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# The Chinese Science and Technology Planning Sub-System: Process and Organization

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## Abstract

Government planning has expanded enormously in China over the past fifteen years, but relatively little is known about how planning works in practice. In this working paper, Siwen Xiao, Yaosheng Xu, and Barry Naughton examine the planning process for the 13th Five-year Plan for S&T Innovation (STI) (2016–2020) and provide some preliminary observations about the operation of planning in China. Among their findings, they show that science and technology planning became a fully formed sub-system only in 2015; and that although the relationship between the national plan and the local (and ministerial) plans is theoretically that of superior and subordinate, in practice localities have a great deal of flexibility. The authors identify mechanisms through which various plans are harmonized, and how plans are prioritized. As resources, the authors rely primarily on the plans themselves as well as a class of documents they call "preparation guidelines"—official documents promulgated in order to inform and assist government agencies in the planning process. These primary sources are supplemented with a number of press reports that describe specific events in the planning process.

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# Introduction

Government planning has expanded enormously in China over the past fifteen years, but we still know relatively little about how planning works in practice.[1] In this paper, we examine the planning process for the 13th Five-year Plan for S&T Innovation (STI) (2016–2020) and provide some preliminary observations about the operation of planning in China. We focus narrowly on the *process* of planning, reserving substantive analysis of the content of plans to future research. As resources, we rely primarily on the plans themselves. In addition, we exploit—apparently for the first time—a class of documents we call "preparation guidelines," official documents promulgated in order to inform and assist government agencies in the planning process. These primary sources are supplemented with a number of press reports that describe specific events in the planning process.

We begin by defining and describing the formal planning process. We define a "planning sub-system," which inevitably is nested within the multi-level, hierarchical Chinese political system as well as the broader national planning system. Science and Technology (S&T) planning illustrates the basic characteristics of a planning sub-system: it is characterized by a national plan; 31 provincial plans; and at least 39 ministerial plans. Below the province level, most of the 293 city (prefecture-level) governments also produce STI plans.[2] A set of rules and standard procedures characterize the sub-system. The first section of the paper provides a description of the formal processes and outcomes of the S&T planning sub-system. We show that S&T planning became a fully formed sub-system only in 2015.

The second part of the paper then asks how this system works in practice. While the relationship between the national plan and the local (and ministerial) plans is theoretically that of superior and subordinate, in practice localities have a great deal of flexibility. Local plans differ from the national plan in the priorities and targets chosen. Moreover, local targets are frequently not reached, which may indicate that localities are not under great pressure to achieve their targets, or alternatively that planners simply lack the ability to accurately forecast. In practice, central, local, and sectoral plans appear within a few months of each other. Clearly, other forms of coordination beyond the purely hierarchical must be at work, and local plans should not be thought of simply as the implementations of central directives. We identify four basic mechanisms through which these multiple plans are "harmonized": (a) the guidance of a

[1] The authors acknowledge helpful comments from Yujing Yang and, especially, Jeroen Groenewegen-Lau, many of whose suggestions have been directly incorporated into the text.

[2] There are a total of 333 prefecture-level governments, consisting of 293 cities; 7 prefectural districts (地区), 30 autonomous prefectures (自治州) and 3 (Mongol) "leagues" 盟. We will sometimes refer to prefecture-level entities as "cities."

top-level “programmatic policy document”; (b) the intervention of individual top leaders; (c) interactions between local and central that provide bottom-up input; and (d) residual flexibility which allows local governments to shape their plans to local conditions and opportunities.

The third part of the paper raises a set of additional questions about planning in practice. The elaboration of a fully realized S&T planning sub-system in 2016–2017 was part of a broad proliferation of plans in China that began in 2005–2006, and has extended through the present. How have planners coordinated—or attempted to coordinate—the rapidly growing number of plans? We exploit the “preparation guidelines” as well as internal evidence from the plans themselves to argue that planners have begun to prioritize certain plans by designating a formal category of “priority special-purpose plans” (重点专项规划). These “priority” plans seem to involve a greater budgetary commitment from higher levels, and as a result involve a binding commitment on the part of implementing agencies to carry them out. However, there is still much we don’t know about how these plans work in practice. We conclude by arguing that the problem of coordinating the myriad of plans in China is an increasingly difficult one, which China has begun to address, but has not begun to solve.

## 1. A Planning Sub-System: The Science and Technology Plan Hierarchy

China’s overall planning structure is composed of many different types of plans, all of which must fit into the hierarchical structure of government. We define a “planning sub-system” is a hierarchical group of plans, at the peak of which is a single national-level plan issued by the central committee of the Chinese Communist Party of China (CCP) and/or the State Council, the highest level of government. Lower-level plans are issued by subordinate government organizations, which can be local governments or ministries. This highest-level, State Council-approved document we label a Level 1 document. (Note that there are still higher programmatic policies that cut across planning sub-systems: we will discuss these later, and classify them as “Level Zero” documents). A Level 1 Document is distinguished by rank and by high similarity with subordinate documents. That is, it is issued by the highest-ranking government agency (the State Council), and then much of its content is expected to be replicated by lower-level governmental agencies. In any given planning sub-system, provinces have a general obligation to produce their own corresponding and directly related plans, and some ministries will also be under such obligation, depending on the relevance of their portfolio. These organizations (provinces and ministries) produce plans that are Level 2 documents. Level 3 plans are then produced by prefecture-level governments (typically

cities), that may also have an obligation to produce Level 3 plans.[3] A planning sub-system has a formal organization and a hierarchical structure. Moreover, a planning sub-system is also a "module," meaning that it is self-contained, but expected to plug into a variety of other planning sub-systems, as well as the overall national planning system (discussed further in Part 3 of this paper).

The national S&T 13th FYP (2016–2020), along with the related local and ministerial plans thus form a complete "planning sub-system." The Level 1 document, issued by the State Council, is very long (78,000 characters) and substantive. Called the "Thirteenth Five Year Plan [Period] National Plan for Science, Technology, and Innovation" (十三五"国家科技创新规划), we will abbreviate it as either S&T 13th FYP or 13F STI Plan.[4] Before this 13F STI, five year plans for science and technology were prepared by the Ministry of Science and Technology, but they were not issued by the State Council and did not constitute a "planning sub-system" by our definition. As discussed later, in 2015, STI planning for the 13th FYP period was raised a level in importance to become a fully-fledged 'planning sub-system."

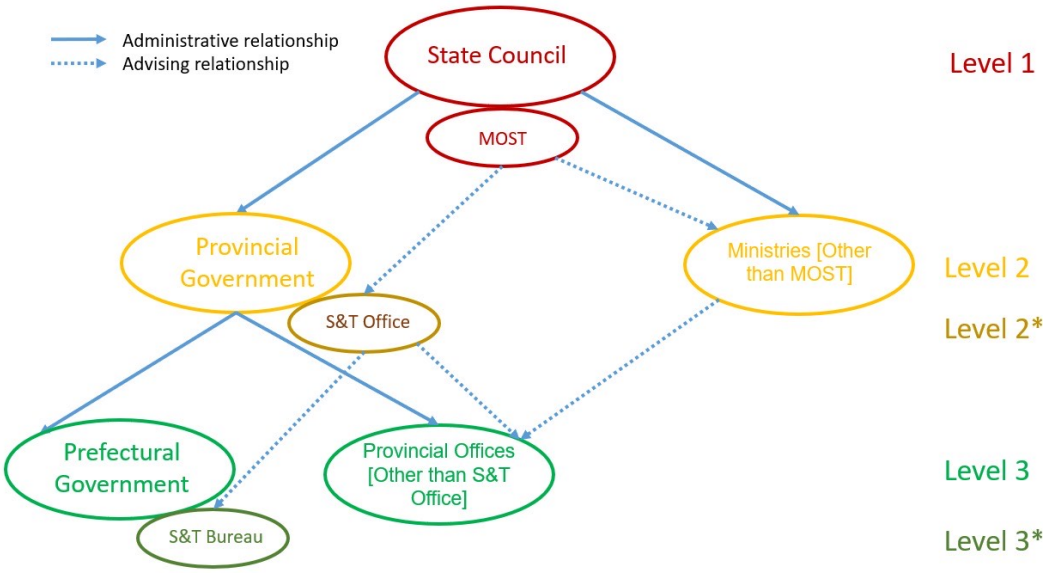
This paper focuses on the S&T 13th FYP and its related plans, and we draw preliminary conclusions about key features of the STI planning sub-system, which we expect to apply to other planning sub-systems.[5]

[3] Obviously, these levels directly reflect the hierarchy of China's government. Here, "province" refers to provinces, municipalities, and "Autonomous Regions" of provincial rank, including the four province-level cities of Beijing, Tianjin, Shanghai, and Chongqing. "Prefecture" refers to prefectures, cities, and urban districts of prefectural rank. Most important cities in China are of Prefectural rank, and we will sometimes refer simply to cities, which without further qualification means prefecture-rank cities. We will often refer to "provinces" (including Beijing, Shanghai, Tianjin and Chongqing) and cities and prefectures (excluding Beijing, Shanghai, Tianjin, and Chongqing) in this report and all future reports.

[4] The document is of course not the 13th time an S&T five year plan has been drafted, but rather the S&T plan drafted for the 13th Five Year Plan period, which is 2016–2020.

[5] Based on the above-mentioned definition, we expect to find about twenty related planning sub-systems, including, but not limited to, other technology and industrial policy plans. For example, the national 13th FYP Strategic Emerging Industries (SEIs) program is also a planning sub-system.

**Figure 1.** China's Formal S&T Planning System




As Figure 1 shows, the level 1 document in the planning system is the national 13th FYP for STI. The Ministry of Science and Technology (MOST) led the drafting process, under the supervision of the State Council, and the completed plan was released in July 2016 by the State Council. Following the guidance of the national plan, 39 sub-national ministerial plans and 31 provincial plans were published, constituting the level 2 documents. Every province has a 13F STI Plan. The 39 ministerial plans all have distinct themes and were released by the MOST jointly with other national ministries. In Figure 1, MOST is treated differently from other ministries, even though they formally have the same bureaucratic rank. In this planning process, MOST has a special and central role. It does not issue its own plan (since that is done by the State Council, MOST's direct superior), but it collaborates with each of the other ministries, presumably as a kind of senior partner, guiding the drafting process. At the provincial level, S&T plans can be issued by the provincial government or by the provincial S&T office. These are both "Level 2" documents, although, as discussed later, there is a difference between them in the degree of authoritativeness. As a result, we have labeled plans from provincial S&T offices as Level 2* documents, slightly below those of the provincial government itself. The relationship is similar at the prefectural level. Thus, the planning system is not identical to the Chinese hierarchical bureaucracy, even though it is based on it. The planning system is adapted to the special role MOST and local functional departments play in the planning process.

