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Public procurement as a demand-side innovation policy tool in China - a national level case study

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Abstract

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Abstract:

The development of non-linear innovation theories especially systems of innovation (SI) approaches has stimulated the differentiation of innovation policy tools, and demand-side innovation policies (DSIPs) started to draw increasing attention because they can effectively remedy system failures especially regarding user-producer interactions. Among various DSIP instruments, innovation oriented public procurement (IOPP) is considered as extremely potent since this approach enables the state to act as lead users to ‘pull’ innovation processes as well as to achieve social missions. The Chinese government announced explicitly in the National S&T Program (2006-2020) to utilize IOPP to spur ‘endogenous innovation’, following which many actions have been taken by related government agencies.

This paper aims to answer two questions through a qualitative case study at the national level: How has IOPP become an innovation policy tool in China under the circumstances and development trends of its national innovation system? What is China’s current national IOPP mechanism like and how it operates? Primary data collection was conducted through elite interviews and secondary data used in this paper are mainly obtained from academic search engines, government reports/statistics and mass media. Main findings include that the IOPP mechanism in China is a result of co-evolution of innovation policy and related research; that the mechanism is systematic with strong catching-up intention, and overwhelmingly top-down rather than bottom-up, which is distinct from EU experiences; that in spite of the distinction, IOPP measures taken by the Chinese government are consistent with theoretical perspectives in existing EU literature.

Keywords:

Innovation policy, demand-side, innovation oriented public procurement (IOPP), catalogue of innovations, IOPP mechanism, China

1. Introduction

The development of non-linear innovation theories especially systems of innovation (SI) approaches has stimulated the differentiation of innovation policy tools, and demand-side innovation policies (DSIPs) started to draw increasing attention because they can effectively remedy system failures especially regarding user-producer interactions. Among various DSIP instruments, innovation oriented public procurement (IOPP) is considered as extremely potent since this approach enables the state to act as lead users to ‘pull’ innovation processes as well as to achieve social missions. In the case of China, it has been argued that IOPP could be even more stimulant given the hugeness of domestic markets, the catching-up intention as a developing country and the important roles played by various levels of governments (OECD, 2008). In 2006, the Chinese government announced explicitly in the National S&T Program (2006-2020) to utilize IOPP to spur ‘endogenous innovation’, following which many actions have been taken at both national and regional levels.

How has IOPP become an innovation policy tool in China? What is China’s current national IOPP mechanism like and how it operates? This paper aims to answer these two questions through a national level case study, which flows as follows: Section 2 serves as a background part with 2.1 covering the definition of key concepts related to this topic (IP, DSIP and IOPP) and explaining the rationale, typology and EU experiences for IOPP as an effective policy tool, and with 2.2 introducing the methodology adopted in this project. Section 3 traces back historically how IOPP has become an explicit IP tool in China in the context of its national innovation system (NIS), followed by section 4 which outlines the current IOPP mechanism at the national level. Section 5 discusses the findings further with policy recommendations proposed.

2. Background knowledge and methodology

2.1 Innovation oriented public procurement (IOPP) as a demand-side innovation policy instrument: definition, rationale, typology and EU experiences

As it has become a consensus that innovation is a crucial means to strengthen international competitiveness in the context of a globalized knowledge-based economy, the effectiveness of innovation policies has also been soundly justified by related theories and verified by practices¹. Here *innovation policy* (IP) is defined as *any policy measure which seeks to, singly*

¹There is sufficient literature on the functioning of innovation in accelerating economical and social development, to name only a few these include Arrow (1962), Fagerberg et al. (2006), Freeman (1987), Freeman & Soete (1997), Kline & Rosenburg (1986), OECD (1996), OECD (1999). The rationality of public intervention in innovation processes has been justified by the neo-classical model’s notion of ‘market failure’ and evolutionary theory’s notion of ‘system failures’, see Chaminade & Edquist (2006), etc. Evaluation and comparison of innovation policies in the global context can be found in *OECD Reviews of Innovation Policy*.

*or collectively, improve the conditions, or promote the development, or stimulate the diffusion of innovations*². Historically the making of innovation policy, underpinned by a linear model of innovation process, had heavily depended on traditional measures such as R&D subsidies. The emergence of alternative innovation theories since 1980s (e.g. the chain-linked model, distributed process model and interactive learning theory) contributed to the development of the ‘systems of innovation’ approaches, providing a coherent framework for differentiating innovation policies (Lundvall 1992; Edquist & Hommen, 1999; Mytelka & Smith, 2001). A taxonomy of differentiated innovation policies has been proposed in Georghiou (2006), where three categories of innovation policies were identified, namely supply-side measures (e.g. R&D subsidies and fiscal supports), demand-side measures (e.g. standards and public procurement), and framework conditions (e.g. human resources, IPR protection).

Here the definition of a *demand-side innovation policy* is *any innovation policy that aims to increase the demand for innovations, to improve the articulation of demand in order to spur innovations and to accelerate the diffusion of innovations* (Edler, 2007). DSIP has been justified by Edquist (1999) as theoretically capable of blending public interventions into various segments of the innovation process, whereby to overcome market and system failures more effectively. Among the variety of DSIP instruments, public procurement is considered as the most powerful since in this approach, governments can act as ‘lead users’ to stimulate the emergence of innovations, facilitate the creation of local markets, reduce the entry/transaction costs for innovative solutions, and hence to accelerate the diffusion process (von Hippel, 1986; Edquist et al, 2000; Edler and Georghiou, 2007). There have been several notions of public procurement activities that are intended to stimulate innovation, e.g. ‘public technology procurement’ (PTP) in Edquist et al (2000), and ‘public procurement of innovation’ in Edler & Georghiou (2007). This paper proposes to name this kind of procurement activities as *innovation oriented public procurement*, since sometimes IOPP doesn’t necessarily involve technological changes but organizational innovations. In this paper IOPP is defined as *any public procurement activities that aim at stimulating the creation, improvement, adaption and diffusion of innovative solutions*.

IOPP can effectively promote innovation through several dimensions. On one hand it can facilitate the articulation of demand. In Edquist (2000), three kinds of demand structures were elaborated³ and the applicability of IOPP in each situation was discussed. The three structures are ‘monopsony’ (only one buyer in the market), ‘oligopsony’ (a small number of buyers in the market), and ‘polyopsony’ (a large number of buyers in the market without big shares). As in the case of monopsony the ‘demand pull’ is highly concentrated, through proper

² This definition of innovation policy is drawn from Georghiou (2006) and Edler (2007).

