

Public Procurement Policies to Foster Innovation Development

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Abstract

Government and public sector demand from the perspective of demand-push policies as a tool of technology and innovation policy have been discussed in detail in the literature. Policymakers have always considered advantages such as promoting local production goals, reducing imports and dependence upon foreign countries, and meeting domestic needs with technology development and innovation. In Iran such policies have been designed and implemented and can be classified into two categories: horizontal and vertical policies. Horizontal policies refer to policy programs that regulate the general government market and the public sector. In vertical policies, however, government demand in a particular product area is regulated. In order to

analyze the different types of application of these policies in Iran, several cases of horizontal and vertical policies have been studied and compared in this article. From the horizontal policies, the law of maximum use of domestic power and Foreign Finance Credit have been selected. Among the vertical policies, the policy of 10 basic oil products and the experience of the Iran-Lab-Expo have been examined. Attempts have been made to analyze and compare the above policies based on the general pattern of government programs to stimulate government demand for technology and innovation. Finally, the lessons learned from Iran's policy experiences in the field of public sector demand orientation as a tool of technology and innovation policy are described.

Keywords: innovation policy; public procurement; demand push; regulatory framework; multiple case studies

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Introduction

Policymakers and researchers are very interested in explaining the ability of the public sector to foster innovation in companies through public procurement (Tammi et al., 2020). In fact, with a share of 12% of the GDP and 29% of the total expenditures of governments in the Organization for Economic Cooperation and Development (OECD), public procurement can be considered as a policy tool, a driver for realizing strategic goals (Dai et al., 2021).

There has been a lot of evidence in the field of innovation policy in recent decades that has confirmed and emphasized the use of public procurement as a policy tool to stimulate demand (Crespi, Guarascio, 2019; Uyarra et al., 2020). As an example, Adler et al. (2015) by examining the impact of public procurement on innovation through a survey of companies and suppliers, reached several important results that prove the effectiveness of these policies:

1. Majority of the innovative companies (around 67%) have considered being a supplier of the public sector to be effective in their innovative activity.
2. More than 75% of these innovative companies have reported that they were able to receive other government contracts in addition to the previous ones. Also, 50% of these companies reported sales contracts with private companies and 30% of them reported sales abroad in areas related to public procurement contracts.

The implementation of this policy in countries is manifested in the format of "Buy Local policy". This policy has been introduced in the United States in the form of the "Buy American Act" and it is similar to the domestic purchase preference in Canada, Australia, New Zealand, Turkey, India and many other countries (Naegelen, Mougeot, 1998).

Today, many developed and developing countries have put support for innovation-oriented public procurement as an independent tool or part of a systematic strategy and effort, such as "policy mix" and "mission-oriented policies" (Mazzucato, 2018) in their program. These countries, in formats such as upgrading existing frameworks in contracts, improving organization and capabilities, identifying, specializing and marking needs, as well as setting incentives for innovative solutions to solve problems, have put it on their agenda (Georghiou et al., 2014).

Although empirical studies at the sector level have confirmed the realization of goals such as protectionism, improvement of the institutional environment and the level of domestic production capacity and even environmental and social aspects in the industrial development policy of countries. Nevertheless, the negative effects of these policies should be considered in their design, especially in violating the competitive environment and creating obstacles in facilitating market liberalization, increasing the risk of inefficiency, reducing productivity, and also reducing the connection of do-

mestic companies to the global value chain (Narimani et al., 2019a).

Some researchers believe that the existence of a common model and similar practical approaches regarding the various dimensions of these policies and their adjustment depends on the characteristics of the countries and the desired goals of the policy makers (Wint, 1998; Khor, 2003). Therefore, it is necessary to study the specific experiences and conditions of each country in order to develop a suitable public procurement policy model (Narimani et al., 2019a).

Also, in Iran, different types of these policies have been designed and implemented, horizontally (which includes the country's parts in general) and vertically (which has been implemented in specific sectors and specific technology fields) (Narimani et al., 2019b).

This research tries to investigate the most important dimensions and characteristics of these policies using the method of multiple case study. Based on this, in horizontal policies, examining the dimensions of the law on maximum use of Iran's production and service capacity and the protection of Iranian goods, the law on holding tenders and the requirements for using export credit facilities (finance), and in vertical policies, the exhibition of laboratory equipment and materials made in Iran and the program Related to ten basic petroleum products, selected and reviewed.

For this purpose, in the second part of the manuscript, by reviewing the innovation based theoretical frameworks of public procurement development, a framework has been developed to explain the mentioned experiences. In the third part, the research method of the manuscript is explained, and in the fourth part, the research findings are elaborated. Finally, the analysis of the research findings and the policy framework for improving this policy tool have been described.

Literature review

The importance of demand for innovation and technological change has been used in the literature since the 1960s (Schmookler, 1962). Godin and Lane (2013) have stated that despite the demand pull policies and its impact on innovation, the demand elasticity model has become a multifaceted and successful model in driving innovation. One of the most important tools of demand-pull policies is public procurement, which is known as an effective tool for creating innovations and encouraging industrial restructuring (Crespi, Guarascio, 2019). The ways in which PP can affect the market have been discussed in the innovation literature mainly from two perspectives (Bleda, Chicot, 2020).

