INNOVATIVE FINANCING METHODS FOR CONSTRUCTION AND MAINTENANCE OF INFRASTRUCTURE IN CHINA

A Professional Report

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by

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Executive Summary

This report first provides a historical review of the financing methods that the Chinese government has used for infrastructure construction and maintenance and identifies the financial shortage currently faced by many Chinese provincial governments in their local infrastructure financing. The report then introduces some innovative financing methods used by several of the more developed countries with most of them proven to be effective and actionable in addressing the issues created by financial constraints. The report finally gives some suggestions and recommendations for relevant administrative units in local government about how to adopt or adapt these methods by taking into consideration the specific economic and political contexts of China.

(As infrastructure is such a broad and complex subject, the methods introduced in this report will mainly focus on transportation infrastructure. There are other domains of infrastructure such as telecommunications, power and energy, which are a bit different in terms of the stakeholders, technology, and dynamics. Accordingly, this analysis and its recommendations can be applied to these other domains only *mutatis mutandis*.)

Keywords: Infrastructure, Innovative Financing Methods, Public-Private Partnership, China

Introduction

"Infra" means "above," so the word "infrastructure" literally means "the structure above the structure of production." It refers to a platform from which others proceed and the framework within which economic activity occurs. In Chinese, we call it "基础设施", which means the underlying foundation or facility of a society, based on which the country can operate and perform well.[1]

According to this definition, infrastructure has some special characteristics compared to other goods or services. First, it often provides services that are considered to be essential public goods (such as electric power systems, roads, bridges and tunnels) with the characteristic of non-exclusivity, meaning that the service is one which can be consumed/enjoyed by one without denying the same benefits to someone else, that one person's enjoying it does not exclude others from similar enjoyment, and that the consumption by one consumer does not prevent simultaneous consumption by others.

Second, it has another characteristic called "lumpiness", meaning that the good or service cannot be readily provided in increments or in small proportions. The construction of infrastructure often [not always – but as a general rule this is true; so it cannot be a defining characteristic] [non-exclusion is also not so simple because with user fees, one can exclude some from use – those who will not or cannot pay] requires a large amount of upfront irreversible investment and a long investment payback period, which is impossible or too risky for the private sector to provide alone. As a result, the investment and construction of infrastructure becomes an important public sector

[1] Generally, infrastructure can be divided into two types: hard infrastructure and soft (or social) infrastructure. Hard infrastructure includes roads and highways, bridges and tunnels, electric systems (generation, transmission, and distribution), drinking and waste water treatment systems (pumps, plants, and pipes), communications systems (land line systems, cell towers) etc. Soft infrastructure includes schools, hospitals, prisons, courthouses, senior centers, etc.

responsibility, or to be specific, government's responsibility, both in developed and developing countries.

Well aware of this, the Chinese government has paid close attention to this issue from the very time the People's Republic of China (PRC) was established in October, 1949. Consistent with the characteristics of a centrally-planned economic system and the political structure of socialism, the Chinese government has carried out one of the most ambitious infrastructure construction programs in history, especially in the transportation area. By the end of 2015, China had the largest road network in the world by length (4.5 million kilometers), including 110,000 kilometers of expressways, according to the Chinese Ministry of Transportation.

In addition, the investment of this infrastructure made great contributions to the fast growth of Chinese economy, which was well known throughout the world as China's growth miracle. "Where there is a road, there will be prosperity and wealth" has become the rule of thumb for public officials to stimulate their local economy. According to the National Bureau of Statistics of China, the average GDP growth for the past thirty years after China's economic reforms (from 1979 to 2012) is 9.8 percentage points in real terms and about 4 percentage points come from investment.

However, behind this success is the Chinese government's nascent exploration into infrastructure financing. Nowadays, the central government is actively promoting public-private partnerships (PPPs) as a "panacea" or "silver bullet" to solve the current infrastructure financing challenges faced by many local governments. In this report, we would argue that these problems are not unique to China, and PPP is not the only solution, we would introduce some innovative financing methods used by some of the more developed countries in addressing this issue as well as some innovative managing methods that have been developed and applied across the world.

The rest of the report is organized as follows:

Section 1 states the background of the report, providing a historical review of the methods that the Chinese government has used for infrastructure construction and maintenance in the last three decades.

Section 2 presents the current situation, analyzing the financing woes faced by the Chinese government nowadays: constrained budgets on the one hand and the high demand for infrastructure construction and maintenance on the other.

Section 3 discusses innovative financing methods for infrastructure construction, introducing innovative methods used by some of the more developed countries in addressing this issue.

Section 4 talks about innovative managing methods for infrastructure maintenance, introducing innovative methods and best practices that have been developed and applied across the world for infrastructure maintenance.

Section 5 identifies the most urgent problems existing in current infrastructure management system and gives recommendations for future reforms based on internationally best practices. Taking into consideration the realities of China, we propose setting up a two-tier institutional framework (national and regional level) and implementing a three-step reform strategy (short-term, medium-term and long-term) to solve the problem.

Section 6 presents conclusions from this review and analysis.

Section 1: Evolution of Infrastructure Financing Method in China

We can roughly divide the methods that the Chinese government has used for infrastructure construction and maintenance into four stages: centrally-planned financing period (1949-1978), market-based financing period (1978-2000), land-based financing period (2000-2010), and the promotion of Public-Private Partnerships (after 2010).

Centrally-Planned Financing Period

During this period, the new republic was just built and the Chinese leaders wanted to copy the Soviet-type economic planning, which was best known as the planned economy. Within this economic system, the central government was the sole planner and financier of urban infrastructure projects. Starting in the 1960s, the central government began to gradually modify this system, which aimed to delegate certain powers and to give some autonomy to local governments (De Wang and et al., 2011). At that time, some types of taxation (industrial and business taxes) were permitted to retain as the funding resource for local infrastructure construction. However, infrastructure project selection and construction had to be approved by the National Planning Commission, which was a powerful organ of the central government.

Market-Based Financing Period

Along with the implementation of reform and opening up policy in 1978, local governments gained greater autonomy from the central government and the centrally-planned financing period gradually gave way to the market-based financing period. In 1985, the city maintenance and construction tax was implemented to expand local infrastructure funding sources with the idea that local government

should pay for their own bill if the infrastructure benefits their own local residents and economy (De Wang and et al., 2011).

Subsequently, taking note of international experience, Chinese government introduced Public-Private Partnerships (PPPs) which was adopted in several provinces. The Shajiao B Power Plant which came into operation in 1988 in Guangdong Province is generally considered to be the first PPP project in China (Ke et al., 2011) and later the BOT (build-operate-transfer, one of the PPPs methods) had been further promoted since the 1990s, mostly used in the construction of expressways[2]. However, due to the limited capacity of local government in implementing PPPs, most contracts were signed to the advantage of the private partners (most were foreign companies at that time)[3]. As a result, the central government prohibited the practice of guaranteeing fixed returns for foreign companies in the early 2000s, and the participation of foreign companies in PPPs in China gradually faded away (Wang et al., 2012).

