

RESEARCH ON THE PATTERN OF TECHNICAL SERVICE INNOVATION OF RAIL TRANSIT INDUSTRY BASED ON INDUSTRY CHAIN VIEWPOINT

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Abstract: The complete industrial chain and unique technical service characteristics have formed in the rail transit industry in China. In this paper, we study the existing technical service pattern of this industry from the viewpoint of industrial chain. We also discuss the pattern of technical service innovation from up, mid and down-stream of industrial chain respectively and analyse its evolution trends. Analysis demonstrates that industry alliance and collaboration innovation will be the important developmental direction of the pattern of technical service innovation, which should be helpful for continuous innovation of rail transit technical service providers.

1 INTRODUCTION

With the development of society and economy, one important trend of the world is urbanization. During this process, cities with different scales and in different development stages produce different traffic demands, and they need relevant traffic technique level and transportation tools to satisfy themselves. Among them, rail transit with its big ridership, fast speed, security, punctuality, environmental protection and saving resource and land, has become a necessary part of city traffic structure.

As a service-oriented industry, urban rail transit offers the service products with 4 characters: Intangibility, Inseparability between production and consumption, Non-storage, Knowledge and Technology intensive. The demands for rail transit service industry mainly consist of two parts. One is the service and industry toward the public, which offers passengers with whole journey total service rather than single-route transportation service products. They include service and information service like rail-station, riding service and One Card solution ticket service, etc. The other is the service enterprise industry toward rail transit enterprises, meaning service offered by industrial clusters surrounding the rail value chain. They offer the operation service of facility and equipment rather

than products themselves. Just as shown in Fig. 1, the two grey round circles will become the key points of rail transit service industry. Their main targets are service enterprises which offer user-centric, integrated service toward relatively to passengers and rail transit enterprises.

2 PRESENT CONDITION

2.1 Rail Transit Industry Chain

Urban rail transit is a large-scale industry. It has its own integral industry structure and characters with long industry chain, wide scope and self-industry system.

If we use industry chain concept based on industry view to define and analyse rail transit industry chain, we can see the main business of rail transit is offer various transportation services for passengers' convenient journey. The added activities formed by underground entity like the decision-making, investment and fund-raising, early stage planning and design, construction, operation of rail transit projects and the added activities for business meeting the need of its major business form the key value chain for rail transit. Rail transit industry also has some intrinsic resources. They are interactive relations and business group formed by resource

development created by underground construction and operation, and are stretch and expansion of underground key value chains.

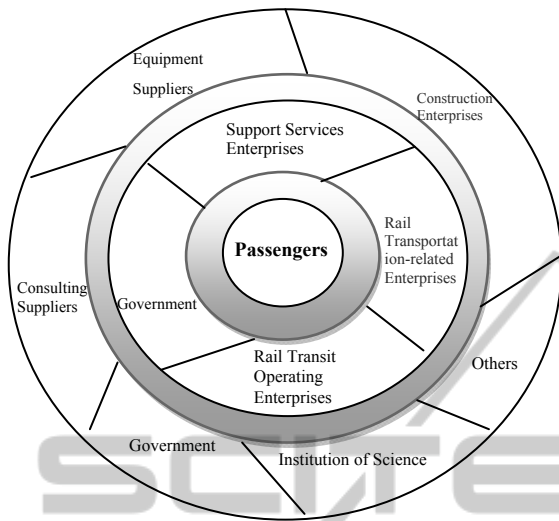


Figure 1: The sketch map of rail transit industrial structure.