In the first view, it is based on solving "market failures" in the field of information deficiencies and asymmetries. In this view, markets are considered as pre-existing or "given". The second view emphasizes the importance of knowledge and interactive learning in markets. This view considers that markets are rarely predetermined and that they must be created and changed and

developed over time. Therefore, the analyzes within this view are a more realistic and dynamic view of what innovation markets are and how they work. Regardless of different views, in a wide range of company-level surveys, the effectiveness of this tool has been confirmed as the most important incentive for the company to invest in innovation and the driving force of technology diffusion. The most important reasons for using this tool can be summarized as follows:

1. Market public procurement creates or increases the demand for specific goods or services, reduces product development costs and the risk of research and development activities. In other words, public procurement ensures a minimum market size and improves predictability of demand and thus may drive innovation; Therefore, public procurement can eliminate market failure for R&D activities (Bleda, Chicot, 2020).
2. Government organizations can act as the main user and finance the learning costs or innovative products improvement. As the main buyer, in various industries, these organizations can provide information about the needs and unmet needs of the market, which in turn will lead to innovation and give it to companies (Dai et al., 2021).
3. Public procurement can facilitate standard setting and technology diffusion. In addition, public procurement can address system failures by improving interactions between users and producers (Uyarra et al., 2014).

In the literature, there are two different understandings (narrow and broad) of the concept of public procurement supporting innovation (PPI). In a limited sense, public procurement as an innovation policy tool is usually referred to as "indigenous technology provision", which means the provision of products that have not yet been produced but can be developed in a reasonable period of time. These products usually require research and development. Also, these policies are more focused on radical innovations and ignore other types of innovations (Uyarra, Flanagan, 2010).

Generally, PPI is defined as the procurement activities of public agencies that encourage all types of innovation (including radical and incremental or product and process innovations) (Rolfstam, 2012). In fact, incremental innovations resulting from public purchases, which are based on adaptation or improvement of existing solutions and products or even non-technological innovations, can have a greater impact on the market and innovative activities (Lember et al., 2011).

Furthermore, the broad definition of PPI implies that innovation can be a by-product of public procurement, regardless of whether public procurement is explicitly dedicated to innovation (Uyarra, Flanagan, 2010). Some researchers also believe that conditions can be considered in foreign contracts, such as technology attachment and internal manufacturing requirements (commitment to purchase a certain part of the proj-

ect's components and equipment internally, even if the work is referred to outside), the innovation development is considered indirectly (Ssennoga, 2006).

For optimal use of these tools, some researchers have described various dimensions. As an example, Uyarra et al. (2014), in addition to the government's policy efforts, things such as supply capabilities, risk management, interactions between suppliers and buyers, transparency of government demand, detailed specifications in tenders, incentives to provide innovative solutions, management of intellectual property rights and access to bids and other restrictions on the bidding process are key features of effective public procurement programs.

They conclude that two important dimensions including characteristics of suppliers and the nature of the market are the most important influencing dimensions in public procurement supporting innovation. From the perspective of small and medium enterprises, the main obstacles to using this capacity in the development of innovation can be found in the lack of information exchange and interaction between enterprises and government agencies that are responsible for the contract. In addition, the lack of proper specialization of the topics related to the holding of tenders for the development of innovation and the weakness in the acceptance and risk management structures in the contracting authorities are also other obstacles (Uyarra et al., 2014).

Uyarra et al. (2020) based on the study of Wanzenbock et al. (2019), have also considered four different scenarios to explain the problem/solution-based public procurement framework. They have proposed hybrid strategy (government as R&D buyer), solution-based strategy (government as catalyst), problem-based strategy (government as main user) and government as intermediary as four different scenarios. These scenarios are followed to mobilize public purchases as one of the main components of innovation policy.

By examining the concepts in the background of research related to innovation-supporting public procurement, the dimensions of a suitable policy for this area can be found in the "formulation of innovation demand" (Uyarra et al., 2014), "the capabilities of supplying products and innovations by suppliers" (Edquist et al., 2015; Lember et al., 2014), "the role of intermediary institutions to reduce the risk of transactions" (Edler et al., 2015; Landoni, 2017; Georghiou et al., 2014) and "governance and regulatory structure" (Rolsfam, 2012; Vecchiato, Roveda, 2014; Li et al., 2015) summarized.

Research Method

Empirical evidence on the effects of public procurement on firm innovation outcomes is lacking (Dai et al., 2021). Based on this, it seems that case study is suitable methods for used in research related to public procurement. This research using multiple-case study (Appendix 1), based on qualitative content analysis, for

scrutiny public procurement in Iran and present the strategic principles of formulating an effective innovation policy.

For analyzing, based on Wolcott (2008), three stages of description, analysis and interpretation of the textual data resulting from the interview, were used. Undoubtedly, the interview is the most common technique for conducting systematic social research. Therefore, for collecting data, researchers uses a semi-structured in-depth interview that allows the interviewee to describe, without any limitations, as much as possible about their experiences, understanding, actions, and behaviors. Despite limitations due to the COVID-19 pandemic, most interviews were conducted in person by researchers to obtain more satisfactory results while observing health protocols. This approach allowed the researchers to use information from previous interviews in subsequent ones. The purpose of the interviews was to understand and explain the complexity and processes involved in the implementation of public procurement policies in four case studies. The majority of the interview time was devoted to identifying initiatives employed and lessons learned by individuals who played an active role or had significant experience in the process.

In the content analysis stage (primary and secondary coding), the success and failure factors in the historical process of implementing the studied policies were first coded and categorized based on the results obtained from the interviews. Then, in the second stage, the obtained codes were classified and collected into relevant themes based on their internal coherence and consistency. Finally, after examining and identifying the themes as the main factors influencing policy-making and implementation, the researchers were able to discover a set of key factors. A network of themes was then discussed for each case study.

In this study, alongside of data triangulation (using all source of data e.g. Policymakers, Buyers, Suppliers etc.), interviews continued until theoretical saturation of the topics was achieved. In other words, researchers found that there was no longer possible new data. Based on the results obtained, the components of each theme have coherence and consistency in terms of meaning and concept within each theme, while clear differences also exist between them. The grouping of themes was carried out according to the obtained content and, in cases where similarities existed, based on the literature and theoretical foundations of public procurement literature.