For example, the national 13th FYP for STI in the environmental area was issued jointly by the MOST, Ministry of Environmental Protection, Ministry of Housing and Urban-Rural Development, State Forestry Administration, and Meteorological Administration. Most of the ministerial plans were made public in April and May of 2017. Proceeding down the hierarchy, level 3 documents are those issued by the prefectures and provincial bureaus. It appears that a large majority of prefectures (cities) issued a 13F STI Plan, but they have not all been published, and we do not have a full count. The documents issued by provincial offices (functional departments 厅) are—like the ministerial documents—thematic and are formulated and released jointly by the provincial S&T departments and other offices.[6] Among the case study provinces (see below), Liaoning by itself has at least 10 departmental and thematic S&T plans for the 13th FYP period, while the other provinces have published very few or no departmental plans. In total, there are well over 400 plans in the 13F STI Planning Sub-system.[7]

## 1A. The Plan Formulation Process

National level preparation of the 13F STI Plan developed out of the mid-term assessment of the 2006–2020 National Medium- and Long-Term S&T Development Plan (MLP). During 2013, evaluation of the MLP was transformed into research for the 13F STI plan (see below). Preparation of provincial plans began about a year later, in 2014. According to Xu Jing (许倞), director of the Innovation and Development Department of MOST, the 13th FYP for S&T innovation was the first time that China carried out the "top-level planning of S&T innovation as a whole (Ling 2016)." To be sure, there were earlier national efforts to plan large-scale research projects, and there had been multi-year Science and Technology programs. There was even a 12th FYP for S&T Development (2011–2015), but this was published by MOST, itself, while the S&T 13th FYP was issued by the State Council. According to Ling (2016), the S&T 13th FYP was the first effort to create a "comprehensive, national plan for S&T" (Ling 2016). Using our vocabulary, this was the first time there was a fully elaborated S&T "planning sub-system." The plan is expected to provide general guidance for China's S&T planning in all areas during the 13th FYP (and even later periods), and it also lists key industries in which technological development should be promoted. In defining some of the 2030 megaprojects, the S&T 13th FYP even takes over some of the functions previously performed by the Medium and Long Term Plan for Science and Technology (2006–2020).

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[6] The Chinese bureaucratic system is very consistent, but the terminology applied to bureau agencies is not at all consistent. In an effort to bring out the underlying simplicity, we use "office" to refer to functional departments under the provincial government (usually labeled a *ting* 厅 in Chinese), and "bureau" (局) to refer to the functional department under the prefectural government.

[7] By the very conservative assumptions that 80% of prefectures have S&T Plans, and that the average province has two specialized (and one general) S&T plan, along with 39 Ministerial plans, there would be 398 plans at prefecture level and above in the 13F STI Planning Sub-system. In addition, many counties and even townships have 13F STI plans.

The formulation of the national 13th FYP for STI is divided by Chinese sources into three stages: "preliminary research, centralized drafting, and comment solicitation (前期研究、集中编制、征求意见)" (MOST 2016). These stages describe the formulation process of the 13F STI Plan at the national, provincial, and prefectural levels. We studied the process at all three levels. First, we examined the available information on the central formulation process. Second, we examined the totality of 31 provinces, and performed in-depth exploration of 8 provinces—Beijing, Shanghai, Jiangsu, Guangdong, Liaoning, Henan, Guangxi, and Hubei. These "mini-case studies" were selected to get a diverse range of provincial innovation capabilities. Using an index of innovation capabilities published by MOST,[8] we first selected the four provinces with the strongest innovation capability, namely Jiangsu, Guangdong, Beijing, and Shanghai. To explore less innovative provinces, we selected four of the provinces ranked 11–20, with two provinces from central China, one from northeast China, and one from southeast China. The provinces ranked below 20 were not selected for case study investigation due to their weak innovation capabilities and a lack of open-source information.

To supplement and validate the provincial findings, we reviewed a sample of 50 prefectures, in two different sub-samples. The first sub-sample comprised all 16 urban districts in Beijing.[9] These were selected to provide deeper insights into local interactions in the capital city, which has special importance in STI planning in China. The text of the district STI plan was available for eight of the 16 districts; there were three districts where the title of the plan is known but no text has been located; and five districts for which no evidence of a plan was found (See Table A2). The second sub-sample consists of 34 prefectures in 14 provinces in China. There were 4 prefectures where the title of the plan is known but no text has been located; and 2 prefectures for which no evidence of a plan was found (See Table A3). The prefectures in the second sub-sample were selected randomly, conditional on a ranking of city innovation capabilities.[10] We divided the list of 283 prefectural-level cities into two halves according to their ranking on the innovation capability index, and then randomly selected one prefecture in the top half of the ranking.[11] If an STI plan was not available for that prefecture, it was discarded, and we searched for an alternative prefecture from

[8] This is the regional "comprehensive innovation capacity index" (区域创新能力综合效用值) from (CASTED & UCAS 2016; see Figure A1 in the Appendix). This report is posted on the MOST website (see Figure A1 in Appendix; CASTED & UCAS 2016), giving it a quasi-official character. The index is constructed with 2014 data.

[9] Strictly speaking, the four province-level cities in China do not have prefecture-level governments, but their urban districts are close counterparts to prefectures in other provinces, and indeed have special prefecture-like powers.

[10] Data on Prefecture-level Cities are from the "Report on the Science and Technology Innovation Development Index in Chinese cities 2017" (中国城市科技创新发展指数报告 2017) by the Capital S&T Development Strategy Research Institute. The ranking in the report is also based on the 2014 data. (see Table A1 in Appendix for the sub-indices of this index).

[11] The 4 provincial-level cities (Beijing, Shanghai, Tianjin, and Chongqing) were excluded from the selection process.

the province, in the same half of the distribution, for which an STI plan was available; and for one prefecture in the same province in the other half of the distribution. We then repeated this process for a prefecture in the bottom half of the distribution. In this way, we generated a nearly-random sample of two prefectures with S&T plans in each of 14 provinces, with one in the top half and one in the bottom half of the distribution (Table A3).[12] In this way, we ensured that each of the 14 provinces has two prefectures selected with different innovation capabilities and available 13th FYPs for STI for further analysis.

## 1B. National-level Formulation

The initial stage in the formulation of the national 13F STI was preliminary research stage. In this particular case, though, in January 2013, as part of the mid-term evaluation of the Medium and Long-term Plan for Science and Technology (MLP) 2006–2020, local governments, ministries, and industrial associations in January 2013 had been required to report on the implementation status of the MLP in their jurisdictions (MOST 2013). In November 2013, an overall MLP evaluation leading group was established, consisting of 22 national ministries, more than 200 experts and scholars, and led by academician Pan Yunhe (潘云鹤) (MOST 2014). These reports and evaluations were then streamed into the preliminary research for the 13F STI. Activities included holding expert seminars, presenting evaluation reports, forecasting key technologies, etc. Based on the products of preliminary research, the "centralized drafting" of the national 13th FYP for STI started in 2014. During this stage, research on key technologies continued, with proposed major tasks and projects listed. In addition to research on specific technologies, studies of the overall innovation environment, including policies and strategies beneficial to S&T development, were carried out (MOST 2014A).

MOST was the lead agency throughout the process. During 2015, cooperation among the MOST and other national ministries was stepped up, in preparation for the formulation of sub-plans (MOST 2015). Based on a report in August 2015, we infer that the initial draft was completed at that time (completing the "centralized drafting" phase) and sent out for comment (MOST 2015A). Opinions were sought primarily from academicians in the key areas, institutes, and relevant bureaucratic agencies (MOST 2015B). During the first half of 2016, the plan's final draft was given a final review by (at least) three bodies formally independent of MOST. First, the draft was reviewed by the "Specially Invited Committee for Strategic Consulting and Comprehensive Review"

[12] The only exception is Quzhou prefecture in Zhejiang province, whose ranking is before 143. This is because the rankings of all prefectures in Zhejiang are higher than 143.

composed of key experts,[13] and then the National S&T Planning Management Inter-Ministerial Joint Conference. These rounds of comment clearly represent an effort to bring in a range of different stakeholders. These include the scientific community, diverse government agencies, and a handful of relatively independent experts with links to industry and academia. Finally, the State Council itself conducted a final review (MOST 2016A; MOST 2016). After being approved by the State Council, the plan was officially released in late July 2016.

## 1C. Provincial and Prefectural Plan Formulation

As at the national level, provincial and prefectural governments independently carry out the same three stages of plan formulation, namely preliminary research, centralized drafting, and comment solicitation described above. In general, each of the first two stages can take half a year to a year, and the last stage tends to last less than half a year. While the national plan's formulation began with the evaluation of the national MLP's implementation status, provincial plans did not require this step, and thus generally began research during late 2014 or early 2015, more than one year after the national plan's formulation started. Most provinces proceeded to drafting in 2015, and the bulk of the provincial plans were published in 2016, after a preparation process of not quite two years.

The provincial plans were completed beginning in April 2016 (Figure 2). Five provinces produced their plans before the national plan was published. Fujian's plan was finished three months before the national plan! However, most provinces (22 out of 31) completed their plans within six months of the national plan (i.e., by January 2017). Four stragglers, including Guangdong, were not done until later in 2017. There is ordinarily a short lag between when a plan is completed (成文) and when it is officially released (发布), but presumably the completed plan is available within the bureaucracy before it is officially released to the public.

To reveal any potential temporal pattern of the provincial timing, we also graphed the timeline geographically in Figure 3. There are several striking outliers—Guangdong, a province with very strong governmental and innovation capabilities, released the provincial plan eight months after the national plan, and the western provinces, such as Tibet and Gansu, with limited capabilities, released the plans very early. At the prefectural level, most plans come out about the same time as the superordinate

[13] Xu Kuangdi (徐匡迪) is chairman of the Specially Invited Committee for Strategic Consulting and Comprehensive Review. The committee members are Wang Dazhong (王大中), Tian Lipu (田力普), Li Jinghai (李静海), Liu Xu (刘旭), Qi Rang (齐让), Chen Jiaer (陈佳洱), Chen Qingtai (陈清泰), and Xue Lan (薛澜). The news report also mentions that seven experts attended the review session as well: Sun Jiaguang (孙家广), Tang Qisheng (唐启升), Zuo Tieyong (左铁镛), Wang Hao (王浩), Zhang Wei (张炜), Wu Jiang (吴江), and Dai Yuanshun (戴元顺).

provincial plans. Only 32 prefectures out of our sample of 44 had clear release dates. Seven of the 32 came out before their superordinate provincial plan, and the remainder somewhat later. We will continue to examine this pattern for additional significance. It is immediately clear, however, that it is probably not correct to think of prefectural plans as being top-down implementations of provincial plans. Rather, the two seem to be hammered out more or less simultaneously. Since localities are providing input into the national plan (see below), they presumably also get feedback, and may even need approval, for their proposals. In addition, some local plans apparently get held up for unknown reasons, and whether this is part of an approval process or local stakeholders holding up the process is not known at this time.