As known, the effectively integration of the critical value chain and derived value chain has formed the whole industry chain of urban rail transit. For more detailed information of the Rail transit industry chain, please refer to Fig. 2

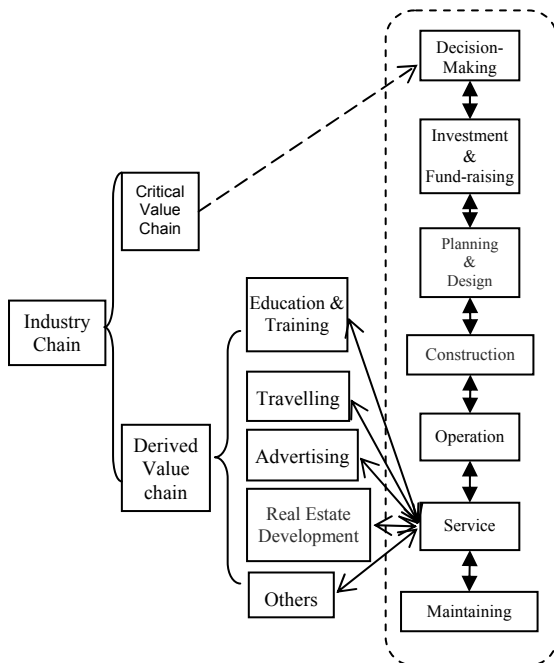


Figure 2: Analysis chart of rail transit industry chain.

The key value industry chain of rail transit can be divided into 3 parts: Upstream mainly refers to decision-making investment and fund-raising, design and construction stage. Mid-stream mainly refers to operation stage, while maintenance belongs to the downstream of industry chain. Certain part of each stage can be further classified into their own up, mid and down-stream. For example, the construction part of upstream can also be divided into stages such as raw material offer, produce, logistics and installation, etc.

2.2 Rail Transit Technical Service

Rail transit is a classic service industry, and is also an equipment-intensive industry. Its main business is supported by the operation of relative technique equipment. Surrounding by the value chain of industry, technology supported system is formed. Traditional rail transit fields form relative industrial clusters based on the technology supported system. Various equipment enterprises offer various equipment technique information and installation during the Planning and Construction period of rail transit, and offer maintenance, support and update of the equipment during the Operation period of rail transit. On the other hand, surrounding by service like public riding and connection and centred on rail transit station, they offer relative transportation products for passengers.

As mentioned above, the two parts of demands for rail transit service industry are respectively assumed by rail transit enterprises and relative enterprises. Therefore, the development center of rail transit still concentrates on transportation products, produce of facility and equipment and product service. The enterprises of rail transit technical service industry can be the expansion of service aspects of present rail transit relative enterprises, and can be some emerging service industry as well. They will integrate service of present relative enterprises just as Fig. 3 shows:

In this figure, service integration platform is the core of concept and management of rail transit technical service industry. Through information platform and logistic platform, and on logics and physics, service integration providers integrate service branch system of each company into service conformity platform. According to dynamic customer demands, they offer dynamic service conformity solution (Li Qiang, 2009). The most outstanding feature is serve demand side with choosing suitable service components and service process module in terms of service outsourcing.

For a long time, with the booming construction and operation of rail transit, emergence of new techniques and products, present industry development pattern has produced some important problems:

- (1) The contradiction between explosion for technical service demand and deprivation on talents in booming construction and operation of rail transit
- (2) The contradiction between aggravation on complexity of technique-related internet and traditional technique labour division refinement
- (3) The contradiction between attentions paid on technical products like equipment and facility and deficiency on integral application pattern

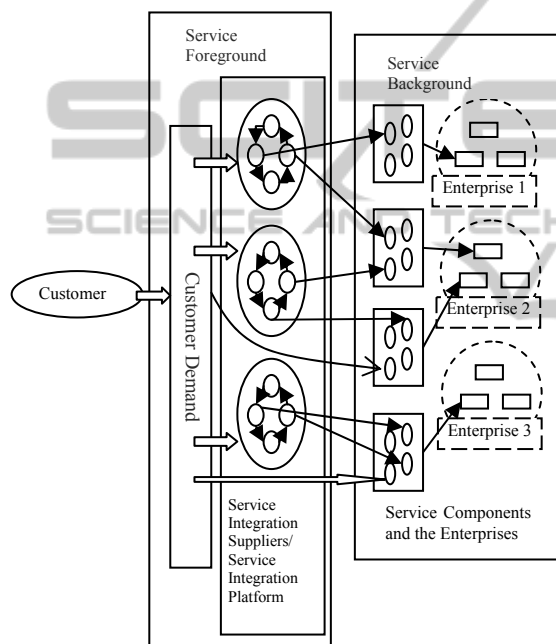


Figure 3: The sketch map of integration development of technical services.