³ This classification of demand structure was proposed initially by Rothwell and Zegveld in 1982.

arrangement, the government can facilitate to form critical mass for innovations. In the case of oligopsony, which is the most favourable condition for innovation, through IOPP the government can play as 'lead users' (Georghiou, 2006) to stimulate the creation of innovations and facilitate the establishment of standards. In the case of polyposony, IOPP could be used as a catalyst for private sector, e.g. by demonstrating the advantages of innovations, the government can encourage the private demand. On the other hand, linking to the classification of system failures⁴, IOPP can firstly remedy infrastructure failures since in this approach public agencies can identify the social needs and translate them into public demand and then fulfil it. The procurement of innovative solutions can lead to a general improvement of public services and facilities. Secondly, IOPP can help to reduce the entry/transaction costs and risks of innovations, which helps firms to overcome capability failures. Thirdly, through IOPP public agencies will enhance the interactions with suppliers (or in the case that the agencies are not end users, the user-supplier interactions; in the case that there are many suppliers, the supplier-supplier interactions; in one phrase, horizontal and vertical integration) and hence remedy network failures. Fourthly, IOPP can help to establish standards and regulations (hard institutions), and help to raise the public's awareness of innovations (soft institutions), which could remedy institutional failures.

According to different rationales, a few authors proposed various typologies of IOPP. Edquist (2000) categorized IOPP into 'developmental' versus 'adaptive', 'procurers as end-users' versus 'procurers as catalysts'. Edler et al (2005) categorized IOPP into 'general' versus 'strategic', 'direct' and 'cooperative' and 'catalytic', 'market creation', 'market escalation' and 'market consolidation'. The typology this paper adopts is the one proposed by Edler & Georghiou (2007), i.e. 'general public procurement' (where innovation becomes an essential criterion in the call for tender and assessment of tender documents) versus 'strategic public procurement' (where the demand for certain technologies, products or services is encouraged in order to stimulate the market), 'state procurement in connection with private users' (where government agencies buy jointly with private purchasers and both utilise the purchased innovations), and 'commercial' versus 'pre-commercial' (according to the degree of commercialization of innovative solutions).

In spite of the theoretical support and academic achievements, there was historical neglect of DSIP in practice; supply-side measures has remained as the dominant innovation policy tools and the measurement of innovation policies has been mainly based on this approach (Edler et al., 2005). Until recent years, DSIP approach started to receive growing attention again; initiatives for conducting IOPP have been taken broadly among EU countries with

⁴ See Smith (2000), Woolthuis et al. (2005), and Carlsson & Jacobsson (1997): system failures are generally classified into infrastructural failures, institutional failures, network failures and capability failures.

quite a few good examples emerging (European Commission, 2007; DTI, 2006; Lember et al, 2007).

Edquist et al (2000) provided a series of case studies regarding public technology procurement practices (PTP) in several Europe countries (Sweden, Finland, France, Italy, Greece and Austria) and argued against the ‘historical neglect’ of PTP as an innovation policy tool. In 2006, the Aho Group Report ‘Creating an innovative Europe’ (Aho et al., 2006) suggested governments to ‘use public procurement to drive demand for innovative goods, while at the same time improving the level of public services’. Following this initiative, many EU countries enhanced their employment of IOPP as an innovation policy instrument, and this has been reflected by numerous case studies conducted by both researchers and public agencies. As one of the initial studies focused on IOPP, the European Commission committed project ‘Innovation and Public Procurement – review of issues at stake’ (Edler et al., 2005) conducted nine case studies (covering Germany, Austria, Norway, Netherlands, United Kingdom and Italy), regarding especially the risk control and internal organization issues during IOPP processes. With methodology adapted from Edler et al. (2005), the project ‘Public procurement in Baltic metropolises’ (Lember et al., 2007) conducted eight case studies highlighting the IOPP mechanisms in innovative Baltic metropolises, e.g. Copenhagen, Tallinn and Malmo. The main features of these case studies were the emphasis on IOPP’s impact on market (i.e. market creation, escalation, or consolidation) and the distinguishing of direct, co-operative and catalytic procurement. Not all the cases were suitable for analysis as IOPP cases since they didn’t all include new or significantly improved technologies; after screening the cases and further analysis, policy recommendations were provided to these cities. Other policy reports covering IOPP case studies include the EU Project of OMC-PTP (Bodewes et al., 2009) and ‘Risk management in the procurement of innovation’ (Tsipouri et al., 2010)⁵. More recently there are specialized IOPP research programs in progress, for instance, the ERA-PRISM project which focuses on IOPP in small EU member countries⁶.

In the case of the UK, several departments have taken the initiative to conduct IOPP practices, e.g. Department of Health, HM Revenue & Customs, and especially, Department for Business Innovation & Skills (BIS). In March 2007, the ‘UK Government’s Sustainable Procurement Action Plan’ highlighted the approach of ‘Forward Commitment Procurement’ (FCP)⁷. Following this, BIS has been working on promoting FCP to stimulate innovations, and has carried out a series of FCP case studies⁸. These case studies, although not as detailed

⁵ This report highlights the risk control issues in IOPP practice, available at http://ec.europa.eu/invest-in-research/pdf/download_en/risk_management.pdf

⁶ See <http://www.eraprism.eu/>

⁷ <http://www.defra.gov.uk/sustainable/government/documents/SustainableProcurementActionPlan.pdf>

⁸ Case studies available at <http://www.bis.gov.uk/policies/innovation/procurement/forward-commitment>

and structured as case studies conducted by the mentioned research projects, have provided a general picture of the ongoing efforts to promote innovation through public procurement in the UK.

To summarize, IOPP in the EU is mainly conducted in a bottom-up rather than top-down way, where ‘best practices’ are identified through concrete case studies as benchmarks for ‘learning lessons’. As to detailed tendering process, the use of market research and technological dialogues (instead of traditional open tendering) becomes more and more popular now, and interactions between stakeholders are strongly encouraged by experts.

2.2 Scope and Methodology

To explore China’s ongoing IOPP activities in a comprehensive way, the scope of this case study includes three dimensions: historical development, current whole picture and regional initiatives, elaborated respectively in following sections. As shown in table 1, this national level case study relies mostly on secondary data, e.g. government reports/statistics and mass media. Particularly section 3 summarizes the history of China’s NIS based on a review of existing literature since there are already a number of articles tracing back this story.

Table1 Scope and methodology of this case study

Dimensions	Data sources	Focus of analysis
Historical development	Policy & government reports, academic literature (Chinese & English)	NIS’s impacts on IOPP development; relation between IOPP research and policies
Current whole picture	Government reports/statistics, mass media, elite interviews	Relations between levels of government and other stakeholders
Regional initiatives	Policy/government reports, local reports, mass media, elite interviews	Relations between IOPP initiatives and GDP & innovativeness

Primary data are derived from elite interviews⁹, with interviewees covering national (from *Ministry of Science and Technology*, MOST) and regional officers (from Beijing, Shanghai, Guangdong and Shandong), researchers (from *Shanghai Jiaotong University*, SJTU and *the Chinese Academy of Science and Technology for Development*, CASTED) and a manager from China Southern Railway Co. Ltd. The selection of interviewees is based on two criteria:

⁹ By January 2011, 8 face-to-face interviews have been conducted in China for this project; it is planned at least 20 more interviews will be conducted in May 2011, covering not only officers and researchers, but also procurers and suppliers in concrete IOPP processes. Different from this national case study which heavily depends on secondary data, regional and micro case studies will rely more on primary data collected from future interviews.