**Figure 2.** Timeline of Provincial and National 13th FYPs for STI

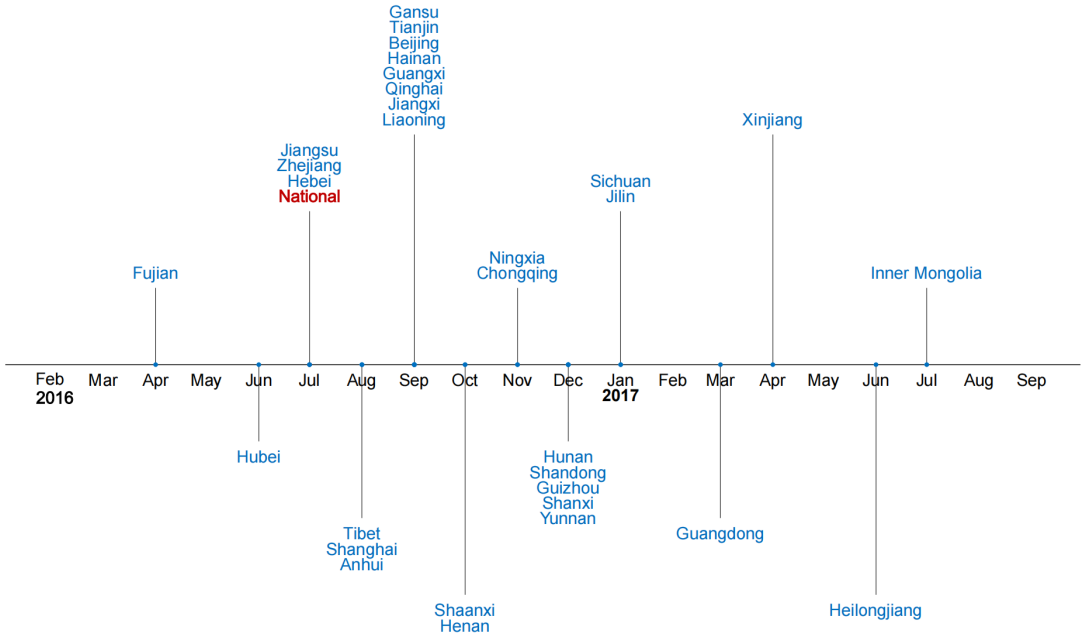
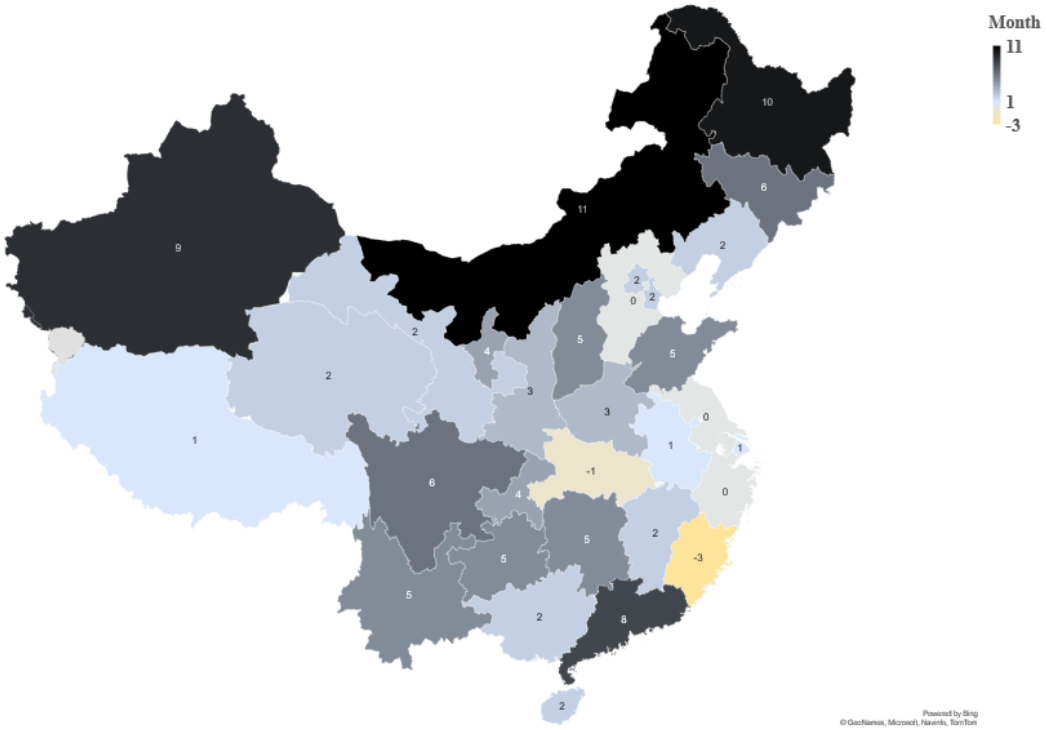


**Figure 3.** Timing of China's Provincial 13th FYPs for STI




We collected information on the provincial and prefectural departments that formally released the final plans. At the provincial level, there are two major types of issuers: the (general offices of) provincial governments and the provincial functional offices (厅). Administratively speaking, the former have full provincial rank, while the latter are one rank lower, equivalent to prefectures. The most important of these functional departments are the provincial S&T offices and the provincial development and reform commissions (DRC). The plans for about two-thirds of the provinces are issued by the provincial government, and one-third by the S&T Office (and DRC). The difference in issuing departments is also apparent at the prefectural level, and the implication of the different local issuers is revealed more clearly in the prefectural case studies, for which there is more open-source information. Among the 36 prefectures with available information on the publishers, 17 prefectural plans were issued by the (general office of) prefectural governments, and the rest are issued by prefectural bureaus. In the prefecture-level studies, the plans (for the 13th FYP) issued by the governments are all "priority special-purpose plans" (重点专项规划) while those issued by local functional departments are all "ordinary special-purpose plans" (一般专项规划). Moreover, the relationship between the plans' statuses and administrative levels of the publishers is confirmed in some of the local planning "preparation guidelines" for the 13th Five Year

Plan period.[14] For example, in Huairou district, Beijing, it is stated that the district's 13th FYP has 41 special-purpose plans (专项规划), 20 of which are "priority special-purpose plans," and that the priority special-purpose plans should be submitted to the executive meeting of the district government and issued and implemented in the name of the district government, while the "ordinary special plans" should be submitted to the district government and jointly issued and implemented by the leading departments and the district's DRC (General Office of Huairou 2015). The plan preparation guidelines vary in details among prefectures, but in general, as exemplified by Guilin, Yichang, and Wuhu, the "priority special-purpose" plans involve some kind of agreement with a higher-level bureaucratic agency and thus leave less leeway to the local functional department that leads the planning process. This observation also seems to hold true on the provincial level. Anhui's preparation guidelines explicitly state that priority special-purpose plans must be issued by the provincial government (Anhui Office 2014).

Combining the descriptions of provincial and prefecture preparation guidelines with national documents, it appears that the principle is the same on the national level: priority special-purpose plans are those designated and formally promulgated by the higher governmental level, in this case the State Council.[15] By contrast, ordinary special-purpose plans are released by ministries and departments. The national 13th FYP for STI is released by the State Council instead of the MOST, and it is included in a list of "priority special-purpose plans" posted on the NDRC website (NDRC n.d.). As we will discuss later, the selection of priority special-purpose plans is one way in which provincial and prefectural 13F STI Plans vary significantly. This appears to be a mechanism designed to combine coordination with superior levels along with local flexibility.

## 2. Planning in Practice

In the previous section, we described a formal planning system as a modular, basically self-contained hierarchical system. Yet we have discovered in investigating that system that the outputs of that multi-level system appear almost simultaneously (within months, that is), and that there are various mechanisms to build in coordination and flexibility. In this part of the paper, we describe the four most important such mechanisms: the role of a programmatic policy document; direct intervention by top leaders; local input into national planning; and residual flexibility left to local governments.

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[14] This type of document is literally called a "13th Five Year Plan Preparation Work Programs" ("十三五" 规划编制工作方案). We use the summary translation of "Preparation Guidelines" for clarity.

[15] Indeed, it seems to be a fundamental characteristic of the entire planning system. This is discussed later.

## 2A. Programmatic Policy Documents

In order to structure a formal planning system, there must be a higher-level policy document to call it into existence. This, and related national policies, we label "programmatic policy documents," and on occasion "Level Zero" documents. These documents provide broad policy guidance and they extend beyond a single planning sub-system. They are national policies designed to inform many different planning exercises. They must be issued not only by the State Council, but also by the CCP Center, because this is the highest political authority (Compare the discussion in Liu et al 2011). The 13F STI Plan process started off under the aegis of the 2006-2020 MLP (as in Chen and Naughton 2016). However, during the mid-term evaluation, enough problems emerged with the MLP that it was effectively downgraded, becoming less important as a Level Zero document for the STI planning subsystem, while policymakers worked on what ultimately became the Innovation-Driven Development System (IDDS). This document was officially promulgated in May 2016, but drafts were circulating much earlier, and the IDDS effectively became the most important programmatic policy document throughout the drafting of the 13th FYP for STI. In addition, the general national 13th Five Year Plan for Economic and Social Development (hereafter ESD 13FYP to differentiate it from other Five Year Plans) functions as a programmatic policy document.[16] There are thus three "level zero" documents with which STI planners must achieve consistency. Among these three, though, it is clear that the IDDS is the most important. We can see this both from process tracing and from internal evidence in the plans.

It is now common for China's policy documents to start off describing the "guiding ideas" or "guiding spirit" (指导精神) of the document, and in the 13F STI all three of the level zero documents are referenced. In all of China's 13th FYPs for STI we examined, the concept of "innovation-driven development" is stressed not only in the preamble, but throughout the whole plans as the major purpose of S&T planning from 2016 to 2020. Moreover, the 13F ESD Plan is a routine document, which must be issued at a specified time, and which requires routine coordination with other FYPs. By contrast, the IDDS was an extraordinary, ad hoc document issued in order to bring in new strategic and technological concepts. Finally, the 13F ESD Plan is ratified by the National People's Congress, while the IDDS was issued jointly by the CCP Center and State Council, which gives it the highest possible status in the Chinese system. Thus, our research shows that during the 13th FYP period, the most important "Level Zero" document is the National IDDS Outline published by the Central Committee of the CPC and the State Council in May 2016.

[16] The ESD 13FYP is procedurally slightly different in that the CCP Center first issues "Suggestions" for the plan, and then the plan is formally approved by the National People's Congress. We treat it as being "jointly approved" by the Party and the government.