Land-Based Financing Period

Actually, land-based financing was developed by local governments in the mid-1980s, the common practice was to sell the use right of state-owned land (land is owned by state in China and cannot be traded in the market) through open auction or competitive tendering[4]. With the tax-sharing reform between central and local governments in 1994, which generally led to more revenue for the central government and less revenue for the local governments, land-based financing had become the major

[2] Typically, the private company provides upfront investment for the road and after construction, the government will sign a contract and give a certain number of years of operation right to the private investor, such as 30 years, for the repayment of their investment through tolls collection. Then, the company will get back its investment and the operation right will be transferred to the government.

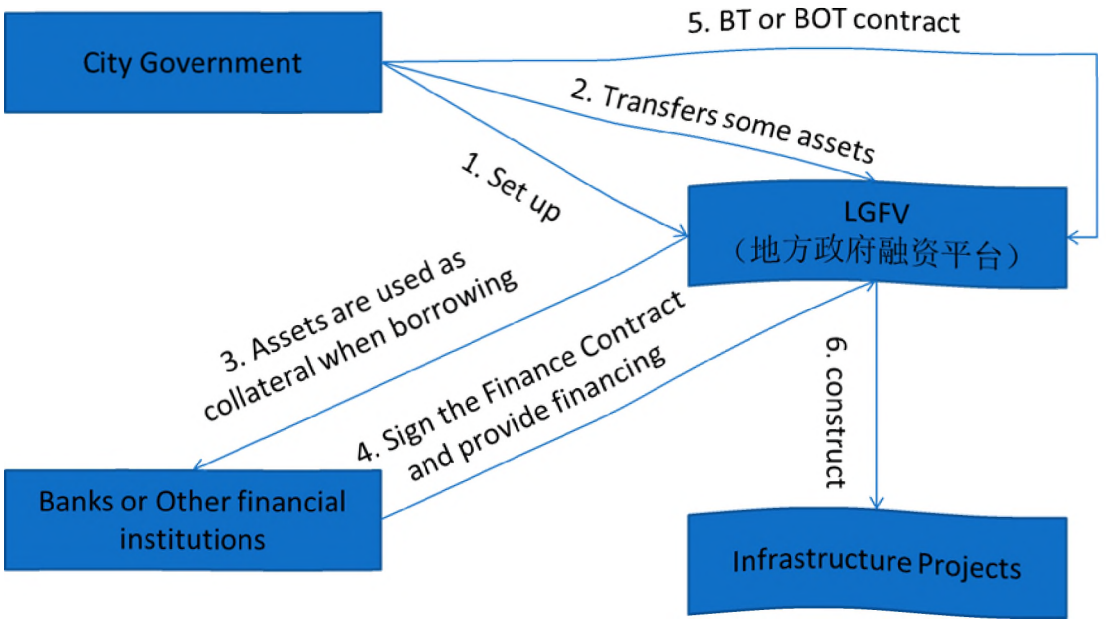
[3] The foreign companies were more experienced at that time, they usually charged disproportionally high fees and requested fixed or minimum return guarantees in the contract (Hui and Isabel, 2015).

[4] Shenzhen, Guangzhou, Tianjin and Shanghai were the first batch of cities permitted to use this method (De Wang and et al., 2011)

financing resource for city infrastructure construction and maintenance from the late 1990s and to the early 2000s. The common financing method used by local government was Local Government Financing Vehicle (LGFV).

LGFV is a kind of state-owned company set up by the local government to finance and implement infrastructure projects. After the new company is founded, local government would typically transfer some of its "high quality assets" to the LGFV to improve its creditworthiness, such as public land or shares of public utilities owned by the local government (Hui and Isabel, 2015). Then, these assets are used as collateral by the LGFV for loans from commercial banks or other financial institutions. Finally, the money will be used for infrastructure construction and maintenance. The whole process can be illustrated by the following Figure.

Figure 1: Local Government Financing Vehicle



Source: Author

The Promotion of Public-Private Partnerships

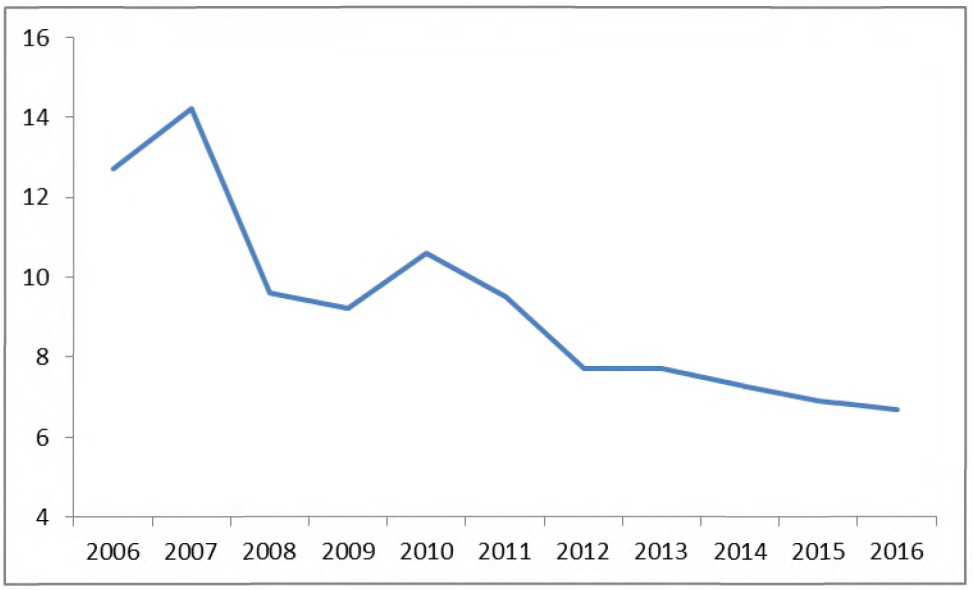
The land-based financing method is the most efficient way so far for local government to finance their infrastructure. However, with the fast increase of LGFV debts, a new concern has arisen since most of the debts are guaranteed by the local governments and have become contingent liabilities, which has posed significant fiscal risks since 2008 (Hui and Isabel, 2015). According to the National Audit Office report, by the end of 2012, the total LGFV debt will stand at RMB 7.0 trillion (about 1 trillion USD), or about 13% of the total GDP of that year. Feeling the threat of LGFV debts, the central government has begun to stop this fast-growing trend and want to make local government debts more controllable (Hui and Isabel, 2015).