Horizontal Policy Case Studies

The law of maximum use of internal capability

The maximum law was proposed in the form of a proposal by the parliament members in 1996 and was approved. But the government's 5-year delay in implementing the law was a sign of the lack of coordination between the government and the parliament and the

government's reception of the implementation. Although the obligation to comply with the law is stipulated in the general approved projects, but the law does not have a proper enforcement guarantee.

Within the normal and non-project purchases of the government, as well as the projects of non-governmental public institutions, the implementation of the law has not been very successful. Analysis of the implementation of the law on the maximum use of internal power, which was required to be observed in many subject laws, including foreign finance and foreign exchange reserves, tenders, construction projects, etc. According to these cases, in 2018, this law has been reviewed and amended again. Table in the Appendix 2 compares the categories extracted from the conducted interviews as well as the initial categories extracted from the new version of this law.

According to most of the experts and interviewees, this law has not been able to be implemented properly and has not been effective enough in improving internal power. Only in limited cases in Iran's steel production chain, this law has been able to be effective in increasing Iran's technological capability (Attarpour et al., 2023).

The main institutional obstacles to the implementation of this law, many of which have been addressed in the new law, will be explained below.

One of the issues that has affected the effectiveness of the implementation of this law is the weak support of the country's financial system for domestic producers.

In fact, government employers prefer to meet their needs with foreign finance due to budget deficit and liquidity challenges. It is natural that foreign financiers in the form of export credit institutions consider their mission to be the development of their country's exports and make the benefit of cheap export credits dependent on the purchase of the products of their own country's companies. Of course, in the new law, an attempt has been made to fix this shortcoming to some extent by regulating the internal financing system.

Another weakness of this law, according to one of the interviewees, was stated that:

As long as they don't want to implement the law, state institutions and companies are investors, this law will not be implemented and this is the main problem of the law, not the financing system.

The experience of successful countries in promoting domestic manufacturing, such as Nigeria and Brazil, shows that specialized institution building in the body of organizations in charge of economic sectors with the mission of domestic manufacturing is more successful than separating institutions in charge of economic sectors and institutions in charge of technology development and domestic manufacturing.

The use of risk management capacity, especially in the production of new and advanced goods (which is also neglected in the new law) and the lack of an evaluation system and database of internal technical capabilities

as well as the requirements of government departments are other institutional problems in the implementation of the law.

Export credit facility (finance)

Export credit (finance) facilities based on the credit line that is the subject of this research includes 72 export credit (finance) facilities, then export credit (finance) facilities include 13 items, mutual purchase agreements, including 7 items, and Finally, construction, operation and assignment contracts include 4 items.

Also, 5 ministries in Iran have the most approved sectoral projects. Based on this, the largest priority projects of each of the 5 ministries have been selected for case study. Appendix 3 presents a summary of the topics mentioned in the interviews in the order of fields.

Based on the analysis of the content of the conducted interviews, the most important issues that should be paid attention to in increasing the effectiveness of this public procurement policy in improving domestic technical capacity can be summarized in the following cases:

1. The presence of domestic contractors as intermediaries in export credit facility projects (finance) is necessary.
2. The use of various financial instruments in a specialized and combined manner (avoiding the entire project's reliance on tied foreign loans and the combined use of domestic financing institutions to provide cash flow along with tied loans and foreign development loans for different parts of the project)
3. Public-private partnerships in formulating and implementing technological priorities, especially the presence of knowledge institutions such as internal engineering offices or private knowledge-based companies as a container for absorbing and transferring technology.
4. Statistics of internal technical, engineering and technological capabilities and preparation of national capabilities bank (database of companies with internal competence)
5. Developing a foreign exchange policy compatible with industrial and technological policy (determining the exchange rate of the project from the perspective of external sustainability)
6. The need to internationalize the legal structure and corporate governance of domestic contractors.

Vertical Policy Case Studies

Exhibition of laboratory materials and equipment made in Iran

The history of "Made in Iran exhibition" goes back to the experience of the special staff for the development of nano technologies in pre-purchasing equipment re-

lated to nano technology and donating them to users, which was put on the agenda since 2006.

At that time, although the program of selling products to potential customers was also followed, this policy was not very successful in practice. Equipment customers were mainly looking for products with special features, and the manufactured equipment was not necessarily suitable for them, and the manufacturers had a non-competitive performance in terms of production features, delivery time, etc., regardless of the market conditions. Based on this, since 2013, it was decided that the contracts should be concluded with the buyers first, and then according to their conditions, the construction order contracts should be concluded with the capable manufacturers. Appendix4 presents a summary of the contents expressed in the interviews in the area of the "Made in Iran" exhibition. In the following years, the experience of the Nano headquarters in designing the development model of the Nano equipment market was noticed by the Vice President of Science and Technology of Iran, and from 2013 until now, in five periods, the initial model was expanded and generalized from the Nano field to laboratory equipment and materials in all fields.

The implementation of this policy continues with the participation of public and government sectors as well as knowledge-based manufacturing companies. The increase in the quantitative statistics of the exhibition and the continuation of its implementation show that paying attention to the challenges of implementing this policy and its achievements can inspire the design of more effective policy models to take advantage of the demand of the government and the public sector in stimulating the demand for technology and innovation.

Based on the analysis of the conducted interviews, the important points in the effective use of this political tool can be summarized as follows:

1. The majority of buyers are governmental and their unfamiliarity with the innovations and complexities of the industry, inefficient financial structure and cost accounting of universities and research institutions;
2. Scattered purchase of universities and research institutions;
3. Ignorance and lack of trust of government buyers towards the technological and innovative capabilities of domestic enterprises.
4. Management of exchange costs and intermediary institutions
5. The presence of a specialized custodian organization next to government buyers

Ten groups of strategic products of the oil industry

The localization plan of 10 groups of goods and equipment needed by the oil industry was put on the agenda since 2013 by the order of the Minister of Oil and with

the cooperation of Sharif University with the aim of strengthening domestic capabilities and making the oil industry rely more on the products of Iranian manufacturers.