3 INNOVATION PATTERN OF TECHNICAL SERVICE IN RAIL TRANSIT INDUSTRY CHAIN

Innovation is a complex systemic project, and this process refers to many elements. The difference on element formation, disposition mode and structure create innovative different patterns.

In the rail transit industry, the innovative pattern of technical services can be recognized as innovative direction, drive and creative formats. The muster of various analytic dimensions such as key innovative elements expresses the total characteristics of rail

transit industry. There are many angles of analysis on the key value industry chain of rail transit. We can analyse from the angles like innovative types, innovative connotation, innovative body, collaboration innovation pattern, innovative drive and intellectual property protection, etc.

According to the analysis to the upstream, midstream and downstream of key value industry chain for rail transit from various angles, we can get these results as the integral innovative features and pattern of key value industry technical service of rail transit. They are as follows:

Table 1: Innovative pattern of technical service in each stage of rail transit industry.

The Innovation Phase	Details	Innovation Objects	Major Innovation Elements
Construction Phase	Investment & Fund-raising; Planning & Design; Building;	Government; Operating Companies; The Financial Institutions; Institutions of Planning and Design; Equipment Suppliers & Purchases & Servicers and etc.	Investment Mode Innovation; Concept Innovation; Technology Innovation; Business Pattern Innovation; Organizational Innovation; Management Innovation
Operation Phase	Core-business; non-core business	Rail Transit Operating Companies; Rail Transit subsidiary and etc.	Management Innovation; Organizational Innovation; Business Pattern Innovation
Maintenance Phase	Self-Maintenance; ally maintenance; total external contractor maintenance	Rail Transit Operating Companies; Rail Transit subsidiary; Equipment Suppliers & Servicers	Organizational Innovation; Technology Innovation; Business Pattern Innovation

(1) From the view of innovative body: Although there are various technical service providers in each stage of rail transit industry and their structures are different from each other. Constrained by the complexity of industry technical service and industry entry barrier, the body is mainly those large and medium-size enterprises and large and medium-size research institutes association.

(2) From the view of innovative elements: The technical innovation is the core and it is throughout the whole industry. The innovation of organization pattern, management pattern and business pattern offer powerful basis and support for technical innovation. Through in-depth analysis, we know that

the produce of technical service depends on new techniques. While during the process of industry development, the infiltration of service makes technique merges with service thus produces powerful vitality. This, to a great extent, promotes the development of rail transit technical industry, improves technical products' added value, and is helpful for promoting adjustment of industrial structure, and further pushes rail transit to upgrade to high increment industry.

Tab. 1 shows the detailed innovative patterns of each stage of technical service in the rail transit industry. Its detailed explanation is as follows:

3.1 At Industry Chain Upstream

So far, except for the decision-making stage of preparation parts, the construction period of rail transit industry in China, meaning the upstream of industry chain, can be divided into 3 stages: ① Investment and Fund-raising stage, ② Planning and Design stage, ③ Construction stage.

3.1.1 Innovation Pattern of Investment, Fund-raising and Programming Stage

At present, 15 cities in China have begun the construction of rail transit. Generally speaking, city rail transit in China is still in the early stages of development. Considered supporting facilities are still not perfect, marketing methods are still deficient, and development mechanism is still not robust. The initial stage of investment and fund-raising is mainly government capital investment. And dominated by government investment, marketing methods are tried to solve financing gap problem of rail transit development (Wei Hua, 2009). In the maturity stage of investment and fund-raising, each big city actively explores to use various patterns such as BOT, PPP Projects, stocks and bonds, credits, leasing and affiance to make innovation of financing model. For some cities, part routines and zones begin to have some features of maturity stage.