Given the constraints of the land-based financing method, and the huge demand for infrastructure, local government had strong incentives to seek alternative and innovative ways to finance their projects. After 2010, the central government begun to encourage relevant ministries and local governments learning international experiences and adopting these best practices to China, and PPPs, which was first introduced to China in late 1980s, became popular again and was considered to have great potential in easing the current situation. In 2014, the National Development and Reform Commission (NDRC) released a list of 80 projects and encouraged private investors to participate, later in that year, the Ministry of Finance (MOF) established its PPP unit, called PPP Center, and begun to officially promote Public-Private Partnerships.

Section 2: Current Infrastructure Financing Difficulty Faced by China

After more than thirty years of rapid growth, nowadays China has entered the so-called "new normal" stage, which means that moderately high economic growth will replace high GDP growth and will be so for some time into the future.

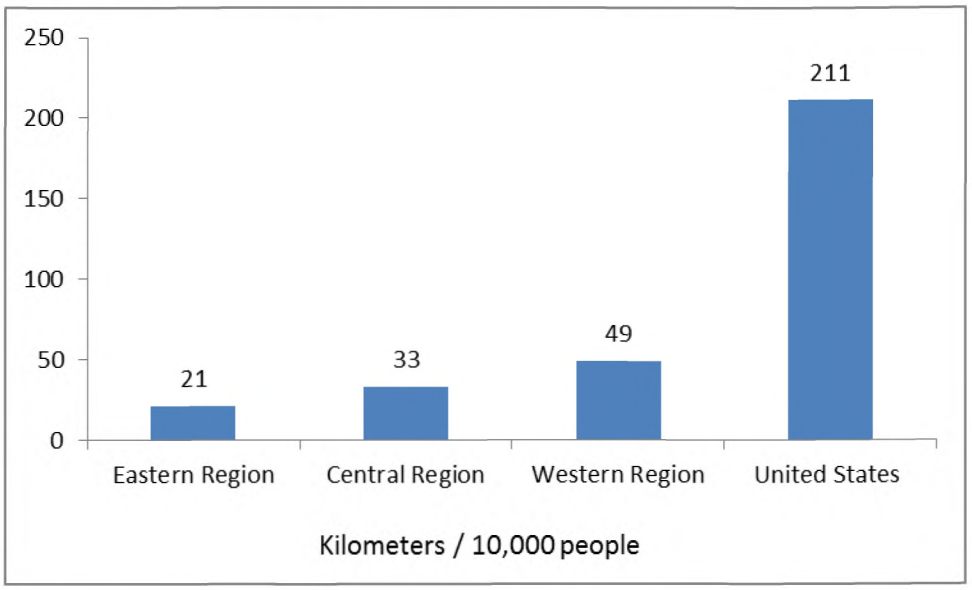
Figure 2: China's GDP Growth from 2006-2016 (%)



Source: National Bureau of Statistics of the PRC

Obviously, the decrease in GDP growth as time goes by will inevitably result in the diminishing of government revenue from taxation, and in a lack of funding to continue providing public infrastructure. However, due to its huge population and vast territory, China is still experiencing severe demand for infrastructure. Although China has made great progress in infrastructure construction, the average infrastructure capacity per capita is comparatively low.

Figure 3: The Average Kilometers of Road Per Capita in Different Regions of China



Source: Zhi Yan Consultant

And also, there is a big infrastructure development imbalance between different regions, the development level has been advanced in Shanghai, Beijing and most of the cities in eastern region, but for the western and central parts of China, many of these areas still have inadequate transportation infrastructure, as well as inadequate telecommunications, water supply, drainage, and electricity supply (Li and Shum, 2001).

In the meantime, China is still under the process of fast urbanization and is experiencing the largest resident migration every year from rural areas to big cities. According to the latest data released by National Bureau of Statistics of PRC, the urbanization rate of China in 2016 is 57.4%, and this rate has experience an average of 1.2 percentage point annual increase in the past 10 years, which means that more than 20 million people moved from rural areas into cities every year from 2006 to 2016. Furthermore, the urbanization rate is expected to speed up and exceed 60% by the year 2020.

As we know, one of the reasons why most farmers want to live in cities in China is related to the uneven development between rural and urban regions, especially the huge infrastructure gap between rural and urban areas. They want to enjoy better education system, health care services and road networks. However, this fast rural-to-urban migration inevitably brought lots of financial pressure on local government. According to central government estimates, in order to keep pace with this transition, city governments have to increase their fiscal expenditure by RMB 140,000, or about $20,000 per person so that every new migrant could enjoy the same level of public service and 20 million new migrants means that there will be a financing gap of 400 trillion dollars faced by the government every year.

It is obvious that infrastructure financing difficulty will persist throughout China's development in the next a couple of years, and most local governments will still experience the contradiction between constrained budgets and the high demand for infrastructure construction and maintenance in the future, and consequently how to find an effective solution is of paramount importance at the current stage.

Section 3: Innovative Financing Methods for Infrastructure Construction

If we review history, the financing gap in infrastructure construction is not unique to China, many developed countries like the U.K., France, and the U.S. have experienced the same situation. After many years of development, different countries have created lots of innovative financing methods to address the infrastructure financing gap.

These innovations may not be new to other sectors. However, their application to infrastructure is innovative. Based on the development realities in China and the latest international practice, this section covers the following three parts. The first two parts talk about two innovative financing methods – PPP and Value Capture. The last part presents a case study of Federal Highway Administration (FHWA) of the U.S. In the case study, instead of just focusing on finding new financial resources, the FHWA applies several useful tools and creates greater flexibility for the use of existing public resources.

Public-Private Partnership

As we mentioned in Section 1, due to its specific characteristics, the investment and construction of infrastructure becomes an important public sector responsibility, or to be specific, the government's responsibility. However, government's responsibility does not mean that government has to construct the infrastructure itself, and Public-Private Partnership (PPP) has been an effective way for these countries to manage to solve this problem. The United Kingdom is generally considered to be the first one to apply this method under the term Private Finance Initiative or PFI.

According to the newly published Public-Private Partnership Reference Guide (Version 3, the World Bank), Public-Private Partnership (PPP) is a long-term contract between a private party and a

government entity, for providing a public asset or service, in which the private party bears significant risk and management responsibility and remuneration is linked to performance. The core concept of PPP is to encourage the public sector to engage the private investors to participate in infrastructure providing process and usually the financing gap can be alleviated to some degree through two ways.

First is cost-saving. The construction and maintenance of infrastructure has many phases, such as designing, building or rehabilitating, financing, maintaining and operating. It is obvious that the government is not an expert in most of these stages and with the increasing of industry specialization, it is wise for the public sector to contract out one or several stages of the whole process. Through PPP, governments can focus on infrastructure delivery at the most cost-effective basis, rather than providing these public services directly. Thus, cost-saving is expected due to the greater efficiency brought by private company with expertise. International experience shows that the biggest part of cost-saving comes from better risk allocation mechanism. When designed well and implemented in a balanced regulatory environment, PPP allow for the better allocation of risk between public and private entities, taking into account their capacity to manage those risks (the World Bank).

