management, and enhance customer service levels. The application value of the Internet of Things is mainly showed to making the object wise, to change the mode way of production and life of the human. The growing of the Internet of Things industry chain is the key of development of The Internet of Things industry. As for the structure, The Internet of Things industrial chain mainly consist of seven parts, namely, sensor chip and core devices developers, Internet service provider, system integration service providers, software and intelligent information system developers, sensor and communication equipment manufacturers, application service providers, clients. Among them the most important are sensor chip and core devices developers and system integration service providers. The former is responsible for the technological levels of the Internet of Things industry chain whilst the latter sets higher demands for the business model innovation. The Internet of Things industrial chain has character of long chain, technology to dominated, application to be driven, and strong relationship. Developmental mechanism of the Internet of Things industry chain can be interpreted from the angles of dynamical mechanism, theoretical model and formation mechanism.

V. CONCLUSION

The developmental mechanism of the Internet of Things industry cluster can also be proven by the construction of convergence factor model and logistic growth model. Exploring Industry growth strategy of the Internet of Things

in China is the end result of this research project. From the Internet of Things theory of industrial growth mechanism and the development of China's industrial progress, industrial growth of China's Internet of Things should follow a strategy based on both the government and the market's wheel drive path. The strategy path should regard industry growth life cycle of the Internet of Things as the main line, and regard resources effect mechanism in industry growth as the driving force, regard the core enterprise in the industry growth, the industrial chain, industrial clusters as effect content, regard accelerating the pace of the Internet of Things industry growth in China as the goal. The method can improve the efficiency and accuracy of management and operation for Internet of things. The application of "Internet of Things" in aviation material supply will make the support environment more transparent, support resource more timely and support more efficient on the condition of information society, which makes great sense to information construction of logistics modernization. The conception and the meaning of the "Internet of things" are introduced. Related to integrative construction of aviation material support, a support model was built on analysis of the characteristics shown in the "Internet of things", which made sense for the information construction of the aviation equipment support system in theory and practice.

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