First, through outlining the Chinese IOPP mechanism, several levels (national, regional and micro) with key stakeholders (officers who participate in policymaking and implementing, researchers who are conducting related projects, procurers, suppliers and users of innovative solutions, etc.) were identified, and thus a list of initial contacts was developed based on available resources. Second, after contacts with potential interviewees were established, a set of pre-interview questionnaires were designed according to their roles in the IOPP mechanism¹⁰, and then sent out to obtain the interviewees' background information and overall attitudes regarding many practical issues in IOPP processes. The results of these questionnaires serve as a second criterion, which helps to identify whether or not the respondents are knowledgeable enough for this project. In this case study, information collected from interviews is mainly used for triangulation for secondary data.

3. Historical development of China's national innovation system (NIS) and the initiative of IOPP as an innovation policy

3.1 Historical development of China's NIS – a brief review of literature

Most literature concerned with the development of China's NIS considers the year of 1978 as a starting point, and analyzes the historical development in terms of 'reforms' (Baark, 2001; Gu & Lundvall, 2006; Xue, 1997; OECD, 2008; etc.). This angle of view is fairly relevant with respect to China's situation as her history in recent three decades, whether of S&T policy and NIS, or of other dimensions of the society (such as education, agriculture and cultural issues), is actually waves of reforms.

Researchers have adopted alternative approaches while analyzing this object, e.g. Baark (2001) interprets the policy evolution through a conceptual framework of 'four competing S&T policy cultures', with a taxonomy namely 'bureaucratic, economic, academic and civic'. This approach is useful when investigating the driving forces of policy reforms and helps to understand the nature and causal mechanisms underpinning S&T development. As one of the first attempts to account for China's history of NIS, Xue (1997) provides quite a holistic view through a case study with documentation analysis as the major method. It generally divides the development of NIS in China into two phases, 'pre-reform' and 'reform & its impacts', ending with an analysis of remaining problems and policy implications. This approach is more commonly adopted and elaborated in other references (Gu & Lundvall, 2006; Chapter 8 in OECD, 2008). It's worth noting that Liu & White (2001) argues that existing analytical conceptual frameworks for NIS are mostly focused on behaviours of various actors, while the

¹⁰ The design of the questionnaires was based on a thorough review of Chinese literature and the author's EU project experiences.

systemic level of analysis is neglected. They developed a novel framework of ‘five fundamental activities’ and a notion of ‘primary actors, secondary actors and institutions’ based on Lundvall (1992), to increase the applicability of the framework to various national contexts and thus towards a more theoretical approach. This analytical model is argued as transferable to many concrete situations, especially in the sense that there are not as many papers focused on China’s NIS as focused on OECD countries, this approach could be applied to the Chinese context (as demonstrated in Liu & White, 2001) as well as other countries. Integrating the findings of literature above, the historical evolution of China’s NIS could be summarized in table 2.

Table 2 Evolution of China’s NIS in terms of policy milestones (based on literature review)

Years	Background	Main measures	Actors and Interactions	Impacts
1975-1978	Termination of Cultural Revolution; Imperative of economic development.	‘Bringing order out of chaos’ for the role of S&T; removing ideological and cultural barriers.	Public research institutions as the only R&D means; barely any interactions within the ‘NIS’.	People’s mind emancipated for economic and S&T development.
1978-1985	‘Open-door’ decision; unfolding experimental economic and education reforms.	Learning by doing; addressing the shortcomings of Soviet S&T model.	Universities getting involved; R&D abilities of firms recognized; weak science-industrial link established.	Successful spin-off firms; better innovation diffusion.
1985-1995	Rapid international S&T development; the need of complementing economic reform.	Initiating institutional and personnel reforms; commercializing PRIs; initiating key S&T programs.	Stronger firm R&D; university-firm link established; PRI-firm link enhanced.	Systemic structure established; confidence for further reforms.
1995-2005	Fast economic growth; severe S&T competition; globalization.	Deepening the reform; systemic measures; specialized S&T programs.	Connections between actors strengthened: firm-PRI; univ.-firm; univ.-PRI.	More efficient policymaking; more systemic and dynamic NIS.
2006-	Sustainability of development highlighted; imperative of corresponding social development	<i>The National Guideline on Medium-and Long-Term Program for Science and Technology Development (2006-2020)</i> was issued; towards a harmonious society and endogenous NIS.	Firm-centered, stronger interactions between innovative actors; the role of government being adjusted from top-down to an interactive component of NIS in the knowledge-based economy.	Towards the development of a coherent NIS with differentiated policy tools and reflection mechanisms.

The National Guideline on Medium-and Long-Term Program for Science and Technology Development (2006-2020) (hereafter Program (2006-2020)) has designed a relatively ideal structure of future Chinese NIS, which puts the firms in the centre of the system, interacting with other factors such as universities, public research institutes (PRIs) and governmental departments (the State Council of P.R.C., 2006). The Chinese government is determined to introduce a new framework for innovation governance, i.e. to create a friendly environment for innovation processes instead of direct interventions, to interact with main actors of NIS instead of simply issuing orders to them, and to adopt differentiated policy instruments under certain conditions instead of one-size-fits-all policy measures.

3.2 IOPP gaining ground: a co-evolutionary phenomenon in the Chinese political and academic arenas

The emphasis on enterprises as the core factor of China’s NIS makes it more realistic to promote innovations through IOPP. To distinguish ‘routine’ government procurement practice which seeks to save budgets and increase transparency from the notion of innovation oriented public procurement (IOPP), here the routine procurement is categorized as *regular public procurement* (RPP). Regular public procurement in China has been developed rapidly since 1996, spurred by an organizational reform initiated by the Ministry of Finance (MOF). In 2002, the promulgation of *Law on Public Procurement of the People’s Republic of China* indicated the legalization of RPP, and corresponding expenditure expanded steadily during past decades, see figure 1.