The main mechanism in this plan was that in addition to the three characteristics of quality, price and time, technological capability was also considered as one of the determining characteristics of the tender winner based on a designed model. To extract the level of technology in technological tenders, the "Evaluation of qualitative competence and technological and production capability" model is used. This model was a combination of three models TRL, MRL and CRL. Therefore, companies that have technological and production capabilities and can formulate and implement a technology development roadmap were selected in this process. This shows that the current production capacity of these companies, which shows the existence of more absorption capacity and basic capabilities, is more important. Appendix5 shows the execution coordinates of this program.

Based on the analysis of the conducted interviews, this program has not been able to have the necessary effectiveness in improving the technological and construction capabilities for various reasons, the most important of these are as follows:

- Absence of purchase guarantee mechanism by oil industry companies
- Incomplete evaluation system in determining the ability to build as the most important factor in determining the quality score of bidders
- Absence of a specific plan for capacity development in the government system
- Impossibility of cooperation with foreign companies for technology transfer
- Absence of coordinating institutions to implement this program

Summarized insights from case studies

Based on the findings of our research on challenges of effective implementation of public procurement policies of the government, the historical course of the implementation of four policy programs can be seen in Figure 1. As it is known, these policies first started with horizontal policies in Iran, and then, due to the low effectiveness of these policies, special and vertical policy programs were designed. In general, the strengths and weaknesses of the government's horizontal and vertical procurement policies in stimulating innovation can be summarized in Table 1. The investigated demand stimulation policies can be classified based on Figure 2 and Table 2.

Discussion and Conclusion

Demand stimulation policies have always been considered as a tool of innovation policy in different coun-

tries. However, their effectiveness in developing domestic manufacturing and innovation capabilities has always faced many problems.

In this study, the experience of these policies in Iran has been discussed. It should be acknowledged that although these policies, especially vertical programs, have been successful in creating a market for domestic companies and their existing products, they have not had much impact on the development of innovation in the country.

By examining the issues raised in this study, it is clear that the effectiveness of vertical programs in which public procurement policies have been higher in order to meet the current needs of the sector and create a market for manufactured and standard products is more than horizontal policies. Based on this, it is necessary to convert horizontal policies such as the law of maximum use of internal power into specific policy programs in each sector so that its capacity can be used properly.

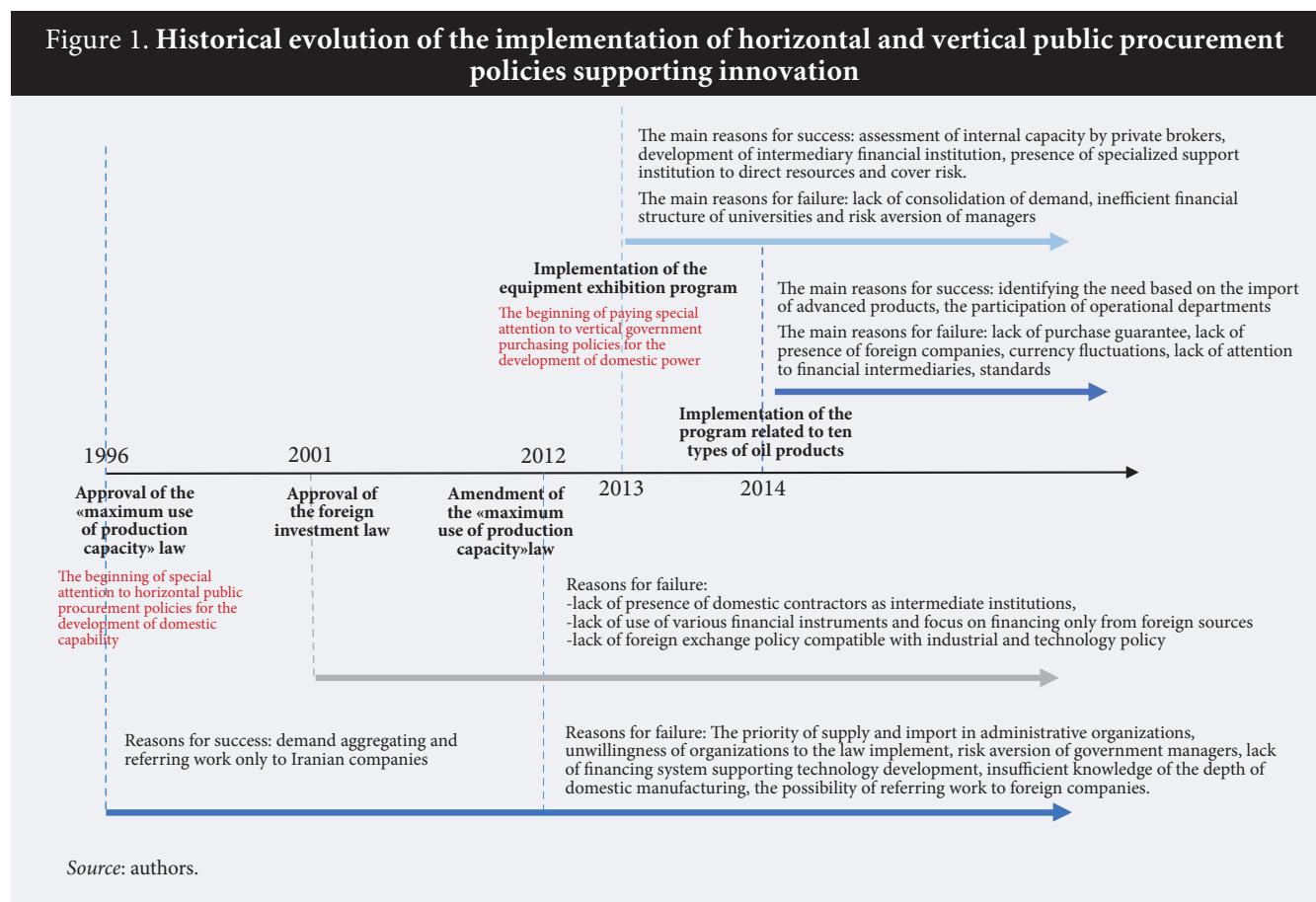
The most important factor in the implementation of such policy programs is the transformation of upstream documents into sectoral executive programs and the willingness and commitment of the country's executive bodies to develop internal capabilities. However, the experience of more advanced countries shows that different economic sectors have prepared and implemented a specific strategy for the development of capabilities based on their upstream documents. Examples of this type of planning can be seen in South Korea (Lee, 2004), China (Mu, Lee, 2005) and India (Kale, Little, 2007).