Second is upfront investment providing. The characteristic of government expenditure is based on a rolling revenue basis year by year, mainly from taxes. However, the construction of infrastructure often requires a large amount of upfront irreversible investment, so one of the main reasons for infrastructure financing gap faced by many countries is the mismatch between stable revenue stream of government budget and the intensive capital expenditure at the construction stage of infrastructure. PPP can solve this problem by attracting commercial financing (including commercial bank financing, bonds, and private equity) as a necessary complementary method at the

beginning stage and pay back these private investments through future taxes or user fees collected after the project is put into operation.

However, the government should be clear that private investors do not indulge in charity for the public sector. They expect (and can require) very generous repayment of principle with high interest in the contract[5]. And also, the government cannot expect to solve the financing problem completely by encouraging private investors to provide upfront construction cost, as it just shifts the burden and passes the cost down to successors or even future generations.

Another problem about PPP which is widely criticized by others is the high negotiation cost when designing and implementing the contract. Some countries have made efforts to standardize elements of PPP contract design to reduce considerable time and cost frequently involved in preparing and finalizing a given PPP contract. They have developed standardized contractual provisions or even complete standardized PPP contract.

Table 1: Examples of Standardized PPP Contracts and Contract Clauses

Jurisdiction	Standard	Links
Australia	Guidelines issued by Infrastructure Australia on standard commercial principles for social an economic infrastructure PPPs	Infrastructure Australia's PPP Guidelines (AU 2017): Volume 3 on social infrastructure and Volume 7 on economic infrastructure
India	Descriptions of model agreements for PPP in a range of transport sectors	Former Planning Commission (IN 2014d), (IN 2009)

[5] If not a higher rate than they can get from the market, they will not put up their money but will rather put it in the market.

Netherlands	Standard PPP contract for DBFM in buildings and DBFMO in infrastructure	Ministry of Finance Publications (NL 2013)
New Zealand	Draft standard PPP contract	National Infrastructure Unit (NZ 2013)
Philippines	Sample contracts for PPP in bulk water supply, ICT, solid waste management, and urban mass transit. The PPP Center is currently developing standardized terms for broader application	PPP Center: PEGR Sample Contracts (PEGR 2009)
South Africa	Standardized PPP provisions published alongside the South Africa PPP Manual	National Treasury Standardized PPP Provisions (ZA 2004c)
United Kingdom	Standardized contracts for PFI projects; includes extensive guidance on each element of the contract	Her Majesty's Treasury: Standardized Contracts (UK 2012 c)

Source: World Bank, 2017. Public-Private Partnerships References Guide (Version 3).

However, international best practices have shown that a well-designed contract should seek balance between certainty and flexibility or even have to make some compromise between them.

On the one hand, the public sectors should send a clear message to the private partner through the contract that what their expectations are regarding to the quality and quantity of the infrastructure or services to be provided. According to Farquharson's study, a successful contract should create clear performance targets or requirements; they should be SMART, which is Specific, Measurable, Achievable, Realistic, and Timely (Farquharson et al, 2011).

On the other hand, due to the long term and complex of infrastructure construction, it's hard for the PPP contract signed by both parties to include all the risks that they may encounter in their following corporation. Since fully predict future is impossible, it's necessarily for the contract to be incomplete, which means it's wise to have some flexibility built in the contract such as setting up some general principles with respect to the unpredicted issues, so that when the circumstance changed or other new problems emerged, the contracting parties can dealt with them within the contract as far as possible rather than renegotiating the contract or even terminating it, which will inevitably cause huge negotiation cost for both parties.

According to the World Bank Public-Private Partnerships Reference Guide (Version 3), the aim of PPP contract is therefore to create certainty where possible, and bounded flexibility where needed-thereby retaining clarity and limiting uncertainty for both parties (World Bank, 2017).Therefore, the public sectors have to be well aware of these issues when applying PPP.

Value Capture[6]

Value Capture is an innovative funding method for infrastructure construction, which aims to "capture" or "share" some benefit or value created by the construction of infrastructure. Usually, this kind of benefit or value is privately enjoyed by individuals or business and making no contribution to the infrastructure cost. In other words, there is a mismatch between cost payers and beneficiaries. For example, a new train station or school will obviously increase the values of adjacent houses or land, and provide significant benefit to their owners. However, these benefits or values created by the new infrastructure are not fully captured or shared by the government or community, who ultimately bears the whole cost.

[6] More information please refers to *Value Capture - Options, Challenges and Opportunities for Victoria.*

Generally speaking, most infrastructures have this kind of effect – they are most beneficial to those living or working nearby[7]. The goal of Value Capture is to get some funding contribution from those who benefit privately from the infrastructure, rather than let the government or users solely bear all the construction cost. The common practice for value capture mechanism is beneficiary charges, including developer contributions, betterment levies and major beneficiary contributions, which can help the government alleviate part of its financial burden by aligning the cost of infrastructure more closely with those individuals or businesses who benefit directly or indirectly from this investment, whether they actually use the facility or not.

Value Capture is generally considered to have two advantages as a complementary funding mechanism for infrastructure. First is equity. Compared to traditional funding resources, Value Capture can provide a more equitable solution for infrastructure funding. Infrastructure has long been recognized as a "public good" that can be used by and benefit society as a whole. However, the alienation of infrastructure cost from not only the users but also the beneficiaries makes the funding burden distribution more equitable and fair. Second is efficiency. The increase of land or house value can be considered as "windfall gains" for their owners, and they can be taxed without distorting economic activities.

We have to keep in mind there are two difficulties when applying Value Capture. First, sometimes it is hard to quantify the benefits of infrastructure caused to a specific beneficiary (a resident nearby), so it is difficult to design an accurately measuring system which can fairly prove the relationship between additional value generation and the construction of the new infrastructure. The second difficulty is the applying process of the mechanism should not be too complex, which

[7] In some cases, infrastructure can also create negative impacts, such as pollution and noise.

may preclude them from being used, particularly if the cost of implementing the mechanism outweighs the revenue potential (Infrastructure Victoria, Value Capture Policy Paper, 2016).

Federal Highway Administration

Most of the innovations are focusing on how to close the increasing gap between infrastructure capital needs and available resources without direct appropriation increase from the government. However, there are also some innovations focusing on how to create greater flexibility for the use of existing public resources, since most of countries have established national or federal infrastructure aid funds. A good example is from United States. In 2002, the Federal Highway Administration (FHWA) initiated its innovative finance initiative, with the aim to accelerate project construction and expand infrastructure investment, which can be achieved by several innovative tools.