The innovative pattern for planning and design mainly depends on concept innovation. In the programming of rail construction we should fully absorb the advanced concept of many international famous programming units, express several principles such as the planning ideology of rail transit coordinated development with land, people oriented and public transportation first, value decorative design, embody humanization design, improve transfer environment, explore new methods

and thoughts for programming connecting rail transit station and surrounding land, and create people-oriented, safe, convenient, comfortable and efficient public traffic conditions.

3.1.2 Innovation Pattern of Construction Stage

The building stage of rail transit contains many links. Its structure is complex, and it is the priority among priorities of construction stage. In detail, the building stage can be divided into two types: construction and equipment purchase, in which the purchase and installation of equipment can be refined and classified into several parts according to their function: power supply system, vehicle description system, communication system, signal system, environmental control system, air-conditioning and ventilation system and other systems, etc.

The technical service providers of this stage are mainly equipment producers, equipment buyers, equipment service providers and construction organizations. Under many conditions, the role design of equipment producers, buyers and service providers has some germination.

The service patterns of technical service providers at present building stage are mainly:

(1) Develop and sell single product or dip into single field and gradually penetrate. Switch from research and produce of single product and simple service to a full set of technical service solutions: For example, GRG Banking Group which has sold products in many rail transit lines like Guangzhou Subway, Beijing Subway, Nanjing Subway and Beijing—Tianjin Inner-City High-Speed Railway pays attention to AFC System, and suggests the all-in-one solution of single product of self-development, self-research, self-produce, self-sale and self after-sale (Li Yushan, 2009). Companies such as OMRON in Japan are also the same.

(2) Diversification strategy: Motorola Company which offers TETRA System for underground and purchases wireless internet programming and management software company Wireless Valley offers wireless dispatch business, making efforts to expand business levels and realize horizontal diversification operation strategy.

(3) The growing up of demand-push service: in the technical service industry of rail transit, many technical service providers have realized that serving for users' demands is the primary task of industry, and technical service is a more interactive process with customers. Value is commonly created through

service delivery and time-continuing process with customers. In rail transit industry we should contact with customers, know the fact that under many conditions, it is not a ready-made product or just a core technique but a full set of technical service that can meet the needs of customers. Before seeing and using products, users cannot predict their needs, so demand-push research and development service pattern offers users with ordered products and service. According to different user conditions, it first offers basic prototype working and system, which is just like setting up a target for customers, and then users suggest some opinions and further demands according to this prototype, and then revise again and again until it meets the need of users. After the products and system put into operation, they need further optimization with the development of time and environmental conditions. Custom-technical service will continuously offer service according to the demands of users. For example, Beijing Rail Transit Running Controlling System State Engineering Research Centre Company, Ltd set up a demand-push technical service pattern. Its characteristics are expressed like: custom-technical products and service, personnel penetration and talent cultivation.

Generally speaking, technical service providers of construction stage of rail transit pay the core attention to company products and the development trend of product solutions. The purpose is to improve the sales of company products and make more profits for the company. Therefore, technical service innovation of this stage stands out the innovative patterns which rely mainly on technical innovation and are supplemented by organization innovation and management innovation.

3.2 At Industry Chain Midstream

Based on the special national conditions of rail transit, the lines of rail transit in many big cities in China are mostly mastered by state-owned enterprises, meaning major underground operating companies taking charge of city fast rail transit system construction, operation and management. Facing present development trend, underground operating companies all realize innovation is their historical mission and requirement of times, is also inevitable demand of forward development of company, and even necessary condition for realizing successful enterprise mode of the public service.

There are core business and non-core business in present underground operating companies (Nie Lingyi, 2008), in which core business means the

basic duty of underground operating companies, including taking charge of operation business of underground, bearing operation management rights issued by the government and financing responsibility, maintaining underground equipment, offering excellent and high-efficiency underground operation service, meanwhile developing the construction business of new-line, efficiently organizing project construction duty, actively implementing the reform of project management system, ensuring to finish underground new-line well, economically and timely.

While non-core business mainly refers to duties within the scope of government authority: developing various resources related to underground, creating best overall economic efficiency, comprehensively researching the interactive promotion function between resource development and underground passenger flow, ameliorating the out environment of underground resource development, enhancing the ability of operating and generating profits. Therefore, the innovation pattern of the midstream of industry chain is mainly the innovation upon business pattern--diversification strategy.