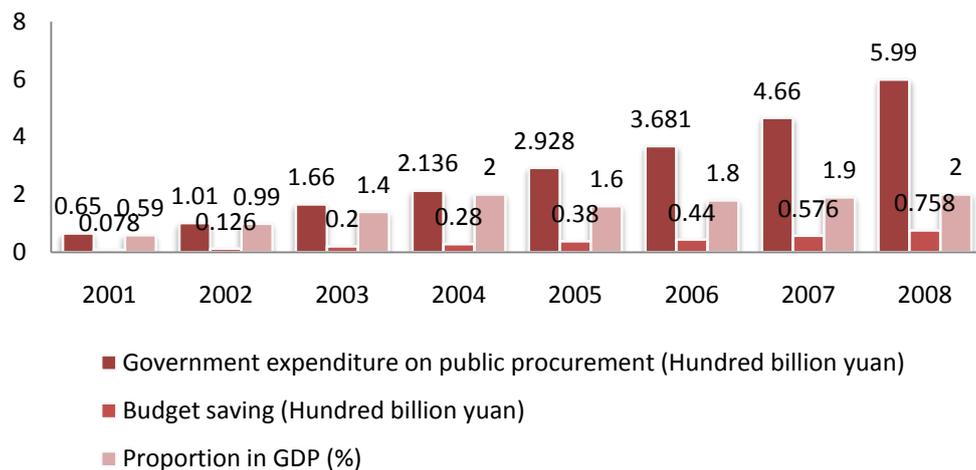


Figure 1 Regular public procurement expenditure in China (2001-2008) ¹¹

¹¹ According to MOF website, expenditure on public procurement in 2009 was more than 700 billion yuan. Data sources: statistics from China Central Government Procurement (CCGP) Website, see <http://www.ccg.gov.cn/specialtopic/ggkf30y/sz10n/816023.shtml>

Although the proportion of RPP expenditure in GDP has expanded from 0.59% in 2001 to 2% in 2008, it is still considerably lower than that of many OECD countries (OECD, 2008). This indicates that IOPP in China can have even greater potential if more budget can be spent on public procurement as a whole, which seems to be the trend in future years.

As mentioned before, Program (2006-2020) for the first time explicitly announced IOPP as an innovation policy tool; to respond to this initiative, in 2006 and 2007, MOF, MOST and *The National Development and Reform Committee* (NDRC) respectively issued a number of measures to implement the Program, constituting as a regulatory system for IOPP practices in China. If we trace back the historical development of this system, this process can be summarized as follows.

In 1996, MOF initiated a public procurement reform among governmental departments, and the year 1996 has been considered as the first year of ‘the public procurement era’ in China. By that time, the government had depended mainly on supply-side S&T policies especially R&D subsidies as the main instrument (Wang et al., 2000). In 2000, MOF set up a specialized website named *China Central Government Procurement (CCGP)*¹² as a platform of communication between suppliers and procurers, the government and the public, and other people who may concern e.g. researchers and the media. CCGP’s local branches for provinces and municipalities were set up in following years as well, aiming to enhance the transparency and equality in procurement processes. In 2002, *Law on Public Procurement of the People’s Republic of China* was promulgated, which was the starting point of the legalization of public procurement in China, and following this lower levels of governments also accelerated the legalization, regularization and implementation of public procurement in their local areas.

In 2006, Program (2006-2020) was issued by the State Council, and IOPP for the first time was mentioned as an innovation policy instrument. The *Implementation Measures for Program (2006-2020)* was announced at the same time, covering many aspects including S&T budget, tax reduction, financial support, IOPP, IPR protection, human resources etc. On December 1st 2006, NDRC, MOF and MOST jointly issued *The National Administrative Measures of Certifying Endogenous Innovations (Trial)*¹³, stating that enterprises can apply for ‘national innovation certifications’ for their innovative solutions, and certificated products form a ‘catalogue of innovations’, which can be used as a guidance for procurers who intend to buy innovative products. Meanwhile, the three ministries announced that they were working together with related departments and expert groups to prepare the first round of certification work. In 2007, five more administrative measures were announced by MOF,

¹² Website: <http://www.ccgp.gov.cn>.

¹³ There is no uniform English translation of these items, as the original documents are all in Chinese.

covering practical IOPP issues such as contract management, product evaluation, budget management, pre-commercial procurement, and procurement of imported products. While no big actions were taken by the central government in 2008 and 2009, many regional governments took their initiatives to conduct IOPP activities. For instance, before the central government could develop any innovation catalogues at the national level, many regions had developed their own catalogues, e.g. Jiangxi, Shandong and Guangdong, and the tendency of decentralization and regional protectionism became more obvious¹⁴. In December 2009, a *Guiding Catalogue of Endogenous Innovation on Key Technological Equipments (version 2009)* was jointly issued by Ministry of Industry and Information Technology (MIIT), MOST, MOF and the *State-owned Assets Supervision and Administration Commission of the State Council (SASAC)*, stating that the technologies listed in the catalogue have the priority to be developed because they are currently in high demand in the country. This key-equipment catalogue has been updated in 2010 and the 2011 version is under modification as well. The national innovation catalogue mentioned above, however, hasn't been published as planned¹⁵. To summarize, the legalization and regularization of public procurement has provided the basis for IOPP in China; the Program (2006-2020), its implementation measures and the six administrative measures have formed a regulatory system for IOPP practices, and the catalogues (existing or to be published) serve as an operational platform for suppliers and procurers.

As public procurement activities in China become more legalized and common at different levels of governments, there have been an increasing number of academic publications focused on the potential of using public procurement to stimulate innovation, which is also significantly affected by the growing interests in this area in the international context. Based on a recent search for Chinese literature in this area¹⁶, various research themes have been identified, including IOPP rationale justification, e.g. Zhao & Cai (2007), and Sun & Yang (2009); IOPP legalization, e.g. He et al. (2010) and Dong (2009); foreign IOPP experiences introduction, e.g. Jiang (2010) and Zhang & Cheng (2006). According to the search results, before the year of 2000 there was barely Chinese literature discussing the potential of using public procurement to promote innovation. Since 2000, there have been a few articles

¹⁴ There are many news focused on regional catalogues, and for each province's catalogue, they only include local products rather than products from other regions, see http://www.hsw.cn/news/2009-02/17/content_10607553.htm and http://www.hnzbedu.com/zbw/zbxx_show.aspx?id=3819 as examples.

¹⁵ MOST stated clearly on their website that the first version of national innovation catalogue will come out by the end of 2007, see http://www.most.gov.cn/tztl/cxqvgzhy/cxqyhydt/200702/t20070226_41516.htm; on Oct.30th 2009 and May 10th 2010, two other rounds of certification work were initiated again, but still no results have been published yet, see http://www.most.gov.cn/tztg/200911/t20091115_74197.htm and http://www.most.gov.cn/tztg/201004/t20100409_76710.htm

¹⁶ Final updated on September 2nd 2010, search engines include (1) www.wanfangdata.com.cn (2) www.ilib.cn (3) www.cqvip.com (4) www.cnki.net (5) <http://scholar.google.com/schhp?hl=zh-CN>. In total 141 articles, 4 masters dissertations and 1 PhD thesis closely related to this topic were found.

emerging every year, calling for attention from the government to the potential of IOPP (e.g. Peng (2000) and Hu (2001)). According to an interview of a researcher in this area, this academic initiative has ‘undoubtedly lead to the debate of public procurement as an innovation policy among researchers from state-owned research institutes’. Although China is still badly lagging behind in this area, considerable development is witnessed during the past 10 years. Since 2006, the year when Program (2006 – 2020) was announced, the number of IOPP related publications has risen considerably. And through reviewing the content of the literature, it can be concluded that the focus of research has changed as IOPP policies go deeper and deeper in China, from explaining the rationales of IOPP (e.g. Zhang (2004)) to ‘borrowing experiences from foreign countries’ (e.g. Zhang & Cheng (2006)) and more recently, to providing policy implementation suggestions (e.g. Chen & Lao (2010)).