In some cases, they have specified exactly which parts of the value chain of the sector or project should be produced inside the country and with the use of human resources and with the participation of local companies. In Iran, despite the absorption capacity and appropriate technical and engineering capability, this type of planning has not yet found its proper place, and the regulatory system does not have enough dynamics and knowledge to promote the technological capability of the country.

Based on the analysis of the findings, the characteristics of a public procurement program that supports innovation can be summarized in the following cases.

Case 1. Formulation of demand based on priorities in different sectors

One of the most important dimensions related to the formulation of demand is identifying the needs and priorities of the sectoral organizations and focusing on solving them by using government rationality. As seen in the experience of domestic manufacturing equipment exhibition, one of the weaknesses of this program was the lack of purchasing priority in universities, which has led to scattered purchases (lack of consolidation of demand), and will challenge the effec-



tiveness of the government's resource allocation. Another benefit of identifying priorities is identifying areas with high added value in large projects, which will increase the bargaining power of internal parties and their political intelligence. In addition to this, the detection of technological needs based on the amount of imports has also been considered in the project of 10 items of petroleum products, which, while developing technological capability and domestic production, has reduced the dependence of the country in areas with high added value and can even create export markets.

Case 2. Identifying, evaluating and improving internal capability, a basis for upgrading internal capability

One of the most important challenges after the supply has been the clarification of internal capacity in the field of equipment production. If this issue is implemented in all the industrial fields of the country, it will face many complications. This is the reason why the self-expression mechanism was used in the maximum law to check the internal power, which was not efficient.

This challenge becomes more important in lower category referrals where less control and supervision is

applied. Meanwhile, in some advanced industries and high-tech areas, simply putting together parts and assembling work is considered as a serious technical and engineering ability. But identifying the depth of internal construction by separating the levels of technology complexity is both costly and a side specialized field required for the implementation of the maximum law that should be developed in the country.

This is while, in addition to transparency and predictability, aggregation of demand and market of the government and the public sector is a very important policy tool in promoting domestic technological and innovative capabilities. Many international experiences, especially in the field of innovation, even in European countries, have shown the special importance of this policy in promoting domestic capabilities. In general, the statistics of internal technical, engineering and technological capabilities and the creation of an atlas of national capabilities (the database of companies with internal competence) by the economic sectors of the country, including the following items, can be helpful:

- Government and public sector participation with private technology and knowledge-based companies should be on the agenda;

Table 1. Strengths and weaknesses of horizontal and vertical policies to promote government public procurement with the aim of developing the market for innovative products

a) Demand transparency

		<i>Horizontal type of policy</i>
Strengths	<ul style="list-style-type: none"> Attention to the demand side with the requirement to identify the policy target markets 	
Weaknesses	<ul style="list-style-type: none"> Lack of awareness of the components of the value chain Low attractiveness of projects to assimilate foreign resources and low exchange rate of projects Contradiction between regulatory regulations, especially in the field of supporting domestic manufacturing and attracting foreign direct investment 	
		<i>Vertical type of policy</i>
Strengths	<ul style="list-style-type: none"> Using the mechanism and market model against technology (obligation to transfer technology from abroad by the winning companies in the tender) Direction of government subsidies towards domestic purchases Development of leasing mechanism for buyers of the non-governmental sector Better possibility of analyzing the value chain of production development, determining strategic items and required equipment 	
Weaknesses	<ul style="list-style-type: none"> Lack of proper prioritization and lack of clear purchasing priorities in government agencies Willingness to buy foreign products Lack of financial resources and lack of diversity in innovation financial instruments Lack of special support for non-government buyers Precedence of foreign exchange and meeting the need for innovation and technology development Not paying attention to the duration of support for domestic companies and distorting the competition factor 	

b) Recognition, evaluating and developing internal capabilities

		<i>Horizontal type of policy</i>
Strengths	<ul style="list-style-type: none"> Creating databases of internal capabilities Compilation of regulations, instructions and government regulations to identify qualified companies 	
Weaknesses	<ul style="list-style-type: none"> Lack of sufficient recognition of internal capabilities in the field of general contractors and qualified suppliers Failure to pay attention to second category referrals Referral of work with low added value to domestic companies Low power of engineering and project control management departments in domestic companies Lack of attention to knowledge management in large projects of the country 	
		<i>Vertical type of policy</i>
Strengths	<ul style="list-style-type: none"> Development of quantitative and qualitative evaluation system of domestic companies High variety of domestically made equipment in specialized fields Obligation to provide after-sales service and proper warranty for products Preparation of a quality assessment model and technical capability 	
Weaknesses	<ul style="list-style-type: none"> Weakness in marketing and dependence on seasonal exhibitions Lack of formation of innovative cooperation networks between active companies in the same field Uncertainty of order amount Lack of company rating and accreditation Failure to identify the depth of technology in order to distinguish capable domestic producers from importers and assemblers 	