From the administrative perspective, the involvement of both the party and the state indicates the document's top status in the planning system. From the content perspective, the document sets the fundamental tone for China's STI development in the next five to fifty years. In the National IDDS Outline, "innovation-driven development" is defined as economic development whose "primary driving force" is innovation. Specifically, the development pattern will be transformed to one that mainly relies on "continuous knowledge accumulation, technological progress, and labor quality improvement." The document also provides explicit (but vague) goals for 2020, 2030, and 2050. The 13F STI Plan, which is the focus of this report, focuses on the relatively short-term goals (for 2020) of the IDDS: China will have "become an innovative country, basically built a national innovation system with Chinese characteristics, and strongly supported the realization of the goal to establish a moderately prosperous society in an all-round way." These goals require improvement in a variety of indicators, including the contribution rate of S&T progress, R&D expenditure as a percentage of GDP, etc. (CCP Central Committee & State Council 2016). To realize the goals for 2020, China's 13th FYPs for STI need to be consistent with the framing and targets of the "Level Zero" document. In particular, the national 13th FYP for STI was "formulated based on the National IDDS Outline" and details the specific tasks and numeric goals for STI development from 2016–2020, which are strictly consistent with those listed in the IDDS document.[17]

As the programmatic policy document in the hierarchical planning system, the National IDDS Outline is itself the product of long-term consultation and drafting. The concept of "innovation-driven development" was first proposed at the 18th National Congress of the CPC in 2012. In the Congress Report, the implementation of IDDS was put at the core position of China's overall national development (Qu et al. 2012). Since then, unprecedented importance has been attached to innovation, as defined in the IDDS. One year prior to the release of the National IDDS Outline, the central committee of the CPC and the State Council released the "Several Opinions of the Central Committee of the CPC and the State Council on Deepening the Reform of Institutions and Mechanisms and Accelerating the Implementation of the IDDS" ("Opinions" hereinafter). The document proposes that by 2020, "an institutional environment, policy and legal system that meets the requirements of innovation-driven development will have been basically formed to provide a strong guarantee for establishing an innovative country (CCP Central Committee & State Council 2015)." Based on the document, the consultation and drafting process culminated in the National IDDS Outline in May 2016, which keeps the general goals in the "Opinions" but has extended the time frame during which the IDDS will be implemented to 2050 and articulated the strategic tasks and key areas (CCP

[17] In itself, this is hardly surprising, since the two were drafted at approximately the same time. However, targets from top-level documents are repeated in successive lower-level documents, which may imply a degree of inertia when programs need to be adapted in response to rapidly changing technological realities.

Central Committee & State Council 2016). Evolution of the overall system towards one in which there is a long-term commitment to a set of policy objectives clearly changes the functioning of the whole system.

In a related fashion, the decision to synch the S&T planning process to the Five-Year Plan cycle means that the overall national plan—the 13th Five Year Plan for Economic and Social Development—also serves as a kind of programmatic policy document for the 13F STI Plan. The ESD 15FYP also incorporates the IDDS, both as a sub-section and as a "guiding spirit." Thus, a small number of highly authoritative and inter-connected national policies are part of the overall environment in which the 13F STI Plan is developed and implemented.

## 2B. On-the-spot Guidance by Top-level Leaders

Top-level policy interventions do not come solely in the form of programmatic policy documents. As priority given to STI plans has increased, top-level leaders have taken a more direct role. Before or during the provincial planning process, top-level leaders, especially Xi Jinping, can pay visits to provinces and release signals regarding a certain STI topic. Policies on such a key theme are almost certain to be adopted and integrated into the provincial plans. Also, influence of this type is associated with a much closer and more interactive relationship between provinces and the central government. In 2014, Xi Jinping paid two visits to Beijing and Shanghai, during which he explicitly required that Beijing and Shanghai should make efforts to build what we label "global innovation hubs" with specific roles. While the terminology has not been entirely consistent, the concept has always included building Beijing and Shanghai into national innovation hubs (全国科技创新中心) with global significance. The concept thus includes not only industrial activities, but more importantly basic research, and technological support facilities.[18] Accordingly, Beijing and Shanghai's municipal governments released the official documents on accelerating the construction of global innovation hubs in 2014 and 2015 respectively (Beijing Municipal S&T Commission 2014A; "2015 Century China Forum" 2015). The documents were drafted based on Xi's requirements and listed the general guidelines for building S&T innovation centers. Following Xi's guidance, Beijing and Shanghai's municipal government and S&T department cooperated with the State Council and national ministries, especially the MOST, to draft the two State Council Proposals for building global innovation hubs, which lay out the short-, medium-, and

[18] A "global innovation hub" is thus substantially broader and more multi-functional, compared to an "innovation center," such as those in the Made in China 2025 Plan, or an "innovation district" under local government sponsorship. Subsequently, in the 14th Five Year Plan, the Shenzhen-Hong Kong "Greater Bay Area" was added as a global innovation hub, and a series of "National Comprehensive Science Centers" were identified in specific places within Beijing (Huairou), Shanghai (Zhangjiang), the Greater Bay Area, and Anhui (Hefei).

long-term targets for Beijing and Shanghai's hubs. Of course, it cannot be excluded that Xi's visit simply endorsed programs already agreed within the bureaucracy, but Xi's visit occurred before any external signs showing the local-central cooperation happened.

However, direct intervention by top leaders did not happen very often during the 13th FYP period. In the six other case-study provinces, we did not observe any public specific interventions from Xi. In Jiangsu in 2014, Xi Jinping did pay a visit to Jiangsu Industrial Technology Research Institute and proposed several requirements for Jiangsu's S&T development, but the requirements were about general industrial development rather than a specific STI theme (Huo and Wang 2014). Although Jiangsu's provincial 13th FYP for STI did indeed turn out to be focused on hi-tech industrial development, this is too broad a coincidence to be specifically related to Xi's visit (Jiangsu Provincial People's Government 2017). In addition to Xi, we found Li Keqiang also exerting influence on provincial S&T planning. Still, such influence is not as obvious as we observe in Beijing and Shanghai's cases. In 2015, Li Keqiang paid a visit to Henan province and stressed the importance of promoting "mass entrepreneurship and innovation (Henan Provincial S&T Department 2015)." As was the case in Jiangsu, the guidance was later reflected in Henan's provincial 13th FYP for STI, but since the theme is extremely general, it cannot be conclusively attributed to Li's visit (Henan Provincial S&T Department 2016).

Based on our initial survey of informal top-leader inputs into the provincial and national planning, it appears that the plan formulation process generally follows institutionalized routines: after the central government releases the programmatic policy document, the provinces follow the policy guidance and begin to formulate their plans. Top leaders do occasionally visit individual provinces and talk about the plan, but—at least so far as public evidence goes—their objective is to increase priority and visibility of Science and Technology, and underline broad national themes, rather than to directly shape province-level decision-making. To be sure, when provinces receive signals from top leaders, they are supposed to absorb it and incorporate it into their planning process. Even then—as we will show below with respect to Beijing and Shanghai—the "guidance" seems to be re-absorbed into the ordinary bureaucratic process, as provinces and national-level agencies discuss or bargain about the best way to fulfill this guidance.

## 2C. Local Inputs into Higher-Level Planning

Although the national planning process precedes provincial plan formulation by a few months, provincial planners do not simply follow along the national process. They also provide input into the national planning, in order to get the local needs "heard" and reflected in the national plan. Among the provinces we examined, Beijing and Shanghai are by far the most active input providers and have maintained a close two-way relationship with the national planners. In the national S&T 13th FYP, it is clearly stated

that "(the central government will) support Beijing and Shanghai to build STI centers with global influence (i.e., global innovation hubs)" as a part of China's overall STI task. Moreover, a whole section is devoted to describing how Beijing and Shanghai can reach the goals—for Beijing, the goal is to "leverage its advantages of high-level universities and scientific research institutions, high-end scientific research achievements, and high-level talents to build a national S&T innovation center with a strong leading role;" for Shanghai, the goal is to "leverage its resource advantages in S&T, capital, and markets, as well as its high level of internationalization, to build an S&T innovation center with global influence (State Council 2016)." Judging from the plan's content, a global innovation hub is a status for the two cities as a whole and it certainly involves investment at least several specific projects, zones, and research facilities.

As the previous section discussed, the development of the Beijing and Shanghai global innovation hubs was "launched" by Xi Jinping's visits to Beijing and Shanghai in 2014. There is no evidence to determine whether or not these themes were developed in the bureaucracy and then simply boosted by Xi's public advocacy. But in any case, the actual planning was quickly brought into the bureaucratic process. The detailed features included in the national plan for Beijing and Shanghai could not have been painted without input from the two cities. It appears that Beijing and Shanghai were given a big role in the interactive process by the national government because the two cities were seen to have the strongest scientific resources (though not necessarily the strongest innovation environment, see Table A1). Evidence for this can been found in Beijing and Shanghai's formulation processes. When Beijing was formulating the plan, the Municipal S&T Commission held multiple meetings with central organizations such as the Development Research Center (DRC) from the State Council, to discuss Beijing's planning and provide Beijing's inputs for the national planning (Beijing Municipal S&T Commission 2014). The same holds true for Shanghai: in 2015, the chief engineer of Shanghai Municipal S&T Commission led a team to Beijing where they met on the formulation of Shanghai's 13th FYP for STI. At the meeting, experts from MOST, the State Council DRC, the China Academy of S&T for Development (CASTED), etc., proposed suggestions for Shanghai's formulation (Shanghai Municipal S&T Commission 2015). The two cities' continuous interactions with the central government soon led to national documents, specifically State Council Proposals for building STI centers in Beijing and Shanghai (State Council 2016A; State Council 2016B). The two documents outlined general short- to long-term goals for STI development for Beijing and Shanghai during the 13th FYP period and by 2030, which later became the key themes of their local 13th FYPs for STI (Beijing Municipal Government 2016; Shanghai Municipal Government 2016). In its section on building STI centers, the national 13F STI Plan strongly echoes the two cities' plans, suggesting the national plan's absorption of Beijing and Shanghai's input.

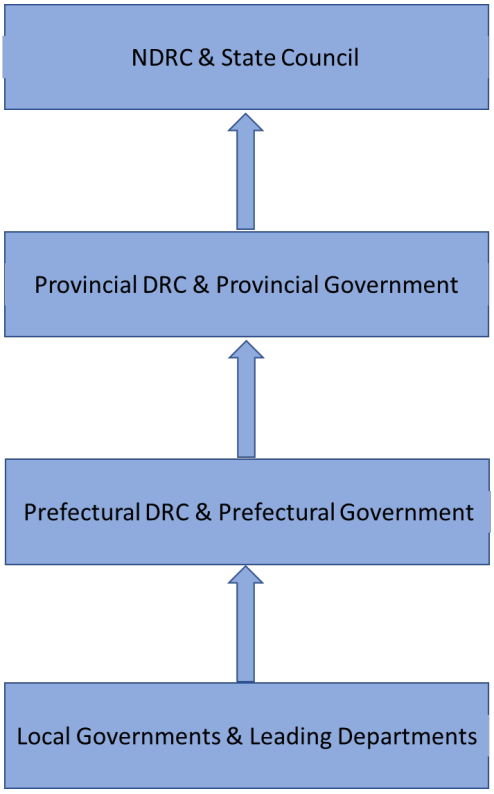
In provinces other than Beijing and Shanghai, local inputs tend to be provided through regular regional meetings between MOST and the provincial planners. For example, the MOST held a multi-province forum on the preparation of the national 13th FYP for STI in Guangdong in 2015 to transmit the key themes of the national plan to provinces and to absorb opinions from the local governments. Participants included the CASTED, the Institute of S&T Information of China (ISTIC), and the S&T departments in southern provinces such as Guangdong, Guangxi, Yunnan, Guizhou, Fujian, etc. (Guangdong Provincial S&T Department 2015). Similar meetings have also been held in Sichuan and Guizhou provinces during the formulation of the national 13th FYP for STI (MOST 2015C; MOST 2016B). These fairly regular meetings provide fora for two-way interactions, provincial inputs into the national planning process combined with the direction from central to local.