By reviewing the history of China’s NIS, the development of public procurement as a more and more regularized government activity, the continuous making of IOPP related policies and the evolution of academic research on IOPP, this section reaches several conclusions. First, the regularization of public procurement and the more firm-centred NIS in China have provided a basis for the systemic use of IOPP; second, IOPP policymaking in the political arena has been affected by IOPP research in the academia; and third, IOPP research has in turn been affected by the development of IOPP policies. In one sentence, IOPP research and IOPP policymaking in China are co-evolutionary with each other under the circumstances of its public procurement system and NIS as a whole.

4. Outlining the current IOPP mechanism at the national level: structure, regulations and themes

After the historical evolution of IOPP has been explained in previous section, this part moves on to provide a holistic overview of the current mechanism that underpins concrete IOPP activities in China. Based on an analysis of the government documents mentioned in 3.2, several factors are identified to compose the mechanism, including: (1) people involved, i.e. policymakers (officers from levels of government, ministries and corresponding local departments), expert groups/think tanks, procurers (professional buyers, governments, and other organizations), suppliers, users (sometimes different from procurers) and researchers; (2) regulations, i.e. international and domestic legal frameworks, policy guidance (e.g. Program (2006-2020)) and implementation measures; (3) themes, i.e. emphasis or development programs in certain areas (environment, new energy, etc.); (4) catalogues, i.e. the catalogues of innovations (national or regional) and the catalogues of key equipments. In particular, catalogues serve as a ‘hub’ for all the factors to operate systematically.

4.1 The use of catalogues: advantages and pitfalls

There are two kinds of catalogues in the Chinese IOPP mechanism, as mentioned before, here short for ‘innovation catalogues’ and ‘equipment catalogues’. According to their respective implementation measures, the notion of ‘innovation catalogues’ came into use in 2007, and MOST, MOF and NDRC are in charge of implementing this instrument based on *The National Administrative Measures of Certifying Endogenous Innovations*. MOST is mainly responsible for the technological part, i.e. calling for applications from firms and local governments and organizing expert groups to conduct certification work, while MOF is more responsible for the financial part, i.e. to amend procurement measures (both at the national level and local levels) more favourable for certificated innovative products. It is clarified that innovation catalogues should be updated regularly, and work as a reference (rather than a regulation) for procurers¹⁷.

The notion of ‘equipment catalogues’ which came into use in end 2009, on the other hand, is very different from innovation catalogues. Rather than a bottom-up approach in which the government calling for applications from enterprises and then form a ‘what we have’ list, an equipment catalogue states clearly what kinds of key technologies are in great need in China (a top-down ‘what we want’ list with specified technological requirement), and if enterprises (or other organizations/individuals) intend and have the potential to develop the listed technologies, the government will provide them various supporting measures such as R&D subsidies, tax reduction and pre-commercial procurement. If a technology on the equipment catalogue is successfully developed, it has the priority to be listed in the innovation catalogue, and the updated version of equipment catalogue will no longer include the developed technology (MIIT et al., 2009). By working together in two directions, these two kinds of catalogues are supposed to stimulate innovation through both ‘push’ and ‘pull’ forces.

However, the implementing progresses of the two catalogues have been distinct by now. As mentioned in 3.2, although MOST has announced for three times (2007, 2009 and 2010) that they were conducting certification work for innovative products, no catalogue has come out yet. The missing of innovation catalogues at the national level didn’t discourage local governments: according to a recent search (by February 2011) across regional government websites, around half of the provinces/municipalities in mainland China have their own innovation catalogues. On contrary, the implementation of equipment catalogues seems to be in a very centralized way, with national level catalogues keeping updated year by year and no localized versions at lower levels of government.

¹⁷ MOST officers explaining the use of innovation catalogues http://news.xinhuanet.com/politics/2007-02/26/content_5775034.htm

Are innovation catalogues actually working well at the regional level? Here the information from in-depth interviews with regional officers may provide some clues. An officer from a provincial S&T committee (supervised by MOST) thinks that a main problem hindering the implementation of innovation catalogues lies in that 'it is the S&T department's job to design the catalogues, while it is the financial department who has money, decides what to buy, and monitors the process'. Another provincial S&T officer thinks that monitoring the using of innovation catalogues is 'beyond our missions', so he has no knowledge about downstream effects. Again, on contrary, a provincial officer from local commission of economy and informatization (supervised by MIIT) seems to be very confident about the implementation of equipment catalogues, talking about several successful examples actively. Through interviews and further analysis of related regulations, it has been identified that both equipment catalogue design and implementation are conducted by MIIT and its lower level departments, which can effectively prevent the co-ordination problems between different departments. To summarize, compared with bottom-up innovation catalogues, the top-down and centralized equipment catalogues are more consistent with the institutional setup of China's IOPP mechanism, and hence can come into effect more quickly.

There are also other difficulties hindering the implementation of innovation catalogues. First, it is difficult to draw a boundary for 'endogenous innovative products'. As stipulated in the certification measures, seven criteria are set up for innovative products, including: it should be consistent with laws and science, technology & innovation (STI) policies; the enterprise/individual should have intellectual property (IP) ownership in China through their own innovation activities; the product should have a trademark registered in China and owned by the applicant; the product should embody high innovativeness, leading technologies in terms of international standards, reliable quality, and a great potential of commercialization. In practice, however, these criteria are not detailed enough, and the definitions of 'IP ownership', 'registered trademark', 'high innovativeness' etc. haven't been officially clarified yet, which can easily lead to rent-seeking and fraud activities (Peng & Luo, 2009; Cao, 2010). Second, linking endogenous innovation catalogues directly to public procurement has drawn criticisms from foreign business sectors who are in 'deep concern' that foreign companies will not get fair treatment in China as a result of the IOPP policies¹⁸. A third challenge is China's forthcoming accession to the WTO's Government Procurement Agreement, which is currently under intensive preparation in the country¹⁹.