c) Intermediate institutions

		<i>Horizontal type of policy</i>
Strengths	<ul style="list-style-type: none"> Considering insurance and investment guarantee of public and private contractors Paying attention to social security insurance contracts Paying attention to the improvement of the standard system and the development of product conformity certificates Providing incentives and effective tax exemptions 	
Weaknesses	<ul style="list-style-type: none"> Absence of internal binding financing system and letter of credit (LC) system in Rial (Iranian currency) and foreign currency Not fully understanding the requirements related to cross-selling financing and finance Lack of support from the domestic financing system for issuing technical and engineering services and winning domestic contractors and builders in international tenders. Lack of appropriate tariff system to support domestic products and technologies Lack of attention to the empowerment of domestic companies 	
		<i>Vertical type of policy</i>
Strengths	<ul style="list-style-type: none"> Organizing brokers to evaluate and coordinate supply and demand The presence of innovative financial institutions for things such as producer financial guarantee, management of government budget fluctuations, and contract regulation Requirement to compile a road map for the development of technology and innovation as a commitment of tender winners 	
Weaknesses	<ul style="list-style-type: none"> Low interaction between buyer and seller in order to performance improvement and equipment quality Financial and information gap between companies and government buyers Absence of advance payment mechanism and need-based purchase guarantee 	

Table 1 continued

d) Governance structure

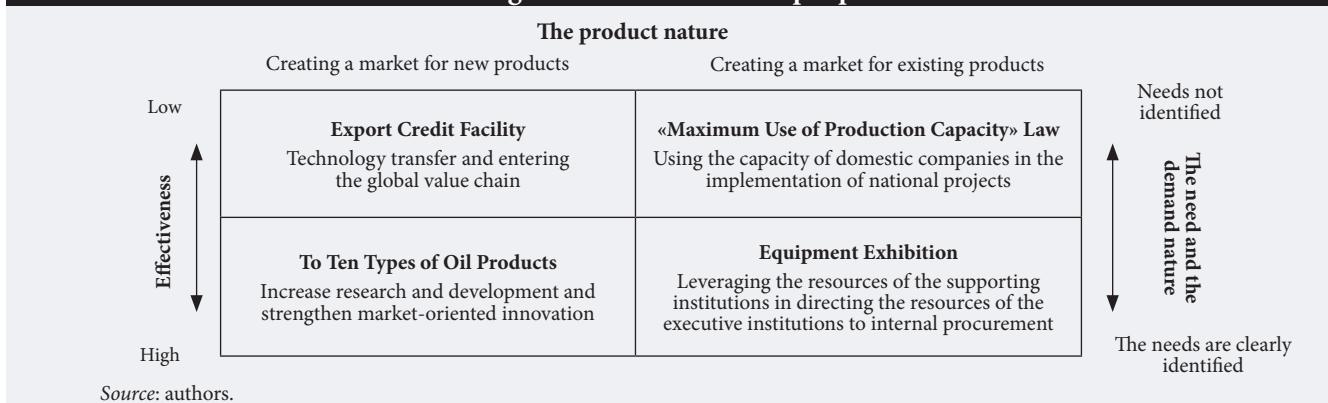
		Horizontal type of policy
Strengths	<ul style="list-style-type: none"> Explaining the mechanism of monitoring the good implementation of programs 	
Weaknesses	<ul style="list-style-type: none"> The focus of the executive bodies on the provision and absence of a regulatory system for the development of domestic production capacity Low risk tolerance of the highest executive authority of devices to support domestic production Weakness of government employers in project design and lack of specialized ability to supervise and manage projects Lack of actual calculation of foreign finance costs by executive bodies 	
		Vertical type of policy
Strengths	<ul style="list-style-type: none"> Improving internalization and technological level of products by creating a leveling mechanism for domestically manufactured technological products The role of the intermediary specialized policy agency in providing subsidized resources, implementing and reducing the risk of vertical programs Horizontal and vertical coordination between different departments of the queue and headquarters of the buyer organization 	
Weaknesses	<ul style="list-style-type: none"> Low attention to guaranteed purchase against gratuitous aid (market creation) Lack of attention to the production of export-oriented products Low management of collusion and dealing with corruption 	

Table 2. Effectiveness Requirements for the Analyzed Government Programs

Category	Description
Export Credit Facility	
Demand	Prioritizing domestic supply and specific work division between domestic and foreign companies
Supply	Identifying capable domestic companies and requiring them to be used in international projects
Intermediary institutions	Promotion of internal tied financing and development of internal contractor as an intermediary entity
Governance	Reducing the cost of using unsecured commercial loans
«Maximum Use of Production Capacity» Law	
Demand	Transparency and consolidation of demand and referral of work to Iranian contractor companies
Supply	Identification of Iranian general contractors, determining the value of work for the internal party in each project in points with high added value
Intermediary institutions	Development of domestic tied financing
Governance	Improvement of sector regulatory system
To Ten Types of Oil Products	
Demand	Recognition of sensitive points with high valuation based on value chain analysis
Supply	Identification of the indigenous chain and the requirement to formulate a technology development plan with a focus on technology transfer from abroad
Intermediary institutions	Specialization of the tender process using technological capability criteria
Governance	The presence of support institutions and main purchasing companies
Equipment Exhibition	
Demand	Specifying the purchase priority and aggregating universities' budgets for purchase
Supply	Evaluation and ranking of companies and allocation of subsidies according to the depth of domestic manufacturing capability
Intermediary institutions	Creation of specialized intermediary financial institution, organizing sales brokers and management of exchange costs
Governance	Promoting the role of development and support institutions

Source: authors.