Prefectures also routinely provide local input into the provincial planning process. This is particularly clear in the "preparation guidelines." For instance, Shangrao, Jiangxi stipulates that during the second stage of plan formulation, all localities and prefectural departments should "study and put forward policy proposals, major projects and major issues that they hope to incorporate into the national and provincial 13th FYP, and that the prefecture DRC should summarize and report them to the provincial DRC" (General Office of Shangrao Municipal Government 2014). Prefectural planners provide feedback to the provincial planners and even the national planners in an attempt to obtain more resources and potentially more land. The interaction both provides information and facilitates lobbying. In this process, the approval of specific projects—perhaps with associated funding—plays an important role. In Changzhou (in southern Jiangsu between Nanjing and Wuxi), the preparation guidelines emphasize that the planning process is a sorting process of major projects. The guidelines exhort planners to not merely focus on existing big projects, but to propose new major projects which are likely to be ratified by provincial or national governments (Changzhou General Office 2014). Dalian even tried to incorporate some of the key "indicators, projects, and reforms" into the national and provincial 13th FYPs ("Dalian's preparation guidelines" 2014). Despite the slightly different descriptions, there is no doubt that the institutionalized mechanism for the "upward" local inputs does exist.

Even below-prefecture lower-level governments contribute to upper-level planning. In the Beijing suburb of Huairou (a quasi-prefecture-level "urban district"), the preparation guidelines state that during the formulation of the prefectural plan, all counties/townships should study and propose the main indicators, major projects, major policy measures, etc., to the prefecture DRC (General Office of Huairou District 2015). Anhui's provincial preparation guidelines contain a similar statement. While these observations are based on preparation guidelines for the general ESD plan, not specifically the 13F STI Plan, they appear to apply to the STI planning process as well.

Based on these local preparation guidelines, the basic procedure of the "upward" local inputs is graphed as below:

**Figure 4.** Local Inputs into the National Planning




In the process shown in Figure 7, the DRCs at all levels act as coordinators and the governments act as deliberators. All the information submitted to the superior DRC is supposed to be assessed and approved by the local government. In other words, both the "tiao" (vertical: specialized system under MOST) and the "kuai" (horizontal: regional system represented by the DRC) systems are functioning in the mechanism. In normal bureaucratic procedure, localities cannot bypass their direct upper-level governments in the hierarchy. However, there exists outlier prefectures that manage to directly communicate with the national ministries. For example, Haidian District in Beijing, where the core of Zhongguancun S&T park is located, communicated with the national MOST, MIIT, etc., when preparing and implementing its 13th FYP for STI (Haidian District Government 2016). The most intuitive explanation is that Haidian's status as the region with the most intensive intellectual resources in the country (Chen 2021) gives it special status in China's national S&T planning.

## 2D. Flexibility in Provincial & Prefectural Formulation

As described earlier, prefectures follow the same three formulation stages that national and provincial planners follow: preliminary study, formal drafting and consultation. Moreover, the role of different local government bodies, in particular the local planning agency the Development and Reform Commission (DRC) is specified in local preparation guidelines. These features might seem to imply a high degree of uniformity among local governments in STI planning. In fact, that seems not to be the case. We found that local planners have substantial flexibility to (a) choose the national policy documents to reference; (b) organize knowledge resources for their plans; and (c) choose specific targets. This flexibility may also be reflected in the extremely heterogenous outcomes of local planning, including a relatively low rate of target fulfillment.

In the preliminary study stage, the prefectural S&T bureau organizes relevant experts to conduct research in the field of STI and propose the preparation plan for the 13th FYP for STI in conjunction with the research on major topics of the general ESD 13th FYP. This is then submitted to the prefectural Development and Reform Commission (DRC) for consideration, marking the large, institutionalize role this organization plays in local planning. Prefectures of course have less planning capability than provinces, or the national government. In terms of organizing relevant experts, the prefectures may use local resources, or they may seek support from other provinces, in the extreme totally outsourcing the plan preparation research. In the formal preparation stage, the prefectural S&T bureau usually spends about half a year to complete the first draft and then submits it to the prefectural DRC for review and coordination, as is stipulated in many prefectural preparation guidelines. After the consultation phase, the S&T bureaus must re-submit the draft plan to the prefectural DRC, which will revise the STI plan, as needed, to correspond to the overall (ESD) plan. Subsequently, the STI plan is submitted to the executive meeting of the prefectural government for approval. Approval by the prefectural government gives it authoritative status, and the plan is finally released by the corresponding government agencies (Xining Municipal People's Government 2015). The local S&T departments clearly lead the plan formulation. This is reasonable as the local S&T departments are the direct subordinate agencies of the national MOST, which also led the formulation of the national 13th FYP for STI. However, in addition to the formulation, another equally or even more important task, namely coordination, tends to be carried out by the DRCs, which are responsible for directing all the planning tasks and report to the prefectural governments. The role of the DRC is clearly specified and observable at the prefectural level, which is useful because there is less open-source information about the planning process at the provincial level. Still, the DRC’s leading coordination role can be glimpsed through a few provincial preparation guidelines that are available (Anhui Office 2014; Guangxi Office 2015).

Local governments also organize inputs for their own plans. Some provinces have strong planning capabilities and organize broad consultation processes to provide independent inputs into their planning process. To build an internationally competitive STI center, Shanghai had invested significant resources in preparing its 13th FYP for STI. At the party and municipal level, the CPC Shanghai Committee set up "Accelerating the construction of an S&T Innovation Center with global influence" as the No. 1 project in 2015, and conducted an in-depth multi-year study (Xu 2015). On the part of the Shanghai S&T Commission (SSTC), which led the preparation of the 13th FYP for STI, they invited several government agencies, such as the Economy and Informatization Commission of Shanghai Municipality, and non-governmental organizations, such as Shanghai American Innovation and Development Research Center (at East China Normal University:上海市美国创新与发展研究中心), to participate in the comment solicitation symposium for the plan (Shanghai Municipal S&T Commission 2015A). Also, the SSTC held seminars to listen to the suggestions of experts from major universities, research institutes, and various enterprises in Shanghai on the 13th FYP for STI (Shanghai Municipal S&T Commission 2015B). Furthermore, Shanghai serves as a prominent case to illustrate that local governments can spend great efforts to study the STI policies or cutting-edge developments in developed economies during the preliminary research stage. The SSTC had organized several research groups to study the STI plans in developed economies such as the United States, the European Union, Singapore, and South Korea (Shanghai Municipal S&T Commission n.d.).

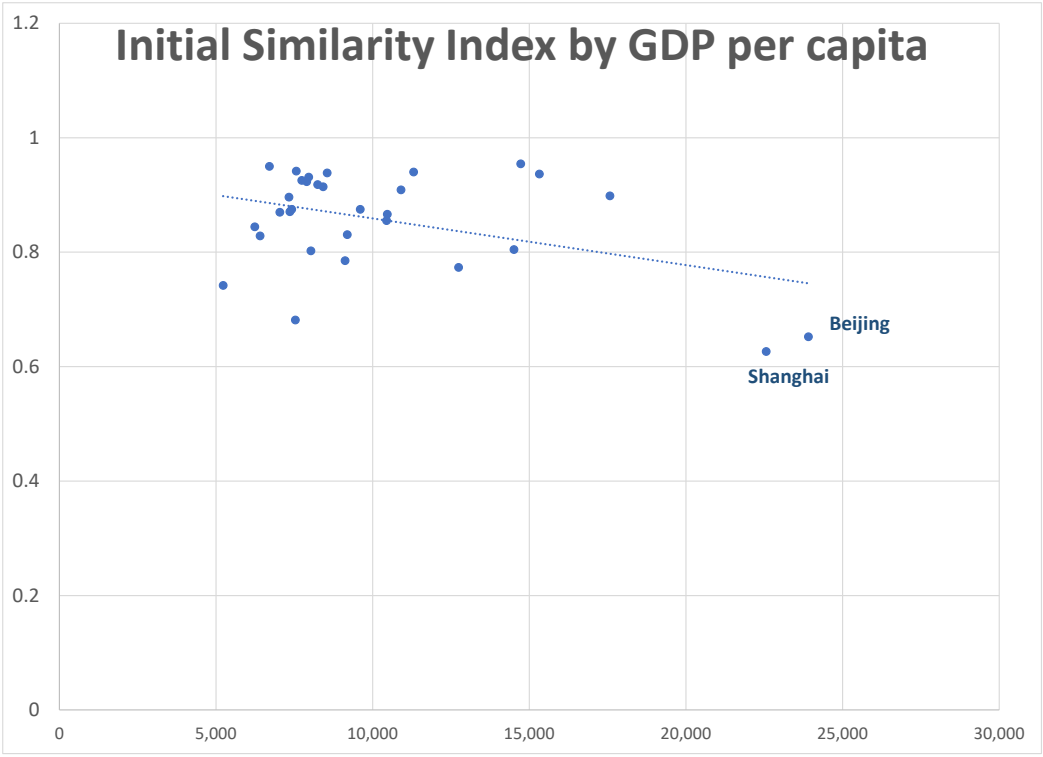
However, other provinces with less capacity need to find other ways to formulate their plans. Guangxi, a province with weak planning capabilities, “outsourced” its formulation process to Fudan University in Shanghai and to CASTED instead of to the provincial S&T department or universities and institutes within the province (Guangxi Provincial S&T Department 2015). Although the other provinces we examined did not disclose the specific institutes leading the formulation of provincial plans, we would assume that normally the leading institutes would be those within the province. We deduced that Guangxi's provincial administration is unable to develop its own STI programs due to a lack of STI resources. As a result, the local government engaged the outside prominent institutes/universities to draft the plan to make it more professional.

While following a routinized formulation process, the provinces and prefectures display a substantial amount of flexibility to choose additional channels of influence and local development targets. Since S&T planning is not an isolated arena, it can be strongly influenced by policy guidelines from various systems and documents. The IDDS—to take the most extreme example—exerts influence over multiple S&T planning systems and all kinds of S&T and industrial policy documents. There is an external “policy flow,” indicating the influence of policy guidelines from other systems and documents. The

difference from the "planning system" and the "policy flow" lies in the level of institutionalization—while the former is generally routinized, the latter largely stems from the provincial and prefectural governments' flexibility in the choice of "source documents." The "source documents" refer to the documents whose titles are specifically mentioned in the provincial STI plans and which exert influence on the policy focuses on the provincial plans. We regard the appearance of a document's title as a signal of policy guidelines from the document.[19] In other words, when formulating local STI plans, the local governments can choose which policy documents to reference in order to reflect the province's characteristic policy orientations. They include programmatic policy documents, but also reach beyond this. For example, provincial 13th FYPs for STI tend to state at the very beginning that "this plan is formulated according to the provincial 13th FYP ESD, national 13th FYP ESD, national MLP, etc.," or state that "the province will implement the Made in China 2025 Initiative, the State Council Opinions on Deepening System Reforms and Accelerating the Implementation of IDDS, etc." The documents mentioned in the examples are all regarded as the "source documents." In the eight province case studies, the average number of source documents is 5.375. Guangdong has the highest number of source documents, i.e., twelve, while Beijing has the lowest number of source documents, i.e., one. The number of provincial source documents is almost always larger than the number of national level zero documents, because most provinces cite their province's ESD 13FYP (the most frequently cited source document at this level). The IDDS and the National 13th FYP for STI are also frequently cited, and the themes of the IDDS are cited in virtually all provinces. The choices of "source documents" depend on local conditions, local leaders' preferences, and/or top leaders' signals. Since a local STI plan can apparently cite as many "source documents" as the local government wishes, China's S&T "policy flow" is an extremely intertwined and extensive network.