¹⁸There are news reporting the 'deep' concerns from foreign business sectors both in Chinese and in English, see: <http://www.nbd.com.cn/newshtml/20101123/20101123133036177.html> and <http://in.reuters.com/article/2010/02/25/idINIndia-46479520100225>

¹⁹ Tracing back the work focuses of different Chinese ministries in past years, MOST focused a lot on IOPP, while Ministry of Commerce (MOC) tried hard to negotiate with concerned countries for China's accession to GPA – this could potentially lead to conflicts between ministries. As the administrative body of public procurement as a

4.2 Outlining China's IOPP mechanism

China's IOPP mechanism is illustrated in figure 2 based on the analysis in previous sections. At the national level, the *State Steering Group of Science, Technology and Education* (SSGSTE)²⁰ lead directly by the State Council is in charge of reviewing, discussing and approving key STI policies and coordinating different departments and localities during STI policy implementation; NDRC is the chief planning agency at the ministry level, responsible for setting the development agenda for the economy as a whole, and STI plan is also part of the agenda; MOST is the main agency for leading STI activities, making implementation measures and in the case of IOPP, designing innovation catalogues and organizing key STI programs; MOF in this mechanism is responsible for making procurement policies, setting budgets and monitoring procurement activities; MIIT is in charge of industrial policy making and especially ICT industrialization, and in this mechanism it is responsible for the designing and implementing of equipment catalogues; other ministries are also involved when necessary, e.g. the Ministry of Railways and the China Railway High-speed (CRH) programs²¹.

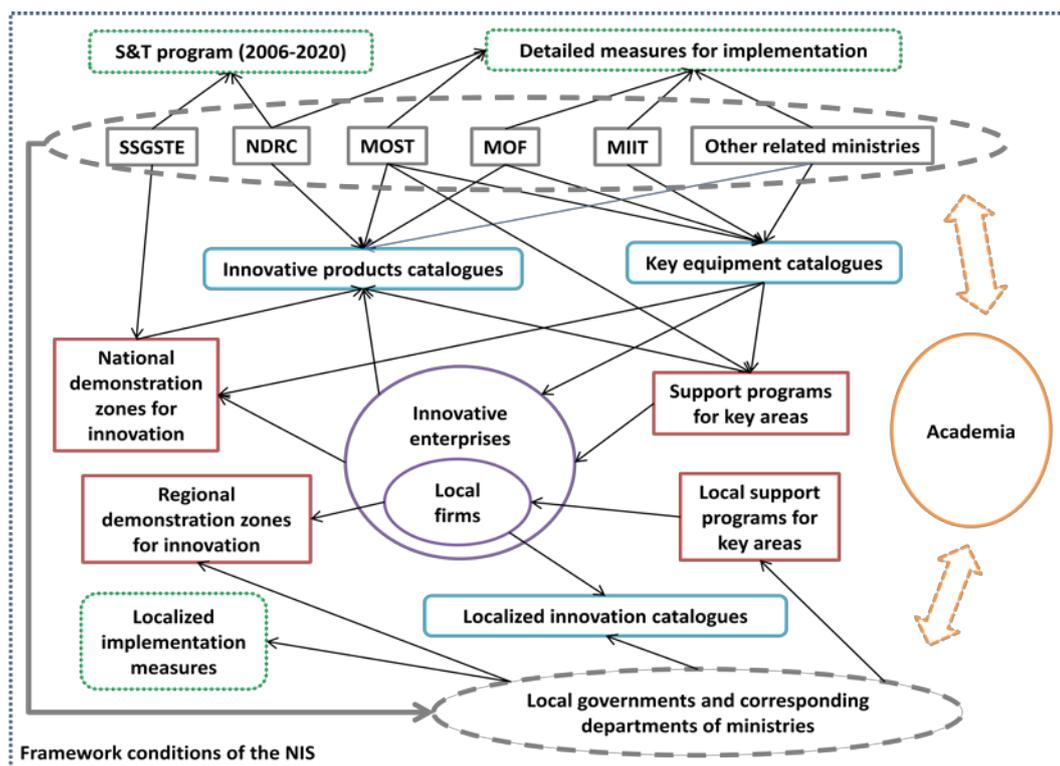


Figure 2 China's IOPP mechanism – the whole picture

whole, MOF announced their focus of work for 2011, available at http://www.china.com.cn/economic/txt/2011-02/17/content_21947324.htm

²⁰ Members of SSGSTE include representatives of major ministries e.g. MOF, NDRC, MOST, MIIT and MOC; this group is lead by the Premier, see http://policy.tech110.net/html/article_380889.html.

²¹ For more information see http://en.wikipedia.org/wiki/High-speed_rail_in_China.

The initiating of support programs for key areas is consistent with the equipment catalogues, for example, the ministries jointly commenced a new-energy vehicle (NEV) program in 2009, namely ‘Ten cities, thousands of NEVs²²’, aiming to enhance the development of NEV technologies in China. Another form of enhancing strategies is the establishment of ‘innovation demonstration zones’, e.g. the Zhongguancun National Demonstration Zone for Innovation²³; demo zones enjoy favourable STI policies from both national and local levels and operate as clusters of innovation. This paper categorizes the support programs and demo zones as ‘themes’ in the IOPP mechanism.

With respect to the regional level, local governments tend to commence the implementation process once the STI policies are announced by the central government, and given that the departmental setup at lower levels is similar with the setup of ministries, localized policy measures are normally designed following the path of the national level. In the case of IOPP, regional development and reform committees (DRCs) are in charge of localizing the development agenda, S&T committees are responsible for localized innovation catalogues and support programs, etc. Based on document analysis and in-depth interviews of regional officers, it can be concluded that most regions are strictly following the central government to organize their local IOPP activities in a top-down approach²⁴. Although there are strong inter-factor linkages in figure 2, no obvious feedback connection has been identified; the monitoring of procurements is also conducted by procurers (e.g. financial departments), which makes the micro processes in the mechanism not transparent enough for outsiders.

Through analyzing the results of cross-region internet search, it can be identified that ‘rich’ and ‘innovative’ regions tend to be more active than other regions in terms of IOPP initiatives. A number of most active regions (Beijing, Shanghai, Tianjin, Guangdong, Jiangsu, Shandong and Zhejiang) were identified according to their IOPP actions taken, including: (1) the quality of local public procurement websites, which indicates the degree of regularization, information sufficiency and transparency; (2) the availability of localized IOPP regulations, which provides the implementation measures of IOPP in the locality; (3) the availability of localized innovation catalogues, demonstrating the general IOPP progress; (4) the availability of specialized IOPP webpages, which indicates the possibility of access to further information about concrete IOPP processes. In particular for (1), all the 31 provinces/municipalities have their respective branch website supervised by CCGP, but active regions tend to develop and keep updating their own websites for local public procurement; for (3), the most active

²² See <http://baike.baidu.com/view/2825646.html?fromTaglist>.

²³ English website of Z-park: <http://www.zgc.gov.cn/english/>.