Table 2: Some of the Innovative Tools Created by FHWA

Advance Construction (AC)	States or local governments independently raise up-front capital required for a federally approved project and preserve eligibility for future Federal-aid reimbursement for that project. At a later date, the state can obligate Federal-aid highway funds for reimbursement of the Federal share. This tool allows states to take advantage of access to a variety of capital sources, including its own funds, local funds, anticipation notes, revenue bonds, bank loans, etc., to speed project completion.
Flexible Match	Any non-Federal match that is allowed under FHWA laws and regulations other than state and local cash contributions to a project. Flexible matches permitted under new regulations include use of private cash and in-kind contributions, publicly owned right-of-way, and funds from other Federal agencies.
Grant Anticipation	A GARVEE is any bond or other form of debt repayable, either exclusively or

Revenue Vehicle (GARVEE)	primarily, with future Federal-aid highway funds under Section 122 of Title 23 of the United States Code. Although the source of payment is Federal-aid funds, GARVEEs cannot be backed by a Federal guarantee, but are issued at the sole discretion of, and on the security of, the state issuing entity.
Partial Conversion of Advance Construction	Process allowing states to begin a project with their own source of funding, and then incrementally obligate Federal funds.
Right-of-Way Acquisition	Federal authorization is required prior to contacting property owners in the right-of-way acquisition process and, under traditional funding; Federal funds are obligated with authorization. Using partial conversion of advance construction, State is able to contact property owners early on in the project while preventing authorized funds from being tied up while in negotiation with property owners. As some complicated right-of-way acquisitions can take two to three years, without this technique, authorized funds could be tied up for long periods of time.
TE-045 Innovative Finance Initiative	A research program begun by FHWA in 1994 in response to Executive Order 12893. This finance initiative is designed to increase investment, to accelerate projects, to promote the use of existing innovative finance provisions, and to establish the basis for future initiatives by waiving selected Federal policies and procedures, thus allowing specific transportation projects to be advanced through the use of non-traditional finance mechanisms.

Source: Sihombing L, 2009. Financial Innovation for Infrastructure Financing

Section 4: Innovative Managing Methods for Infrastructure Maintenance

Compared to infrastructure construction, infrastructure maintenance is a relative new theory in China. Today, most Chinese cities focus too much on planning, designing and construction stages of their transportation infrastructure, but little attention is paid to maintenance. In fact, what troubles many developed countries the most is the huge cost of infrastructure maintenance. But due to difference in the stage of development, the problem is not quite prominent in China. Nonetheless, the problem starts to appear in well-developed cities such as Beijing and Shanghai. China needs to plan ahead. This section introduces two innovative managing methods applied in infrastructure maintenance – Capacity Map and Performance-Based Management. We will also introduce an innovative method for road maintenance financing adopted by Oregon, United States.

Capacity Map

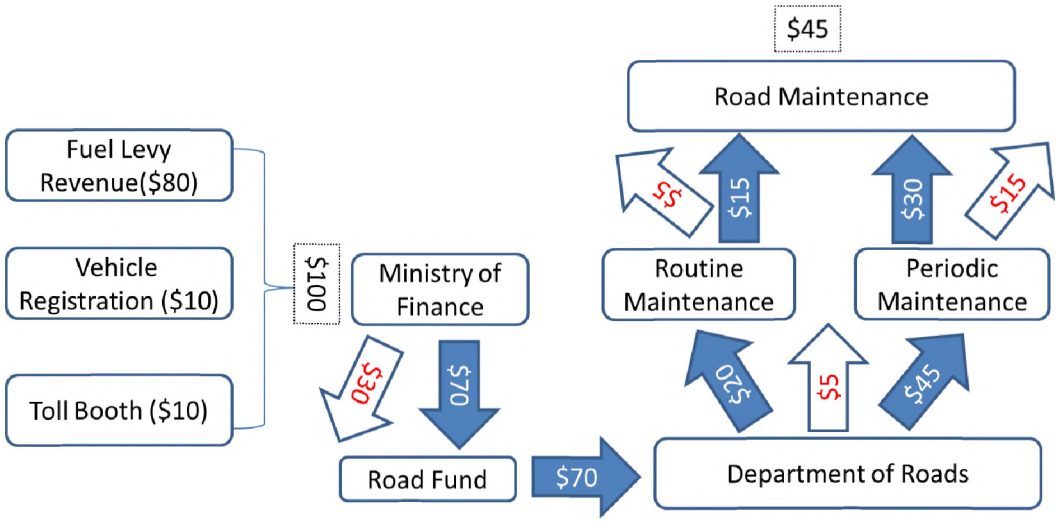
Road maintenance has been a complex challenge for many countries, especially in undeveloped areas. To ameliorate the situation, Capacity Map (CM) has been widely applied as a new solution for public sector, which focuses on the flow of public funds from the point of "extraction" into their "disbursement", with special attention paid to 'leakage' in the overall system (Kaiser P, 2016). As an effective tool, CM assists development partners and government to place emphasis on political root reasons, besides the importance of insufficient budget. CM provides with identification and measurement of the leakage during the process, in which there are administrative flaws from official command. It acquiesces that a high efficient bureaucracy is the one that "extracts" or collects tax, but also spends it on providing sufficient public goods (Peters, 2002).

CM bonds the relationship between bureaucrats and other political agents who offer good public service. In order to detect the main reason and related leakages, CM acts as a balance between solving problems and providing entire advantage which ties in well with stakeholders and problems analysis.

An example is given to demonstrate the typical road maintenance system in developing countries. And the effect of CM is meant to show the flow of funds from "extraction" to "disbursement" in the process (Figure below). We assume that the cost of road maintaining is $100 for every year, which consists of 80% fuel levies, 10% vehicle registration fees and 10% toll booth payments. The figure shows that $70 of the total is sent to the road fund and $30 goes for other non-maintenance purposes. From road fund, $20 is applied to routine maintenance. However, $5 of it is lost because of deficient management. Besides, $45 of the total contributes to periodic management, but $15 is missing because of fraud by contractors or corruption by related government agencies. As a matter of fact, only $45 of the tax is used for maintenance in the end.

Figure 4: The Flow of Public Funds in Developing Country

(Revenue from the beginning to the end)



Source: Kaiser P J. Following the Dollar in Reforming Road Maintenance.

Apart from that, as the government continues to build new roads, more budgets are needed from road fund as new projects need routine and periodic maintenance as well. So by unpacking the process, the CM highlights the possibilities of leakages on the implementation and road construction, which assists policy-maker to manage the process.

Performance-Based Management[8]

Performance based management is a kind of concept that helps government agencies to develop an effective measuring system for its projects. This measuring system will translate government intentions and societal goals into Key Performance Indicators, which is designed by the government and will be included in project documents for operating and maintaining transportation facilities. Typically, these KPIs are different numbers which include percentage, time, cost, ratios, indexes, dates, along with whatever can reflect project targets and government intentions and goals such as congestion management. Environmental protection can be achieved by conducting periodic review and indicator check, through which the government can guarantee that the operation of infrastructure projects comply with relevant regulations.