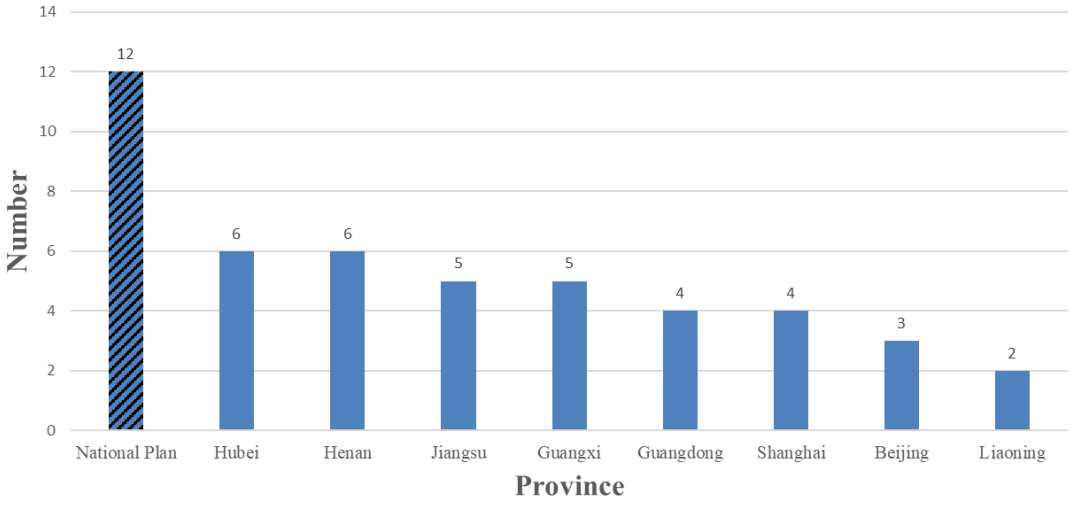
Heterogeneity of plan preparation ought to be accompanied by heterogeneity in the outcomes, the plans themselves. As a preliminary test, we examined the text-based similarity of provincial plans to the national plan. The results (shown at right) confirm the different status of Beijing and Shanghai (discussed earlier), whose plans are much less similar to the national plans than other provinces. However, since the similarity index has not yet been calculated by a fully-trained model, the results can only be considered suggestive.

[19] We exclude the situations where the provincial plans mention the policy document titles when describing the past STI achievements and where the cited documents are future targets but do not exist yet. For example, the plan describes that "the province has published <document titles> during the 12th FYP period." Or, the plan says "the province will issue <document titles> during the 13th FYP period."




Continuing to examine planning output, we also found substantial heterogeneity in choosing development targets among the national and provincial plans. First of all, there are outstanding differences between the national and provincial targets. The national targets cover twelve areas, including the contribution rate of S&T progress, R&D expenditure as a percentage of GDP, the number of R&D personnel per 10,000 employed, and the income of high-tech enterprises. However, in the eight provincial case studies, except for a small number of indicators that are consistent with the national plan, the vast majority of indicators are unique, such as the number of S&T-based SMEs, the technology self-sufficiency rate, the number of incubated enterprises in various incubation institutions, and the coverage rate of good crop seeds. As Figure 5 shows, among the eight provinces, Hubei and Henan exceed the other provinces by adopting six of the national plan's target indicators, but Liaoning adopted only two of the national indicators. Although the underlying reasons are still unknown, the heterogeneity does reveal that provincial governments have a considerable degree of flexibility in the planning process.

**Figure 5.** National Indicators Adopted by Province



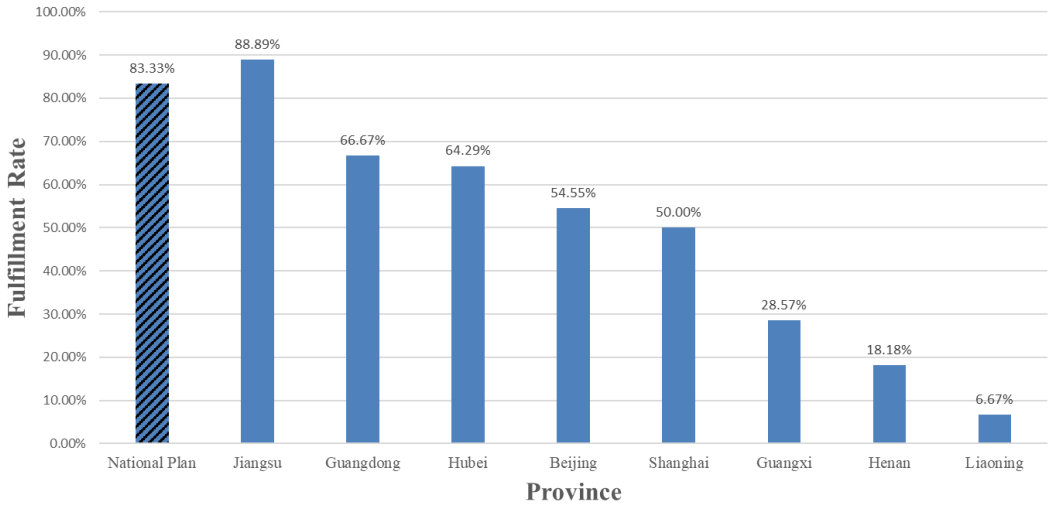

In setting these targets, provinces differ among themselves even more than they differ from the national plan. For example, Hubei set many targets for establishing R&D platforms in its 13th FYP for STI, such as the number of critical laboratories of province level or above; the number of industrial technology research institutes; the number of national high-tech zones, etc. However, by contrast, Liaoning set utterly different goals in its STI plan than Hubei, such as the number of high-level research talents to be trained, the number of STI teams to be trained, the number of young STI and entrepreneurship talents to be trained, etc.

Turning to target fulfillment, overall provincial fulfillment rates in the 13F STI Plan was rather low. When provinces do reproduce national-level indicators, our preliminary finding based on the eight case-study provinces, is that the indicators shared by national and provincial plans tend to have better fulfillment rates . For example, seven provinces shared the indicator of invention patents per 10,000 population and four provinces shared the indicator of technology contract turnover. The 2020 data shows that the achievement rates of these two indicators are 71% and 100% respectively. In other words, for the number of invention patents per 10,000 population, five of the seven provinces met the target. All four provinces achieved the expected target for the technology contract turnover. There was, however, one shared indicator that was not well accomplished: all eight provincial plans included R&D expenditure as a percentage of GDP as a target, but only half the provinces achieved their targeted value. However, this target was also missed at the national level, so provinces were probably not under much pressure to hit their target. Otherwise, the fulfillment rates of the shared indicators were better than those of unique provincial targets. For instance, Shanghai set eight targets in total and completed three of its four shared targets but failed to

achieve three of the four unique goals. It should be noted that all of the provincial targets examined are "indicative," meaning they have predictive value and are not considered compulsory. Even missed targets may serve a function if they have communicated an ambitious vision and contributed to progress in the direction indicated by the target. Future work will focus on collecting more target data.

Fulfillment rates varied greatly across provinces (see Table A4 in Appendix). At the national level, China managed to achieve most of the targets listed in its 13F STI Plan, with a completion rate of 83%. By contrast, most of the eight provinces we examined performed worse. Only Jiangsu performed better than the national plan, with a fulfillment rate of 89%. The worst performer was Liaoning, which achieved only 7% of its targets. Overall, according to Figure 6, the majority of the eight provincial 13th FYPs for STI have achieved less than 70% of their targets. Furthermore, in our small sample of eight provinces, there is a correlation between completion rates and provincial S&T capabilities—the four provinces with stronger S&T innovation capabilities (see Table A 4 in Appendix), Jiangsu, Guangdong, Beijing, and Shanghai fulfilled targets at a higher rate than those with weaker capabilities, such as Guangxi, Henan, and Liaoning. Hubei was an exception, though, hitting most of its targets despite its relatively weak innovation capacity.

**Figure 6.** Target Fulfillment Rates by Province




The heterogeneity of targets also exists among provincial and prefectural STI plans. First, the prefectural numeric objectives are very different from those on the upper bureaucratic level, which echoes the finding at the provincial level. For example, Guangdong set 13 quantifiable targets, while Shenzhen set 22 completely different quantitative targets. Overall, the number of quantitative targets in provincial and prefectural plans ranged from 3 to 35. This finding suggests that China's STI planning

system is not very coordinated in the sense of setting development targets (and also in other aspects as discussed above), meaning the governments at all levels have large flexibility and leeway when planning specific development targets.

## 3. STI Planning in the Broad Plan and Market Context

As the above sections show, although the local planners have always been expected to follow the spirit and main guidelines of the core political leadership, , they appear to have had a great deal of flexibility in how they interpreted the central guidelines, at least during the 13th FYP period. The provincial timing and the departments releasing the provincial plans vary significantly, and the content of local plans might not always share the same focuses with the national planning. We demonstrated in Section 2 that provincial planning followed a partially institutionalized process during the 13th FYP period, although it is difficult to devise a good metric to measure the degree of institutionalization. However, as the emphasis on S&T and on planning has increased in Xi's era, the number of key tasks in the S&T field has increased while there seems to be less space for local flexibility. Naturally, this dilemma has led to increased stress on the need for coordination among bureaucratic agencies and a greater emphasis on standardized procedures, including through laws.

The system of "Ordinary Special Purpose Plans" and "Priority Special Purpose Plans" seems to be part of this coordination process. Though much more research is required, we can trace important parts of this process through the preparation guidelines referred to throughout this paper. In the first place, the government makes an attempt to limit the total number of special purpose plans. For example, Shaanxi's general preparation guideline says that "in accordance with the principle of formulating as few or no plans as possible in the fields of market competition, there will be 11 priority special-purpose plans and 36 ordinary special-purpose plans, the former of which should be published by the provincial government while the latter jointly by the provincial DRC and related provincial offices." (Shaanxi Government, 2014). According to Guangzhou's preparation guideline, the priority special purpose plans are mainly focused on "important areas related to the overall development of the prefecture and where there are market failures." (Guangzhou Government, 2014). This document also points out that priority special-purpose plans have four features: "being related to the areas key to the prefecture's ESD, requiring relatively large amount of investment by the prefectural government, involving key industry layout, and being required by laws, regulations, party committee or government." Priority special purpose plans require a significant budgetary commitment, and they require an instruction (or permission) from a higher level government.

To be sure, these features are related to the most basic feature of priority special purpose plans, which is that they are supposed to be given priority over other, merely ordinary special purpose plans. At the national level, the 13F STI Plan is one of twenty-two priority special purpose plans, such as the 13F Plan for Informatization, the 13F Plan for Ecological and Environmental Protection, and the 13F Plan for Energy Development (NDRC n.d.). This designation gives special purpose plans enhanced status when it is necessary to weigh resource allocations and priorities among the many different objectives all included in the plan, that is the overall national Economic and Social Development 13th Five Year Plan. In principle, the overall ESD Plan is supposed to be the most authoritative, and other plans are supposed to be subordinate to it. But the overall ESD plan is also more vague, and is couched in generalities that are not always easily translated into practical measures. Lower-level plans concretize the vague parts in the overall plan. Moreover, based on the local preparation guidelines, it is likely that the list of priority special purpose plans was already known when the general purpose plan was drafted. Moreover, while the national 13F STI Plan is a priority special purpose plan, many of the 13F STI Plans at the prefectural and provincial level are not. This difference reflects the practical outcome of the struggle to balance huge ambitions with limited resources.