²⁴ There are regions being considered as innovative and ahead of the country in this dimension, e.g. Guangdong province, see <http://www.gdgpo.gov.cn/gdcztPortal/appmanager/guangdong.html>.

regions such as Beijing, has already produced the 10th version of its innovation catalogues, while there are still quite a few regions who haven't commenced the certification work yet. These seven active provinces/municipalities identified are all leading regions in China in terms of both GDP ranking and innovativeness²⁵.

5. Conclusions: problems, trends and policy implications

A national level case study is elaborated in this paper through investigation into the historical development, current whole picture and regional initiatives of the Chinese IOPP mechanism. Two major questions are answered: firstly, how has IOPP become an innovation policy tool in China under the circumstances and development trends of its NIS? It is concluded in section 3 that the regularization of public procurement and the more firm-centred NIS in China have provided a basis for the systemic use of IOPP, and that IOPP policymaking and related research are in a co-evolutionary relationship with each other. Secondly, what is China's current national IOPP mechanism like and how it operates? In section 4, the current Chinese IOPP mechanism is outlined, and four key factors (people involved, regulations, themes and catalogues) are introduced. The mechanism features the use of innovation and equipment catalogues, which serves as 'hubs' to link different stakeholders. The section then moves further to take a glance at the IOPP actions taken by the regions in mainland China; it is identified that regions with higher GDP performance and innovativeness tend to be more active in implementing IOPP policies.

It is argued that the IOPP strategy adopted in China relies heavily on top-down methods, and the central government and related ministries play a very important role of constructing the mechanism in a systematic way. No reports or literature focused on concrete IOPP cases have been published, and thus downstream impacts of the IOPP mechanism are still in great need to be investigated. These characteristics are quite different from that of EU countries, which features the use of bottom-up approaches, e.g. identifying best practice and drawing lessons.

However, the IOPP instruments adopted in China are to a great extent consistent with the theoretical perspectives raised in EU literature, which was reviewed in 2.1. Innovation catalogues can be considered as a useful means to enhance the communication between suppliers and procurers; equipment catalogues can facilitate the reducing of risks and entry/transaction costs for innovative enterprises; themes are effective to demonstrate the use of innovations, to create lead markets or 'catalyze' the development of certain areas. Linking

²⁵ GDP ranking available at the National Bureau of Statistics of China <http://www.stats.gov.cn/english/>; MOST analysis of regional innovativeness is available at <http://www.most.gov.cn/kjtj/tjbg/>

to the typology proposed in Edler & Georghiou (2007), innovation catalogues can be categorized as ‘general’ IOPP activities, with themes and equipment catalogues being categorized as ‘strategic’ activities; as innovation catalogues deal mostly with ‘commercial’ products, equipment catalogues are focused on ‘pre-commercial’ technologies; there are also examples of ‘state procurement in connection with private users’, e.g. subsidies for private purchase of NEVs²⁶ since June 2010.

Although China has achieved a lot in IOPP since the launch of Program (2006-2020), there are several problems hindering the development of this policy instrument. First, the certificating of innovative products requires more specified regulations and standards, which seems to be the most urgent issue regarding the design of national innovation catalogues. Second, co-ordination between different governmental bodies seems not smooth enough, and hence downstream effects of STI policies can’t be fully traced and monitored. Third, based on the observation of local IOPP practices, regional protectionism is a common problem with all the localities, whose IOPP regulations never take enterprises from other regions into account. Fourth, the implementation processes are overwhelmingly top-down in the IOPP mechanism, without any obvious feedback connection (neither from localities to the national level, nor from enterprises to governmental bodies). Fifth, there is no neutral body from outside to monitor procurement activities, and this lack of transparency can easily lead to corruption. And sixth, the ambitious notion of innovation catalogues has caused criticisms from abroad, and this strategy is very likely to conflict with international regulations once China’s accession to GPA is realized. Policy recommendations regarding these problems include: to rely more on support programs and pre-commercial procurements rather than innovation catalogues; more centralization, both vertically (to integrate regional demands into national demands) and horizontally (to fully engage different departments); to establish feedback and external monitoring loops.

There are foreseeable trends as well. As China intends to open her public procurement market to the world shortly, it is inevitable that IOPP activities will be more regularized, centralized and transparent. At a deeper level, the ‘endogenous innovation strategy’ has penetrated into awareness of normal people in China, and this subtle cultural change can help to make the framework conditions more innovation-friendly in future.

²⁶ See details about the program at <http://topic.eastmoney.com/xnyqcb/>.

References:

- Aho, E., Cornu, J., Georghiou, L. & Subira, A., 2006. Creating an innovative Europe. *Report of the Independent Expert Group on R&D and Innovation appointed following the Hampton Court Summit*.
- Baark, E., 2001. The Making of Science and Technology Policy in China. *International Journal of Technology Management*, 21, 1-21.
- Bodewes, H. et al., 2009. Exploring Public Procurement as a Strategic Innovation Policy Mix Instrument. *OMC-PTP project*. www.innovation.lv/ino2/publications/Publicprocur.pdf
- Cao, H., 2010. Thoughts on Implementing the Government Procurement Policies for Self-innovation Products (in Chinese). *China Public Procurement*, 104, 76-77.
- Carlsson, B. & Jacobsson, S., 1997. In Search of Useful Public Policies—Key Lessons and Issues for Policy Makers. *Technological systems and industrial dynamics*, 10.
- Chen, L. & Lao, Z., 2010. Analysis of the Legal System of Governmental Procurement for Indigenous Innovation Products—Review on Guangdong’s Policy Measures (in Chinese). *China S&T Forum*, 2010(1): 14-18.
- Dai, Y. & Zhou, H. 2009. The implementation of public procurement policy for innovative products and implications (in Chinese). *Science and Technology Today*, 2009(9).
- Dong, C., 2009. The Economical Foundation of Public Procurement Policies for Self-innovation Products (in Chinese). *Administrative Tribune*, 16(4): 65- 68.
- DTI (2006). Using Public Procurement to Drive Skills and Innovation. London, *the Department of Trade and Industry*.
- Edler, J., Hommen, L., Papadokou, K., Rigby, D., Rolfstam, M., Tsipouri, L. & Ruhland, S. 2005. Innovation and Public Procurement—Review of Issues at Stake. *Study for the European Commission ENTR/03/04*.
- Edler, J. 2007. Demand based innovation policy. Working paper series. *Manchester Business School Working Paper No 529*. The University of Manchester.
- Edler, J. & Georghiou, L. 2007. Public procurement and innovation—Resurrecting the demand side. *Research Policy*, 36, 949-963.
- Edquist, C. & Hommen, L. 1999. Systems of innovation: theory and policy for the demand side. *Technology in Society*, 21, 63-79.
- Edquist, C., Hommen, L. & Tsipouri, L. 2000. *Public technology procurement and innovation*, Kluwer Academic Publishers.
- European Commission 2007. Guide on dealing with innovative solutions in public procurement-10 elements of good practice. *Commission staff working document SEC (2007) 280*. Brussels.
- Georghiou, L. 2006. Effective innovation policies for Europe—the missing demand-side. *Prime Minister’s Office, Economic Council of Finland*.
- Gu, S. & Lundvall, B. 2006. China's innovation system and the move toward harmonious growth and endogenous innovation. *Innovation: Management, Policy & Practice*, 8, 1-26.
- Guan, Z. 2009. The construction of evaluating system for endogenous innovation products in public procurement practices (in Chinese). *World Chinese Entrepreneur Economic Yearbook*, 2009(7).
- Guo, Q. 2006. Experience in Canada of supporting innovation using public procurement (in Chinese). *China High Technology Enterprises*, 2006 (4).
- He, L., Su, Y. & Chen, C., 2010. On Promoting the Self-innovation Capability of Firms Through the Perfection of Public Procurement Legalization (in Chinese). *China S&T Information*, 2010(1): 295-296.
- Hu, C., 2001. Measures to improve the legal system supporting public procurement for technology innovation (in Chinese), *S&T Forum*, 2001(5): 35-38.
- Jiang, D., 2010. Is Public Procurement Policy an Innovative Policy? A Case of the Public Procurement Policy of EU (in Chinese). *Journal of Lanzhou Commercial College*. 26(3): 85-89.
- Lember, V., Kalvet, T., Kattel, R., Penna, C. & Suurna, M. 2007. Public Procurement for Innovation in Baltic Metropolises. Tallinn: Tallinn University of Technology.
- Liu, X. & White, S. 2001. Comparing innovation systems: a framework and application to China’s transitional context. *Research Policy*, 30, 1091-1114.
- Lundvall, B., ed. *National Innovation Systems: towards a theory of innovation and interactive learning*. Pinter, London. 1992.
- MOST, NDRC & MOF, 2006. *The National Administrative Measures of Certifying Endogenous Innovations (Trial)* (in Chinese). http://www.gov.cn/zwhd/2007-03/16/content_552435.htm