This methodology was not invented exclusively for infrastructure sector, but was applied to transportation area about two decades ago by the U.K., Australia, Canada, Japan and New Zealand, which are now recognized as leaders in performance based management. Application of this management systems has increased rapidly in transportation sector over the last decade and this management was initially referred to as a "transportation assent management system", which was famous for its effectiveness and potential for inducing success and some practitioners have built their infrastructure agencies on the general principles of performance based management, such as Japan's

[8] More information please refers to *Key Performance Indicators in Public-Private Partnership-A State-of-the-Practice Report.*

Ministry of Land, Infrastructure, and Transportation (MLIT) and Queensland (Australia) Department of Transport and Main Roads.

Table 3: The Application of Performance-Based Management in United States

Built on the notion of better understanding and controlling outcomes, the concept of using performance measurement to manage the efficiency of services and programs has been in the United States for over half a century. It was introduced under titles such as "RAND Corporation's system analysis" in the 1950s and "planning-programming-budgeting systems" in the 1960s. However, the approach of using performance measurement to manage highway systems is a more recent phenomenon' for a number of U.S. highway agencies. The process has been in development for about 40 years, but has made only incremental advancements each decade in the transportation sector. The 1970s and 1980s found Ohio, Pennsylvania, Washington, and Wisconsin creating maintenance management systems using performance indicators to reflect the scope and scale of the programs being performed at that time. In the early 1990s, Florida, Minnesota, Oregon, and Utah defined an early set of performance benchmarks for transportation after realizing that broader performance measurement focusing more on the outcomes of government programs was needed." In the mid-1990s, more State departments of transportation (DOTs) and metropolitan planning organizations (MPOs) began to establish and apply more comprehensive approaches to performance measurement in transportation systems. Over the past 10 years, more State DOTs and MPOs have turned to performance-based management in response to the limited resources for transportation systems and the resounding plea from the public for increased accountability in government programs before more tax dollars are spent on highway projects. All State DOTs now track asset condition and safety data, vital elements of a comprehensive performance management system, and are progressing toward a full and successful application of this system.

Source: Excerpt from *the Key Performance Indicators in Public-Private Partnerships, A State-of-the-Practice Report*

Recently, some researches give explanations to this method. They found that it is better to specify the private sector's performance in terms of required outputs (such as road surface quality), rather than inputs (such as road surfacing materials and design) wherever possible (the World Bank,

2017), since required inputs may limit private sector's creativity and innovation in responding to the contract requirements and also specifying inputs instead of outputs may result in less competition and more opportunity for corruption (Farquharson et al, 2011) For example, a World Bank study shows that for the power sector procurement in some countries, the contract will specify a particular technology in the RFP (Request for Proposal), with the intent of limiting competition and facilitating corruption. (World Bank Sourcebook on Government in the Electricity Sector)

However, the monitor and enforcement is another key consideration for performance requirement, how to gather useful information and how frequently the information is collected is critical for the public sector to evaluate the performance. And also, we have to notice that information is only part of the solution, public sectors (managers and elected officials) need to make good decisions based on this information for the process to be a success (Michael G, 2011).

Innovative Method for Road Maintenance Financing in Oregon

Nowadays, most countries finance their road maintenance fund from fuel tax. China initiated a modest reform of its fuel tax (excise tax imposed on the sales of fuel) in 2009, which led to an increase in the gasoline consumption tax. The original intent of this reform is good with the idea that whoever benefits more from using the road should contribute more to the road maintenance. However, due to the defects of the tax, the revenue is unstable and inadequate.

First, the fuel tax is levied on liter basis, it will not change with oil price and inflation. When the cost of road maintenance increases with the increase of labor and material cost, the revenue from fuel tax remains the same. Second, cars are becoming more fuel efficient due to technological progress and stricter environmental policy. According to a new survey conducted by the U.S. Department of Transportation, the average mileage per gallon of new cars increased from 20 in 2007 to 25 in 2015

and such efficiency improvements will definitely continue. Third, with the development of technology, electric vehicle becomes more and more popular in China. As a matter of fact, according to the International Energy Agency, China registered as many as 352,000 new electric vehicles (EV) in 2016. So relying on fossil fuel taxes "is a policy at war with itself".

One of the best international practices is the Road User Fee Task Force (RUFTF) implemented in Oregon, United States. The Oregon Legislature created the Road User Fee Task Force, an independent body in 2001 to investigate options for generating sustainable funding for Oregon's transportation system. This Task Force examined the challenges and benefits of a mileage-based road user charge system and the resulting program is OReGO, the nation's first fully-operational road usage charge program that was launched on July 1, 2015, which shows a new way to fund road maintenance, preservation and improvements.

Table 4: OREGON, Mileage-Based Road User Fee Evaluation

The Road User Fee Task Force (RUFTF) has examined various revenue raising alternatives for replacing the fuels tax as the primary source of revenues for Oregon's roads. The Oregon Department of Transportation (ODOT) is administering the task force. The driving motivation behind this effort is concern over the steadily eroding purchasing power of the fuels tax, a phenomenon resulting from: a) the fact that the fuels tax is not indexed for inflation; b) a general reluctance on the part of voters to approve periodic increases in the tax rate; and c) continued increases in the fuel efficiency of new vehicles, especially hybrids and alternative-fuel vehicles. ODOT conducted a test designed to demonstrate the feasibility of area-wide, mileage-based road user fees. The purpose of the pilot test was to demonstrate the technical and administrative feasibility of implementing an electronic collection system for mileage-based user fees and congestion tolls. The on-board technology was demonstrated in May of 2004. Twenty trial vehicles were equipped with the on-board devices in the fall of 2005. In the spring 2006, after verifying successful functionality, 260 trial participants in Portland, Oregon, had the on-board equipment added to their vehicles. For a period of one year, participants paid distance charges rather than the fuels tax (when they filled up at the station, the fuels tax was deducted from the bill and the mileage charge was added). At the conclusion of the study, ODOT successfully demonstrated the feasibility of mileage-based user fees.

Source: excerpt from *the Final Report of Oregon's Mileage Fee Concept and Road User Fee Pilot Program*

Section 5: Suggestions and Recommendations for Future Reform

The aforementioned methods and cases give great lessons to China in terms of infrastructure financing. However, mechanical copying of these methods will not root out the financing problems once for all. To make tangible progress in infrastructure financing innovation, the corresponding administrative management of infrastructure is required to be restructured. There are two prominent problems in the current management system.

The first one is that there are too many governing bodies which result in the fragmented supervision of infrastructure projects. There are almost ten different ministry-level agencies at the central government supervising different stages of the lifecycle of a infrastructure project, which includes the National Development and Reform Commission (NDRC), responsible for approving the general construction plan and determining the scope and scale of the project, the Ministry of Finance (MOF), responsible for project assessment and project financial ability analysis, the Ministry of Transportation and Ministry of Water Resources, responsible for issuing relevant licenses related to transport and water infrastructure, the Ministry of Environmental Protection, responsible for evaluating the environmental impact caused by the project, the Banking Regulatory Commission, responsible for the financing process of infrastructure, and also other Ministries if part of the infrastructure is related to their responsibilities. In addition, some of the procedures have to go through the local level system, since almost every ministry has their provincial agencies.