Since 2005, the Chinese government has been looking for ways to increase the authoritativeness of the overall ESD Plan, while simultaneously increasingly the scope and integration of planning. “State Council Views on Strengthening the Preparation of National Economic and Social Development Plans” stipulates that national economic and social development planning should have the national-level, provincial-level, and prefectural and county-level planning based on administrative levels; it should also have overall planning, special-purpose planning, and regional planning based on objects and functional categories (State Council 2005). STI plans, which fall under the category of “special-purpose planning,” are therefore required to “obey the overall planning of the same level and the superior levels.” This strict coordination requirement is realized by requiring that “before the overall plan’s draft at the provincial level is sent to the government at the same level for approval, the provincial DRC shall send it to the national DRC for coordination with the national overall plan; sent to the relevant neighboring provinces for coordination with their overall plan; and if necessary, sent to other relevant Ministries for coordination with the national-level special planning.” Despite these strict requirements, none of the local preparation guidelines we examined for the 13th FYP mentioned this complete procedure. There is no evidence showing that the provincial plans were sent to the national NDRC first before they are sent to provincial DRCs, let alone the neighboring provinces and Ministries. Thus, the 2005 document should be regarded as a starting point when China began to emphasize the importance of planning coordination, and made unrealistic demands for full cooperation.

Another burst of national guidelines was produced in 2016–2018. The first was a joint CCP center and State Council document on improving the implementation of the national 13th FYP, which puts forward a number of general requirements (CCP & State Council 2016a) for the 13th FYP's preparation and implementation. In December 2018, the same two bodies promulgated "Opinions on Unifying the Planning System to Strengthen the Strategic Guiding Role of National Development Planning." The document stated that "(the ESD five-year plan) is at the top of the [overall] planning system and the general rule of all other plans at all levels…. subordinate plans obey the superior plans, the lower-level plans serve the upper-level plans, and the plans on the same level are coordinated with each other," and that "it is not only necessary to strengthen the provincial/local plans' connections with national special plans, regional plans, and spatial plans…, but also to adapt to local conditions and highlight local characteristics." (CCP & State Council 2018) The provincial 13F STI Plans, then, are supposed to serve the purpose of the national five-year S&T plans. Whether the 2018 document will be more successful than the 2005 document in achieving a high degree of coordination among plans remains to be seen. However, we should note that it comes out of a very different environment than the 2005 document, since it is based on experience with several rounds of recent actual FYP planning practice and shows China's current determination to bring a higher level of coordination into effect. We expect to see that provincial STI plans during the 14th FYP period (2021–2025) will be more strictly coordinated with the national plan. It is of course possible that the 14F STI plan will never be publicly released, but many provincial 14F STI plans have already been released, and we anticipate extending the research scope to the 14th FYPs for STI.

## Conclusion

The example of China's 13th FYP for STI enables us to trace the operation of a specific Chinese planning sub-system. The STI planning subsystem's growth and institutionalization reflects the greatly increased priority given to technology in China's development strategy. In particular, the "promotion" of STI planning to a fully-fledged planning sub-system for the 13th Five Year Plan is an important milestone in the strengthening of planning in China. The evolution of planning procedures clearly shows that the ambition of China's policymakers is to create a fully developed planning subsystem that is both coordinated with the five-year planning cycle, and highly integrated into the overall planning process. In that sense, the elaboration of the 13F STI Plan is just one step in the steady increase of planning in China overall since 2005.

Overall, the 13F STI planning subsystem is hierarchical with programmatic policy documents guiding the formulation of the Level One national plan, plus a panoply of lower-level plans. The Level 1 document is the core of the planning sub-system, which is formed through a fairly institutionalized process and regulated by a set of explicit

procedures and guidelines. In this formal planning system, the local plans follow the guidance from both the programmatic policy document and the higher-level plans. Despite fairly uniform and perhaps excessively rigid planning procedures, the process in practice has a fair amount of flexibility. Programmatic policy documents—"level zero" inputs into the planning process—are significant and provide a way to introduce new concerns and priorities into planning. Top leader interventions provide another such channel. Meanwhile, within the structured process, lower-level governments are expected to provide information, proposals, and requests for resources to higher levels. Future work is needed to analyze this interaction, and specifically assess the balance between information collection and simple lobbying.

Localities in practice have a substantial scope for initiative and room to define their own priorities. The scope of this flexibility is evident in the way local governments arrange inputs to the planning process, in the diversity of their planning outputs, and in the highly uneven rates at which provinces meet their plan targets. Each of these dimensions provides a basis for further analysis. To be sure, local flexibility is exercised within a national framework, of which the IDDS is the key high-level document. The vision incorporated in the IDDS is ambitious, even visionary. It is not easy for localities to respond to these goals. Many localities lack the expertise and funding to produce results, and some have few or even no "priority specialized plans." Localities missed many of the targets they set for themselves. Yet this does not necessarily mean that the plans themselves were failures. The diversity of approach and a healthy tolerance for failure may in the long run help realize China's ambitions, and spread higher standards for research and innovation to some of China's lagging regions.

The STI planning sub-system and the overall planning system of which it is a part are still in flux, but the trend is strongly towards a more comprehensive, more hierarchical, and arguably more rigid planning system. The 2018 document on unifying the planning systems—some of the content of which was incorporated in the national comprehensive ESD 14th Five Year Plan—calls for a higher level of formalization in the Chinese planning system. We expect to see this incorporated into the 14th FYP period planning that we are currently examining. In the face of these trends, it seems likely that the space for local discretion and experimentation is shrinking. In future work we will examine the changes in planning process during 14th FYP period and consider how this apparently more centralized approach affects science, technology and innovation in China.

# Appendix

**Figure A1.** Comprehensive Utility Value of Provincial Innovation Capabilities from 2016 Report on China's Regional Innovation Capability Evaluation (using 2014 data)

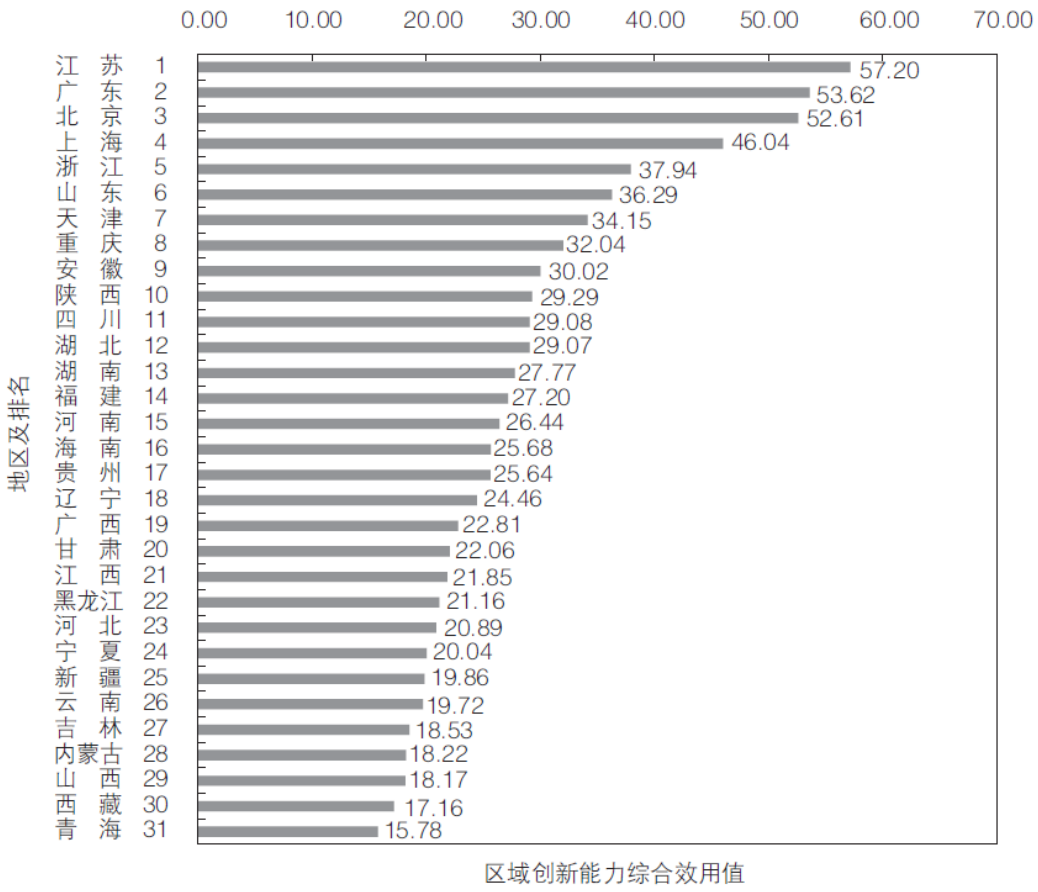


**Table A1.** S&T Innovation Index of China's 287 Cities (First Page) from 2017 Report on the S&T Innovation Development Index in Chinese cities (using 2014 data)