3.3 At Industry Chain Downstream

The technical service of maintenance part in rail transit industry mainly refers to daily maintenance, timing overhaul and fault treatment aiming at vehicle description, power-supply system, electromechanical device, communication device, official duty device, etc.

There are mainly 3 maintenance patterns at present rail transit industry in China: total external contractor maintenance, ally maintenance, and self-maintenance. (Zhou Hang, 2008)

Excellent and high-efficiency hardware equipment and software environment are the pre-conditions to ensure the normal operation of rail transit industry. While the maintenance of equipment and software is the important step, which directly links to systemic service quality offered to operator and influences the profits of underground. Therefore, the best maintenance pattern for rail transit is realizing optimization of overall efficiency with smallest resource devotion and best configuration mode.

Our investigations about maintenance pattern of each rail transit line indicate that, at present, the domestic line depends on self-maintenance and ally maintenance. Based on the double consideration of economic benefits and social benefits, each subway

running company all tends to have a special place on maintenance stage.

Meeting this situation, each maintenance technical service provider actively pursues development, realizes innovation of business pattern, create optimized, reasonable and simple management mechanism, strengthens information exchange about different maintenance bodies, reduces the operation companies' apprehension of external contractor maintenance to the greatest extent, and makes efforts to change subway operation company from maintenance provider to maintenance supervisor. The most representative measure is to cooperate with each government and subway running company and set up external contractor maintenance basis. CSR Corporation Limited, which is one of the two biggest vehicle produce groups respectively, cooperates with Zhejiang Province Government and Guangdong province Government to set up Hangzhou rail transit maintenance and installation basis and CSR rail transit vehicle maintenance basis. While another group, CNR Corporation Limited cooperates with Yunnan Province Government to set up Southwest China rail transit equipment maintenance and installation basis.

4 CONCLUSIONS

At present, in the industry of rail transit, domestic service normally rests on pure-technical service, which is superficial level service. Whether with the innovation of management pattern or technical application, rail transit business is still in active exploration stage, which needs adventurous innovation to promote common development.

However, real deep-rooted level service is all-dimensional service, including production management service and process engineering service. And this demands technical service providers to have enough innovation capability. It produces some requirements about the ability at innovation consciousness, innovation culture, innovation organizational forms and applied new techniques. The present condition and dilemma of the technical service of rail transit industry, to some extent, hastens industry alliance. As a new-type industry format, industry alliance is likely to play an important role in promoting the formation of innovation cluster of rail transit industry. It offers new mechanism for communication and collision of innovative body and innovative elements, and is helpful for promoting internal innovation to go out

for collaboration innovation and supporting the efficiency of industry development. To hasten industry alliance, we should aim at technical innovation, focus on market, rely on enterprises, and surround special industry. Advantageous enterprises take the lead to set up alliance to promote the cooperation and exchange enhancement among enterprises (He Dong, 2009); research institutes associations and alliances, and form innovative internet and innovative cluster.

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REFERENCES

- He Dong, 2009, Conceptualization about Building Chengdu Rail Transit Industry Alliance [J], *Decision-making Consultation Message*, No.6
- Li Qiang, 2009, Discuss about Technical Service Innovative Pattern [J], *Shanghai Architecture Science*, No.2.
- Li Yushan, 2009, The Development Road of AFC Industry of GRG Banking [J], *Manager Eye view*.
- Nie Lingyi, Han Zhiguo, 2008, Initial Exploration of City Underground Resource Development from the Angle of Industry Chain [J], *Railway Project Engineering Cost Management*, No.7, 2008
- Wei Hua, Wang Wenjuan, 2009, Brief Analysis on Investment and Fund-raising Pattern of Underground Construction in China [J], *Public Business*, No.4.
- Zhou Hang, 2007, Discussion about Maintenance Pattern of Subway Civil Communication Equipment Management [J], *City Fast Rail Traffic*, Vol.20, No.6, December