- MOF, 2007a. *Administrative Measures on Contract Management in Government Procurement of Endogenous Innovation Products* (in Chinese).
http://www.most.gov.cn/ztl/gjctx/ptczfcg/200802/t20080225_59307.htm
- MOF, 2007b. *Administrative Measures on Evaluation in Government Procurement of Endogenous Innovation Products* (in Chinese).
http://www.most.gov.cn/ztl/gjctx/ptczfcg/200802/t20080225_59306.htm
- MOF, 2007c. *Administrative Measures on Budget Management in Government Procurement of Endogenous Innovation Products* (in Chinese).
http://www.most.gov.cn/ztl/gjctx/ptczfcg/200802/t20080225_59308.htm
- MOF, 2007d. *Administrative Measures on Government Procurement of Imported Products* (in Chinese).
http://www.most.gov.cn/ztl/gjctx/ptczfcg/200802/t20080225_59304.htm
- MOF, 2007e. *Administrative Measures on Initial and Prescriptive Procurement of Endogenous Innovation Products* (in Chinese).
http://www.most.gov.cn/ztl/gjctx/ptczfcg/200802/t20080225_59305.htm
- MIIT, MOST, MOF & SASAC, 2009. *Guiding Catalogue of Endogenous Innovation on Key Technological Equipments (version 2009)* (in Chinese).
<http://www.miit.gov.cn/n11293472/n11293832/n11293907/n11368223/12937690.html>
- Mytelka, L., Smith, K. & Karelplein, K. 2001. Innovation theory and innovation policy: bridging the gap. *Social sciences and innovation*, 125.
- OECD, 2008. OECD Reviews of Innovation Policy – China.
http://www.oecd.org/document/44/0,3746,en_2649_34273_41204780_1_1_1_1,00.html
- Peng, H. & Luo, J., 2009. Conflict, Loss and Reconstruction – Analysis of Independent Innovation Products Government Procurement Policy (in Chinese). *S&T Progress and Policy*, 26(7):34-37
- Peng, J., 2000. The Function of Government Procurement in Advancing Technological Innovation and Thinking of the function in Practice (in Chinese). *Journal of Nanjing University of Science and Technology*, 13(4): 31-35.
- Smith, K. 2000. Innovation as a systemic phenomenon: Rethinking the role of policy. *Enterprise & Innovation Management*, 1, 73-102.
- The State Council of P.R.C., 2006a. *The National Medium- and Long-Term Program for Science and Technology Development (2006-2020) - An Outline* (in Chinese). http://www.gov.cn/jrzq/2006-02/09/content_183787.htm
- The State Council of P.R.C., 2006b. *Implementation Measures for the National Medium- and Long-Term Program for Science and Technology Development (2006-2020)* (in Chinese).
<http://www.most.gov.cn/ztl/gjctx/>
- Sun, X. & Yang, B., 2009. Justification of the Rationale of Government Procurement to Stimulate Technological Innovations – Evidence from 9 EU Countries (in Chinese). *Journal of Zhongnan University of Economics and Law*, 176:3-7.
- Tsipouri et al. 2010. Risk management in the procurement of innovation - Concepts and empirical evidence in the European Union. *EC Expert Group Report*. www.ec.europa.eu/invest-in-research/pdf/download_en/risk_management.pdf
- Von Hippel, E. 1986. Lead users: A source of novel product concepts. *Management science*, 32, 791-805.
- Wang, C., Xu, J. & Li, H., 2000 et al. Analysis on Technological Innovation Policy Since 1980s in China (in Chinese). *China S&T Forum*, 2000 (5): 26-28.
- Woolthuis, K. et al. 2005. A system failure framework for innovation policy design. *Technovation*, 25, 609-619.
- Xue, L. 1997. A historical perspective of China's innovation system reform: a case study (in Chinese). *Journal of Engineering and Technology Management*, 14, 67-81.
- Zhang, A., 2004. How Can Government Procurement Support the Development of High-tech Industries (in Chinese). *China Government Procurement*, 2004(4): 33-35.
- Zhang, K. & Cheng, R., 2006. Making Public Procurements into Real Innovative Procurements – on the EC Report of ‘public procurement of research and innovation’ (in Chinese). *China Soft Science*, 2006(9): 156-158.
- Zhang, X., 2007. The US mechanism of public procurement for innovation – analysis and implications (in Chinese). *Group Economics Research*, 2007(8).
- Zhang, Z., 2002. Research on public procurement policy and implementing measures to support the development of high-tech industry (in Chinese). *China S&T Forum*. 2002(5): 19-23.
- Zhao, H. & Cai, W., 2007. Analysis on Government Procurement to Stimulate Innovation From an Angle of View of Economics (in Chinese). *Economic Issues*. 2007(8): 19-21.