中国 287 个城市科技创新发展指数及排名

| 指标 | 科技创新发展指数 | | 一级指标 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 创新资源 | | 创新环境 | | 创新服务 | | 创新绩效 | |
| 城市 | 指数 | 排名 | 指数 | 排名 | 指数 | 排名 | 指数 | 排名 | 指数 | 排名 |
| 北京 | 0.587 | 1 | 0.603 | 2 | 0.344 | 10 | 0.546 | 2 | 0.689 | 1 |
| 深圳 | 0.587 | 2 | 0.414 | 25 | 0.698 | 1 | 0.621 | 1 | 0.582 | 3 |
| 上海 | 0.499 | 3 | 0.466 | 17 | 0.338 | 11 | 0.313 | 4 | 0.623 | 2 |
| 广州 | 0.464 | 4 | 0.602 | 3 | 0.390 | 5 | 0.263 | 6 | 0.511 | 4 |
| 东莞 | 0.452 | 5 | 0.465 | 18 | 0.611 | 2 | 0.416 | 3 | 0.396 | 24 |
| 天津 | 0.416 | 6 | 0.469 | 15 | 0.316 | 23 | 0.253 | 10 | 0.486 | 5 |
| 武汉 | 0.405 | 7 | 0.508 | 9 | 0.315 | 24 | 0.207 | 18 | 0.466 | 6 |
| 杭州 | 0.391 | 8 | 0.488 | 11 | 0.322 | 18 | 0.175 | 31 | 0.450 | 8 |
| 南京 | 0.390 | 9 | 0.609 | 1 | 0.277 | 49 | 0.144 | 59 | 0.441 | 10 |
| 苏州 | 0.384 | 10 | 0.315 | 55 | 0.359 | 8 | 0.255 | 8 | 0.448 | 9 |
| 厦门 | 0.378 | 11 | 0.485 | 12 | 0.271 | 56 | 0.256 | 7 | 0.423 | 13 |
| 海口 | 0.376 | 12 | 0.547 | 6 | 0.222 | 153 | 0.134 | 71 | 0.455 | 7 |
| 珠海 | 0.376 | 13 | 0.574 | 4 | 0.387 | 6 | 0.230 | 12 | 0.357 | 39 |
| 长沙 | 0.367 | 14 | 0.432 | 22 | 0.305 | 28 | 0.144 | 60 | 0.436 | 11 |
| 西安 | 0.364 | 15 | 0.534 | 8 | 0.234 | 122 | 0.183 | 26 | 0.418 | 16 |
| 呼和浩特 | 0.362 | 16 | 0.457 | 20 | 0.294 | 34 | 0.148 | 52 | 0.421 | 15 |
| 成都 | 0.358 | 17 | 0.352 | 38 | 0.317 | 22 | 0.149 | 49 | 0.434 | 12 |
| 中山 | 0.356 | 18 | 0.481 | 13 | 0.282 | 43 | 0.253 | 9 | 0.380 | 30 |
| 乌鲁木齐 | 0.351 | 19 | 0.498 | 10 | 0.237 | 115 | 0.191 | 23 | 0.399 | 22 |
| 青岛 | 0.347 | 20 | 0.324 | 53 | 0.281 | 44 | 0.226 | 14 | 0.413 | 18 |
| 太原 | 0.340 | 21 | 0.558 | 5 | 0.307 | 27 | 0.134 | 72 | 0.350 | 44 |
| 沈阳 | 0.339 | 22 | 0.427 | 23 | 0.285 | 41 | 0.122 | 114 | 0.397 | 23 |
| 大连 | 0.339 | 23 | 0.314 | 57 | 0.421 | 4 | 0.116 | 129 | 0.376 | 32 |
| 昆明 | 0.337 | 24 | 0.411 | 26 | 0.250 | 83 | 0.111 | 151 | 0.413 | 19 |
| 长春 | 0.336 | 25 | 0.339 | 45 | 0.326 | 17 | 0.095 | 213 | 0.407 | 21 |
| 鄂尔多斯 | 0.336 | 26 | 0.126 | 286 | 0.472 | 3 | 0.092 | 220 | 0.409 | 20 |
| 无锡 | 0.336 | 27 | 0.300 | 68 | 0.303 | 30 | 0.133 | 79 | 0.414 | 17 |
| 贵阳 | 0.333 | 28 | 0.476 | 14 | 0.203 | 190 | 0.221 | 15 | 0.375 | 33 |
| 济南 | 0.329 | 29 | 0.456 | 21 | 0.261 | 65 | 0.102 | 183 | 0.384 | 28 |
| 佛山 | 0.324 | 30 | 0.388 | 29 | 0.286 | 40 | 0.212 | 17 | 0.353 | 41 |
| 哈尔滨 | 0.324 | 31 | 0.346 | 42 | 0.290 | 36 | 0.112 | 148 | 0.391 | 26 |
| 常州 | 0.324 | 32 | 0.349 | 41 | 0.269 | 60 | 0.129 | 90 | 0.393 | 25 |
| 福州 | 0.320 | 33 | 0.338 | 48 | 0.245 | 95 | 0.162 | 36 | 0.388 | 27 |
| 合肥 | 0.319 | 34 | 0.366 | 33 | 0.247 | 87 | 0.146 | 55 | 0.382 | 29 |
| 三亚 | 0.318 | 35 | 0.468 | 16 | 0.142 | 279 | 0.271 | 5 | 0.357 | 38 |

**Table A2.** Prefectural 13th FYPs for STI in Beijing[20]

| Prefecture | Province | Title of S&T Plan | Text is Available |
|---|---|---|---|
| N/A | Beijing | Beijing's 13th FYP to Strengthen the Construction of National STI Center | Y |
| Haidian District | Beijing | Haidian's 13th FYP to Strengthen the Construction of the Core Zone of the National STI Center | Y |
| Chaoyang District | Beijing | Chaoyang's 13th FYP for STI Development | N |
| Dongcheng Area | Beijing | Dongcheng's 13th FYP for S&T Development | Y |
| Xicheng District | Beijing | Xicheng's 13th FYP for STI Development | Y |
| Fengtai District | Beijing | Fengtai's 13th FYP for Fengtai S&T Park Development | Y |
| Shijingshan District | Beijing | Shijingshan's 13th FYP for S&T Development | N |
| Yanqing District | Beijing | Not found | N |
| Changping District | Beijing | Not found | N |
| Fangshan District | Beijing | Fangshan's 13th FYP for S&T Development | Y |
| Huairou District | Beijing | Huairou's 13th FYP for S&T and High-tech Industry Development | Y |
| Mentougou District | Beijing | Not found | N |
| Tongzhou District | Beijing | Tongzhou's 13th FYP for S&T Development | Y |
| Shunyi District | Beijing | Shunyi's 13th FYP for S&T Development (Discussion Draft) | Y |
| Daxing District | Beijing | not found | N |
| Pinggu District | Beijing | not found | N |
| Miyun District | Beijing | Miyun's 13th FYP for S&T Development | N |

[20] In the fourth column, Y indicates the text of the 13th FYP for STI is available for further analysis while N indicates the text is unavailable. The same applies to Table A3.

**Table A3.** Prefectural 13th FYPs for STI in 14 Provinces[21]

| Prefecture | S&T ranking | Province | Title of S&T Plan | Text is available |
|---|---|---|---|---|
| N/A | | Anhui | Anhui 13th FYP for STI Development | Y |
| Bozhou | 200 | Anhui | Not found | N |
| Chuzhou | 204 | Anhui | Chuzhou's 13th FYP for S&T Development | Y |
| Hefei | 34 | Anhui | Hefei's 13th FYP for STI Development | N |
| Wuhu | 58 | Anhui | Wuhu's 13th FYP for STI Development | Y |
| N/A | | Yunnan | Yunnan's 13th FYP for STI | Y |
| Yuxi | 221 | Yunnan | Yuxi's 13th FYP for STI | Y |
| Kunming | 24 | Yunnan | Kunming's 13th FYP for STI | Y |
| N/A | | Heilongjiang | Heilongjiang's 13th FYP for STI | Y |
| Yichun | 233 | Heilongjiang | Yichun's 13th FYP for STI | Y |
| Harbin | 31 | Heilongjiang | Harbin's 13th FYP for STI | Y |
| N/A | | Jiangxi | Jiangxi's 13th FYP for STI Upgrading | Y |
| Shangrao | 250 | Jiangxi | Shangrao's 13th FYP for STI | Y |
| Nanchang | 37 | Jiangxi | Nanchang's 13th FYP for STI Driven Development | Y |
| N/A | | Guangxi | Guangxi's 13th FYP for STI | Y |
| Guilin | 113 | Guangxi | Guilin's 13th FYP for S&T Development | Y |
| Baise | 255 | Guangxi | Baise's 13th FYP for STI | Y |
| N/A | | Hebei | Hebei's 13th FYP for STI | Y |
| Baoding | 122 | Hebei | Baoding's 13th FYP for STI | N |
| Qinhuangdao | 69 | Hebei | Qinhuangdao's 13th FYP for STI | Y |
| Xingtai | 194 | Hebei | Xingtai's 13th FYP for STI | Y |
| N/A | | Hubei | Hubei's 13th FYP for STI | Y |
| Wuhan | 7 | Hubei | Wuhan's 13th FYP for STI Development | Y |
| Xiangyang | 142 | Hubei | Xiangyang's 13th FYP for S&T Development | N |
| Yichang | 146 | Hubei | Yichang's 13th FYP for S&T Development | Y |
| N/A | | Liaoning | Liaoning's 13th FYP for S&T Development | Y |
| Jinzhou | 147 | Liaoning | Not found | N |
| Tieling | 217 | Liaoning | Tieling's 13th FYP for S&T and Hi-tech Industry Development | Y |
| Dalian | 23 | Liaoning | Dalian's 13th FYP for S&T (Intellectual Property Rights) Development | Y |
| N/A | | Zhejiang | Zhejiang's 13th FYP for STI | Y |
| Hangzhou | 8 | Zhejiang | Hangzhou's 13th FYP for STI | Y |
| Quzhou | 105 | Zhejiang | Quzhou's 13th FYP for S&T Development | Y |
| N/A | | Sichuan | Sichuan's 13th FYP for STI | Y |
| Chengdu | 17 | Sichuan | Chengdu's 13th FYP for STI | Y |
| Nanchong | 224 | Sichuan | Nanchong's Plan to Implement the IDDS and 13th FYP for S&T Development | Y |
| N/A | | Gansu | Gansu's 13th FYP for STI | Y |
| Lanzhou | 36 | Gansu | Lanzhou's 13th FYP for STI | Y |
| Jiuquan | 87 | Gansu | Jiuquan's 13th FYP for STI | N |
| Longnan | 287 | Gansu | Longnan's 13th FYP for S&T Development | Y |
| N/A | | Jiangsu | Jiangsu's 13th FYP for STI | Y |
| Suzhou | 10 | Jiangsu | Suzhou's 13th FYP for S&T Development | Y |
| Suqian | 195 | Jiangsu | Suqian's 13th FYP for STI | Y |
| N/A | | Guangdong | Guangdong's 13th FYP for STI | Y |
| Shenzhen | 2 | Guangdong | Shenzhen's 13th FYP for STI | Y |
| Zhaoqing | 150 | Guangdong | Zhaoqing's 13th FYP for S&T Development | Y |
| N/A | | Shandong | Shandong's 13th FYP for STI | Y |
| Zibo | 53 | Shandong | Zibo's 13th FYP for STI | Y |
| Zaozhuang | 190 | Shandong | Zaozhuang's 13th FYP for STI | Y |

[21] The S&T ranking information in the table is based on the data in Table A1.

**Table A4.** Number of Target Indicators and Fulfillment Rate in the 13th FYPs for STI[22]

| Province | Target Indicators in 13th FYP for STI | Shared Indicators with National Plan | Achieved Targets | Failed Targets | Indicators with Missing Data | Fulfillment Rate (Achieved / Total) | Fulfillment Rate (Achieved / (Total - Missing Data)) |
|---|---|---|---|---|---|---|---|
| National | 12 | 12 | 10 | 1 | 1 | 83.33% | 90.91% |
| Jiangsu | 9 | 6 | 8 | 1 | 0 | 88.89% | 88.89% |
| Guangdong | 12 | 6 | 8 | 1 | 3 | 66.67% | 88.89% |
| Hubei | 14 | 5 | 9 | 3 | 2 | 64.29% | 75.00% |
| Beijing | 11 | 5 | 6 | 1 | 4 | 54.55% | 85.71% |
| Shanghai | 8 | 4 | 4 | 2 | 2 | 50.00% | 66.67% |
| Guangxi | 7 | 4 | 2 | 5 | 0 | 28.57% | 28.57% |
| Henan | 11 | 3 | 2 | 3 | 6 | 18.18% | 40.00% |
| Liaoning | 15 | 2 | 1 | 1 | 13 | 6.67% | 50.00% |

[22] The default status for the targets with missing value is unachieved.

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