As we can image, this kind of multi-ministry supervision system has resulted in huge efficiency loss. A famous example was the Chengdu No.6 Water Plant. Chengdu is the capital city of Sichuan Province, located in the southwestern part of China, due to the fast growth of local economy

and population, the city authority wanted to expand its water supply system. The project had received strong support from the local government from the very beginning. The Chengdu Municipal Government took on the responsibility for the coordination with the central government for obtaining required approvals, and it took about one year to get very thing done before construction, even a special committee was set up to assist with the acquisition of different approvals. However, this was still considered to be very fast compared to other similar projects in China (Chen, 2009).

Table 5: The approval processes for the Chengdu No.6 Water Plant Project

No.	Approval	Approval Authority
1	Approvals for establishment and operation of the project company	
1.1	Approval for project company establishment	Chengdu Foreign Trade and Economic Cooperation
1.2	Pre-registration of project company	State Administration of Industries and Commerce
1.3	Business-opening registration and operating license	State Administration of Industries and Commerce
1.4	Foreign exchange registration	Chengdu Branch of State Administration of Foreign Exchange (SAFE)
1.5	Taxation registration	Local Taxation Administration
1.6	Fiscal registration	Local Fiscal Administration
1.7	Customs registration	Customs
1.8	Approvals on labor administration	Labor Administration of Chengdu

2	Approvals for project financing	
2.1	Approvals of financial agreements	State Development and Reform Commission, Ministry of Foreign Trade and Economic Cooperation
2.2	Foreign debt registration	Chengdu Branch of SAFE
2.3	Registration for foreign security	Chengdu Branch of SAFE
2.4	Registration of mortgage raised on water plant facilities	Chengdu Administration of Property, Chengdu Land Use Authority, and Chengdu Administration of Industries and Commerce
2.5	Audition and approval of loan repayment	Chengdu Branch of SAFE

Source: Chen 2009

The second problem is the lack of communication between governing agencies, and the disharmony between their regulations. The regulatory documents issued by different ministries often conflict with each other. Taking the PPP development for example, after Prime Minister Li Keqiang's famous speech on actively promoting PPP for project financing in 2014, several ministries issued a series of policies aimed to provide basic regulatory framework for PPP. However, there were notably differences in the three important documents issued by the State Council, the NDRC, and the MOF respectively. Meanwhile, the exact roles of the NDRC and the MOF, two powerful ministries for the overall approval and assessment of PPP projects, are still unclear. In practice, the NDRC requires all the local governments' development and reform commissions (local DRCs) to follow its documents, while the MOF instructs local governments' bureaus of finance (local BOFs)

to abide by its regulation (Hui, 2016), which caused lots of confusion and uncertainty to the society, especially private investors.

Table 6: Comparison of Regulatory Documents Issued by Different Ministries

Issuance Authorities	MOF	NDRC et al.	State Council General Office
Issuance Date	November 29, 2014	April 25, 2015	May 19, 2015
Document Title	Operational guidelines for public-private partnerships. (pilot)	Administration method for concession in infrastructure and public works	Notice of instruction on promoting public-private partnerships in public service
Key Legal Term	Public-private partnerships	Concession	Public-private partnerships
Whether VfM and fiscal affordability should be checked before the PPP project is awarded	Both VfM and fiscally affordablity should be checked before government approval; otherwise the project is not suitable for PPP	If the government needs to provide availability subsidy or evaluate VfM, follow the instruction of MOF.	Fiscal affordability should be checked. No mentioning of VfM.
Whether VfM and fiscal affordability should be checked after the PPP	Government approval is needed for contract revision, and the	The signatories of the contract should reach an agreement if the	The public and the private partners should negotiate of disputes,

project is awarded	government should evaluate the project every 3-5 years. However, it is unclear if VfM and fiscal affordability should be checked	contract needs revision, but it is unclear if VfM and fiscal affordability should be checked	but it is unclear VfM and fiscal affordability should be checked.
Legal instruments to resolve disputes	The private partner can resort to arbitration or file civil lawsuits against the public partner. The private partner can file administrative lawsuits against government regulator decisions	The concessioner and the government can invite expert or third-party mediation. The concessioner can file administrative lawsuits against specific administrative decisions.	Unclear.

Source: Hui Jin and Isabel Rial, 2016

A Two-tier Institutional Framework

Given the problems mentioned above, we propose restructuring and reforming the administrative management system with the application of various innovative approaches. Successful practices from other countries suggest that a strong management institution with experienced experts is important for the implementation of innovation.

After the overall introduction and analysis, we believe that a two-tier institutional framework is critical for the promotion of innovative financing methods in China. Creating a two-tier institutional structure, which includes both the national level and regional level can improve the coordination between the agencies affiliated with the central government and thus efficiency. The two-tier framework also gives sufficient autonomy to the local government in infrastructure management and in their innovation based on their individual socio-economic development.

For the national level, a central government agency is necessary to ensure closely coordination among different national authorities. Taking PPP for example, although the central government are actively promoting PPP currently, there is no organization at the national level in China exclusively responsible for PPP projects, such as Partnerships UK or the National Council for Public-Private Partnerships in the U.S., which is nonetheless an international common practice (According to an OECD report, all the 17 member countries have set up a dedicated unit.). In 2014, the MOF established its PPP unit, called PPP Center, with the purpose of becoming the central coordinator and playing a leading role in infrastructure financial innovation. However, due to the lack of representatives from other relevant ministries, especially from the NDRC, the center still cannot make itself a "one-stop shop" for any PPP regulatory issues (Hui, 2016). So we recommend that the proposed national-level framework should include representatives from all the relevant ministries[9].

Apart from the national level, we believe a regional-level institutional framework is necessary for China. As we all know, there are noticeable development differences among Chinese provinces, if we compare the Qinghai Province which is located in the western part of China with the Shanghai City which is the biggest city in the east coast, we can find that there is a huge gap from nearly all

[9] Coordination could not happen unless we bring all the stakeholders on board given the specific economic and political context of China.

available economic indicators you can find in the Year Book and infrastructure gap is the No. 1 cause for this uneven development. Taking advantage of its location and natural resources, eastern provinces became more industrialized and developed from the early 1990s, and entered an advanced stage of economic development compared to western and central parts of China (Yan Song, 2016). And, there are also big differences between western part and central parts of China.