Figure 2. Classification framework of public procurement policies of the government and their purposes



- Assessing the technological, engineering and knowledge capabilities of domestic companies and preparing a complete list of domestic capabilities;
- Supporting the creation and development of a network of specialized companies for evaluating the capabilities of private technology;
- Preparation of the list of competent domestic companies by sector and related sub-sectors.

Case 3. Intermediary institutions (management of exchange costs) are the main players in coordinating supply and demand

Actions such as the following should be included in the agenda:

- Development of specialized financial institutions, especially to reduce the risk of contracts between buyers and sellers
- Development of standard and guarantee tools
- Developing a binding financing system for large domestic projects with the aim of requiring general contractors to buy from domestic companies
- Specializing the process of holding tenders, especially in the area of quality evaluation of bidders and abandoning tender procedures for the first production of required products.
- Development of complementary programs such as guaranteed purchase or pre-purchase for products that are manufactured for the first time in the country.

Case 4. Improving the governance system, in order to develop sectoral innovations

One of the important requirements for the implementation of the innovation government demand policy is to change the rationality and organizational strategies, especially in the interaction between the sector ministries and the ministries in charge of innovation, which requires the responsibility of the highest executive authority of the sector ministries in the implementation of this policy, the existence of an implementation roadmap with clear and transparent goals. And also there are working groups made up of sector ministries and ministries in charge of innovation and governance (Edler, Georghiou, 2007). In the experience of the Made in Iran exhibition, two ministries related to higher education and health played an effective role, both as ministries in charge of technological development in the country and as sector ministries in the form of buyers of laboratory equipment and materials.

The cooperation and coordination of the aforementioned institutions, which in recent years have had mission differences with each other due to some parallel work, has been one of the most important reasons for the continuity and stability of the implementation of this policy. Sympathy of government agencies and effective division of work between sector institutions and institutions in charge of innovation in the country is an important requirement for the stability and expansion of policies to stimulate government demand for technology and innovation.

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Appendix 1. Horizontal and vertical policies of using public procurement in the development of production capacity and innovation

Policy	Selection Reasons	Data Collection Method
<i>Horizontal type of policy</i>		
The law of maximum use of internal capability (1996)	The implementation of the law since 1996 and the existence of the trustee organization	A semi-structured in-depth interview with 9 experts involved in the implementation of this law in three areas: 1- governance and policy-making, 2- executives and general contractors, and 3- associations. (Overall 445 minutes)
Foreign Finance rules (2001)	Implementation of the law on encouraging and supporting foreign investment and contracts approved by the Economic Council	A semi-structured in-depth interview with 22 related experts in the executive branch (Overall 836 minutes)
<i>Vertical type of policy</i>		
10 items of oil products (2015)	High focus on meeting the needs of a specific sector in the field of high-tech products	A semi-structured in-depth interview with 9 participating experts from the scientific and technological vice president, research and technology funds and private companies (Overall 562 minutes)
Exhibition of laboratory equipment and materials (2012)	Directing government resources into financing models to create markets for technology-based companies in a specific area	Examining executive processes as well as A semi-structured in-depth interviewing 5 experts from key stakeholders in the Ministry of Petroleum (Overall 236 minutes)

**Appendix 2. Classification of categories extracted from the interviews
and the text of the law approved in 2018**

<i>Forming the demand</i>
<ul style="list-style-type: none"> • Policy target markets and policy inclusion • Demand transparency • Future demand Forecasting • Referral of work on a conditional basis and against the requirement to improve technical capacity and export • Estimating market size and planning to identify and meet requirements (demand) • Value of work done internally
<i>Evaluation, Recognition and Promotion of internal capabilities (supply)</i>
<ul style="list-style-type: none"> • Identifying qualified contractors and obtaining loans for them from the National Development Fund if they win domestic and international tenders. • Identification of 10 to 15 important and qualified contractors for second category referral • Strengthening engineering departments and project control management in domestic companies • Create and develop GCs and MCs to take over projects • Regulation of competence recognition and job referral • The value of the work of the internal party in areas with higher added value
<i>Intermediate institutions</i>
<ul style="list-style-type: none"> • Financing (letter of credit (LC) in Rial (Iranian currency) and foreign currency) • Fully understanding the requirements related to cross-selling financing and finance • Allocation of loans in case of issuing technical and engineering services and winning domestic contractors and builders in international tenders • Insurance and investment guarantee of public and private contractors • Tax relief and exemption, avoiding tax risks • Development of product conformity certificates • Social security insurance in contracts • Strengthen innovation and research and development • Preventing the import of products that exist inside the country. • Empowering domestic companies
<i>Governance</i>
<ul style="list-style-type: none"> • Sector regulation system for the development of internal power • Knowing the value chain of the project and specifying the important points that should be foreign-Iranian partnership • Unwillingness of the authorities to implement the law • Risk aversion of the highest executive authority of law enforcement agencies • Absence of a mechanism to monitor the good implementation of the law • Non-punishment of those who disobey the law

Appendix 3. Summary of the contents expressed in the interviews in the field of export credit facilities