Due to this discrepancy, the infrastructure demand, financing method, fiscal ability, users' number and the affordable level of user-fee differ substantially across the three regions. With the intention to reflect the difference and to give certain flexibility according to the specific economic development context of each region, the proposed framework will divide all the provinces into three regions, western region, central region and eastern region, mainly based on the economic development level.

Figure 5: Proposed Regions of China

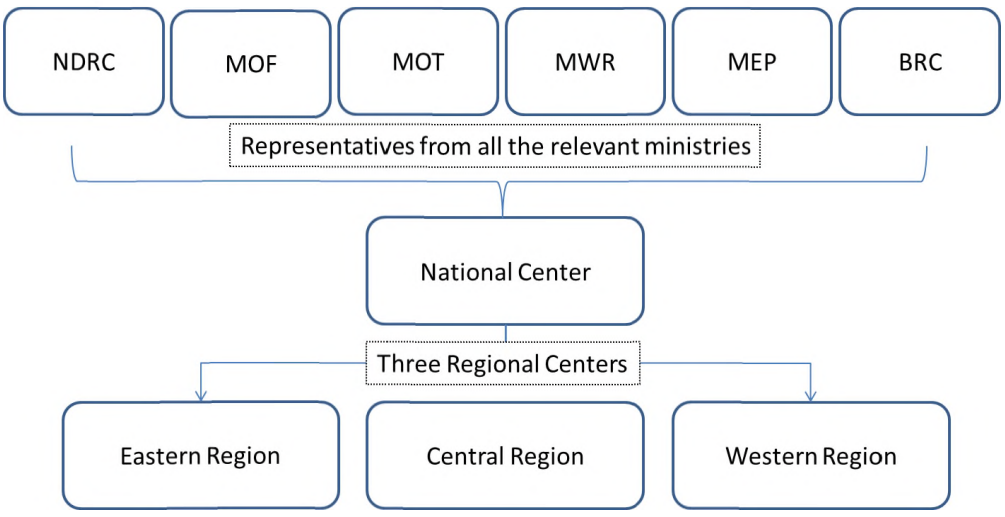
Source: China Regional Map, Chinamapxl.com

We believe that a regional-level rather than province-level institution structure is an appealing system for today's China. First, we all know that infrastructure projects, especially big projects, such as highways and railways often transcend provincial borders, regional infrastructure center will bring greater coordination across provinces and also will facilitate greater multi-province cooperation in the region, which will result in a more efficient construction and maintenance system.

Second, the infrastructure development does not have to be constrained by provincial boundaries, since provinces in the same region are grouped by similar demographics and economic level, the center can make infrastructure development plan based on broader economic activities in the whole region, which will overcome geographic barriers and eliminate infrastructure development imbalance across the region.

Last, such an arrangement will facilitate effectively the use of limited financial resources and avoid wasteful investment by transforming provincial infrastructure development competition into regional infrastructure partnerships, which benefits not only the region but also the whole country overall.

Figure 6: Proposed Structure of the Two-tier Institutional Framework



Source: Author

Table 7: Proposed Regions of China

Region	Provinces
Eastern	Beijing, Shanghai, Liaoning, Shandong, Zhejiang, Jiangsu, Fujian, Guangdong, Hainan, Hebei, Tianjin
Central	Heilongjiang, Jilin, Shanxi, Henan, Anhui, Hubei, Hunan, Jiangxi
Western	Nei Mongol, Gansu, Ningxia, Shaanxi, Sichuan, Chongqing, Guizhou, Guangxi, Yunnan, Xinjiang, Xizang(Tibet),Qinghai

Source: China Regional Map

A three-step implementation strategy

Although the two-tier system aforementioned will enormously improve the effects of the various innovative methods discussed in Section 3 and Section 4, it is advised to adopt these methods step by step, as these methods are experimented and applied by different countries throughout different stages of economic development and based on their own development status. In China's case, we propose a three-step strategy.

In the short term (within 2 years), the promotion of PPP should be the major goal, and the national center should take on the following responsibilities:

- Coordinating among different relevant ministries regarding infrastructure construction and maintenance issues, and making final decisions for any contradictions[10];
- Reviewing and checking relevant documents issued by different ministries to reduce confusion and uncertainties[11];

[10] Improving the coordination among all relevant ministries, especially the MOF and NDRC, is very important at the current stage.

[11] The national center should focus on consolidating all contradiction documents into a single, clear-cut and high-level regulatory document in order to reduce confusion and uncertainties for the society, especially for private investors.

For the three regional centers, they should take on different responsibilities:

- The western region should focus on making its own regional infrastructure development plan based on its comparatively lower development realities;
- The central region should focus on promoting regional infrastructure projects and attracting private investors;
- The eastern region should focus on providing technical assistant and professional advisory for the provinces within this region;

In the medium term (2-5 years), the national centers should take on the following responsibilities:

- Clearly assigning roles and responsibilities to different ministries, reducing their overlapping jurisdictions of infrastructure projects supervising;
- Removing the barriers that still constrain private investors' entrance, broadening the areas and industries where private capital is encouraged to enter.

For the three regional centers, the major goal should be exploring and developing innovative financing methods for construction and maintenance of infrastructure based on their differences, and

- The western region should focus more on adopting the Value Capture method taking advantage of its vast undeveloped land resources;
- The central region should focus more on studying the FHWA's case, and trying to create several tools with the emphasis of improving the using efficiency of the existing capital instead of just focusing on seeking new funding resource;

- The eastern region, which has a more advanced and mature infrastructure system, should begin to think about infrastructure maintenance issue, which troubles many developed countries nowadays[12].

In the long term (5-10 years), the national center should focus on:

- Conducting periodic review of infrastructure projects to guarantee the projects compliance with relevant regulatory documents;
- Disclosing projects information to the public and relevant investors.
- Issuing explicit guidelines for accounting, reporting and auditing procedures;

The regional centers should begin to consider two things:

- How to apply Perform-based management in order to improve the administrative capacity for their provinces and develop an effective measuring system for the projects in their region;
- How to change the fuel tax funding system based on the practice in Oregon (Mileage-Based Road User Fee), which has been proved to be a more sustainable funding method for infrastructure maintenance.

[12] The problem starts to appear in well-developed cities such as Beijing and Shanghai and we needs to plan ahead.

Section 6: Conclusions

We want to stress that infrastructure financing innovation is a complex issue, and there are no perfect methods. In order to make full use of these methods, we must familiarize ourselves with the scope of application and the equipping environment of various financing methods and draw upon the lessons from other countries' application of these methods.

Different countries have their own headaches in this area. This also true for a specific country in its different development stages. Even today, many developed countries are still suffering a lot from infrastructure financing difficulties and are actively working on exploring methods for tackling infrastructure financing. We cannot expect to eradicate this challenge once-and-for-all in the near term, and infrastructure financing difficulties will probably persist throughout China's economic development in the next a couple of years. China needs to draw lessons from successful experiences of other countries, but it should always base its practice on its own development realities.

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