<i>Forming the demand</i>
<ul style="list-style-type: none"> • Inability of most of the projects to cover their costs and earn foreign currency for the country • There is a gap between the amount announced by the Economic Development and Cooperation Organization as the creditor country's share (85% of the project credit) and the amount specified by the country's laws (51% of the minimum share of the Iranian side). • Not forming a transparent division of labor between domestic and foreign companies in international division of labor (Experience of entrusting minor tasks to local activists in large contracts)
<i>Evaluation, Recognition and Promotion of internal capabilities (supply)</i>
<ul style="list-style-type: none"> • The need to increase the quality and quantity of general contractors and developer companies • Lack of involvement of Iranian contractor companies in relation to the country's expertise and technical ability and referring work in the next stages of the project • Lack of attention to knowledge management in large projects of the country • The need for support from qualified contractors to obtain facilities (providing guarantees, etc.) • Failure of the policy of requiring the transfer of technical knowledge in contracts and large foreign investments of the country • Emphasis on the numerical quantity of the percentage of construction within the project instead of the quality of work referral to achieve the goals of improving the internal capacity at the project and department level. • Non-recognition of domestic capacity building in national projects
<i>Intermediate institutions</i>
<ul style="list-style-type: none"> • Necessity of financing engineering and using new methods in project financing • The need to expand the financing of domestic production (letter of credit (LC) system in Rial (Iranian currency) and foreign currency) • Recognizing requirements related to cross-selling financing and finance • The impossibility of using export credit facilities for domestic purchases • The need to develop a specialized financing system to support the promotion of technological capability with international standards • The necessity of the presence of domestic contractors as intermediary institutions in export credit facility projects
<i>Governance</i>
<ul style="list-style-type: none"> • Weakness of government employers in project design and lack of specialized ability to supervise and manage projects • Non-compliance of the legal structure and governance of contractors with international financial laws • Lack of real calculation of foreign finance cost by public administrators (insurance cost, currency fluctuations, etc.) and the short-term vision of executives to overcome current challenges • International non-binding commercial loans are more expensive • The unwillingness of the government to accept the risk of the domestic private sector • Lack of concern for the technology development in the managers of government agencies • Knowing the value chain of the project and specifying the important points that should be considered for external-internal participation • Conclusion of formal contracts with Iranian companies by foreign parties in order to not comply with the 51% limit

Appendix 4. Summary of the contents expressed in the interviews in the area of the Made in Iran exhibition

<i>Forming the demand</i>
<ul style="list-style-type: none"> • Uncertainty of purchasing priorities of universities • Willingness to buy foreign products • Diversity in purchasing officials • Financial challenges of universities in equipment purchasing • The difference in support between different levels of technology • Non-allocation of subsidies based on the universities needs • Lack of special support for non-government buyers • The length of the decision process and the degree of realization of pre-factors • Spreading the budget in universities and buying non-priority items
<i>Evaluation, Recognition and Promotion of internal capabilities (supply)</i>
<ul style="list-style-type: none"> • High variety of provided equipment • Weak marketing and dependence on exhibitions • Proportion of quality with the price of products • Creating the opportunity to cooperate with other companies in order to promote the value chain • Failure to provide after-sales service and proper warranty for products • Uncertainty in the amount of sales • Ranking of companies and accreditation • Expanding the market and gathering demand and creating economies of scale • Depositing the guarantee and deducting the collateral
<i>Intermediate institutions</i>
<ul style="list-style-type: none"> • Innovation in regulating brokerage contracts • Creation and structuring of sales agents • Clarify the evaluation process • Regulation of the contract to reduce the financial costs of the companies • Amendment of contracts in the initial process • Dispute resolution and jurisdiction of financial, legal, technical and executive disputes • Buyer and seller interaction in order to improve the performance and quality of equipment • Producer's financial guarantee and management of government budget fluctuations • Financial and information gap between companies and universities
<i>Governance</i>
<ul style="list-style-type: none"> • Guaranteed purchase against free aid (market creation) • Improving internalization and technological level of products by creating a classification mechanism • Moving towards the development of products export • The need to support the leasing plan for the purchase of non-government sectors • Subsidy distribution based on cooperative purchase • Management of collusion and dealing with corruption • Coordination of the Ministry of Science, Research and Technology as the agency in charge of buyers • The role of the scientific and technological vice president of the presidency in providing subsidized resources and implementation • Executive-expert capability of Nano Technology Development Council

Appendix 5. Summary of the contents expressed in the interviews in the area of the “Made in Iran exhibition” (Narimani et al., 2018)

<i>Forming the demand</i>
<ul style="list-style-type: none"> • Estimated market size is about 80 thousand billion Rial (Iranian currency) (about 200 million dollars). • Import analysis and identification of priorities with the aim of localizing more than 80% of strategic goods and equipment needed in the oil industry • Analysis of the value chain of production development, determining the main items and sub-items of the required equipment (526 main items and 73850 sub-items) • Using the market model against technology (obligation to transfer technology from abroad by winning companies) • Focus on Part industry as a basic industry
<i>Evaluation, Recognition and Promotion of internal capabilities (supply)</i>
<ul style="list-style-type: none"> • Preparation of long and short list of oil industry suppliers • Evaluation and identification from among the manufacturers present in the short list • Consolidation and integration of vendor list • Paying attention to the technology dimension in the quality evaluation indicators of bidders • Preparation of evaluation model for qualitative qualification and technological capability • The greater importance of manufacturing capability in evaluating the technical score of companies (focusing on the development of technological capability in companies that have created at least basic capabilities) • Specializing in determining the technical score of companies based on the technology level of selected items • Identification of capable and indigenous chain and commitment to increase the level of manufacturing readiness, technological readiness and general company readiness
<i>Intermediate institutions</i>
<ul style="list-style-type: none"> • Specialization of tender processes with the aim of developing technology (technological tendering) • Facilitating the terms of contracts (text, amount, method of payment, conditions, preferences and guarantees) • Using the capacity of supporting institutions to provide knowledge-based economy (Innovation and Prosperity Fund) • Qualitative evaluation of bidders • Requirement to create a road map for technology development (improvement of internal manufacturing)
<i>Governance</i>
<ul style="list-style-type: none"> • Forming a joint working group between the stakeholders of the Ministry of Oil and the main purchasing companies • The presence of representatives of operating companies affiliated to the Ministry of Oil • Creating specialized working groups for each group of goods and participation in selecting companies and evaluating activities • Contingent the payment on the achievement of the road map goals