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How Public Procurement of Innovation (PPI) in Developed World Could Inform Technology Transfer in Developing Countries

Authors

Dr. Javad Noori

The Research Institute for Science, Technology and Industry Policy (RISTIP), Sharif University of Technology, Iran

Email: j.noori@sharif.edu

Najmoddin Yazdi

The Research Institute for Science, Technology and Industry Policy (RISTIP), Sharif University of Technology, Iran

Email: N_yazdi@mehr.sharif.edu

Iran University of Science and Technology (IUST), Iran

Email: N_yazdi@pgre.iust.ac.ir

Sadegh Mohsennia

The Research Institute for Science, Technology and Industry Policy (RISTIP), Sharif University of Technology, Iran

Email: seyed.emamian@sharif.edu

Dr. Ali Maleki

The Research Institute for Science, Technology and Industry Policy (RISTIP), Sharif University of Technology, Iran

Email: a.maleki@sharif.edu

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Abstract

Public procurement of innovation (PPI) as a novel promising demand-side innovation policy instrument is a new wave of public procurement reform, being implemented in European countries for the last decade. The literature of public procurement of innovation (PPI) has been grown up based on the needs of developed countries for development of cutting-edge technologies and innovations, and not technology transfer as is the case of the developing world. Based on the recent multi-cases of tendering strategic technological equipment in Iranian oil industry, the present paper takes first steps towards conceptualisation of technology transfer-oriented PPI (TT-PPI).

The results indicate that there are similar challenges for the success of both technology transfer-related PPI and regular PPI in developing and developed contexts, respectively. These include important role of intermediation structures, prominent role of championing, evaluation of tenderers and picking the winner (development of new tendering process, and qualification and selection criteria oriented toward innovation/ technology transfer), monitoring tender winner, determining the success, linking success criteria with payments and clearances, risk management and incentivization, and legal constraints. On the other side, the distinctions were fourfold, including No need to conversion of societal and public needs into functional requirements of solutions, Capability building on the supply side, Adsorption capacity of public procurers and users, and Development and evaluation of innovative solutions. The developing world could advantageously build up on previous efforts on development of PPI, but customized at their technology transfer needs.

Keywords: Technology transfer-oriented PPI (TT-PPI); Challenges; Technology transfer; Capability building; Public procurement for innovation (PPI).

1. Introduction

Public procurement of innovation (PPI), and its antecedent public technology procurement (PTP), was introduced by Charles Edquist in the late 1990s as a novel demand-side innovation policy, which caused a new wave of public procurement reform in Europe for the last decade. The escalating attention to this policy instrument is in part due to its considerable share in GDP, estimated to be around 5 to 20%, and being readily manipulable by governments (Edquist et al., 2015), which is of course more prominent in oil countries with a large public body. Specifically, public procurement of innovation (PPI) has been shown as a powerful government tool and innovation policy in satisfying societal needs, stimulating demand, overcoming market and system failures, reforming public service and spending, and promoting technological and organisational capabilities of both suppliers and demanders (Edler and Georghiou, 2007; Edquist et al., 2015)

Far from this discourse, developing and less-developed countries put technology transfer and catch-up into their priority agenda instead of innovation development. Developing countries attempt to incorporate technology transfer and catch-up as an essential and incentivising element of public tenders (e.x., Turkey case in Annex A of (OECD, 2017)). In this regard, local content policies (LCPs) and localisation are mostly adopted to address self-sufficiency and internalisation of production lines, without being primarily aimed at technological learning, transfer or catch-up (e.x., Petrobras case as an oil industry case in a developing country, in Edquist et al. (2015)). LCPs and localisation instruments and approaches, rooted in trade and economics literature, are not in general aimed at achieving true technology transfer or catch-up. Witnessing such failures of LCPs and local procurement policies during the last decades, Iranian government has recently adopted National Technology Annex by the newly established high-level Resilient

Economy Headquarter as a compulsory annex to all public tenders and public procurements, to ignite a new wave of technology transfer, catch-up and technological learning.

To put an end to unrealised technology transfers during foreign contracts, Iranian Ministry of Petroleum (MoP) recently started an initiative, by first defining ten groups of strategic equipment and goods (needs and targets in PPI), and then setting up a third-party specialised Technological Evaluation Committees jointly from academia and industry to serve as an intermediary. The recent practice of Iranian Ministry of Petroleum (MoP) could be regarded as a multi-case in this regard, including procurement of the strategic equipment of smart pigs, corrosion resistant alloy (CRA) pipelines and instrumentation among others. The present study tries to empirically shed lights on different challenges of the implementation of the new concept of technology transfer-oriented PPI (TT-PPI) as compared with the relatively established concept of PPI, touching topics such as intermediation, monitoring and evaluation practices, promotion of technological capabilities of supply side, risk management, championing and political power, and organisational disruptions and changes.

In the literature review section, the paper first set backgrounds for the concepts of public procurement for innovation, intermediation in technology transfer and in PPI respectively. Then the qualitative methodology of the research is introduced in brief. After that, the multi-case is introduced via three subsections, including development of Technology Annex as an embryonic national effort, and development of ten strategic groups of oil and gas equipment as strategic choices of the oil industry. After that, in the main section, similar and distinct characteristics of technology transfer-oriented PPI are elaborated.

2. Public procurement for innovation (PPI)

Edler and Georghiou (2007) defines demand-side innovation policies as ‘a set of public measures to increase the demand for innovations, to improve the conditions for the uptake of innovations or to improve the articulation of demand in order to spur innovations and the diffusion of innovations’. After a tradition of supply-side innovation policies such as fiscal measures, support for training and mobility, public financing of research and development (R&D), information and brokerage support and networking measures, the recent decade has witnessed a resurgence of interest in demand-side innovation policies, at least Europe-wide (Edquist et al., 2015; Edquist and Hommen, 1999). For example, one could point to the Aho Group report (Aho et al., 2006), European council call for adoption of PPI by governments to spur innovation (Edler and Georghiou, 2007), and the new public procurement directives adopted by the European Parliament numbered as 2014/23/EU, 2014/24/EU and 2014/25/EU which replaced the classic and utilities directives.

Conceptually, these efforts paved the way for reconceptualisation of classic public procurement, to introduce pre-commercial procurement (PCP), public procurement of innovation (PPI/ PPoI) and its antecedent public technology procurement (PTP), and innovation-friendly public procurement, besides other parallel developments such as sustainable public procurement (SPP) and green public procurement (GPP). By definition, PPI could be regarded as replacement of procuring products existing in the market by innovative ones which address societal, grand or local challenges (Edquist et al., 2015). While PPI asks for innovation development in public procurements, innovation-friendly procurement just ensures that innovative solutions put forward by tenderers are not unfairly treated or not pushing them back from suggesting such solutions (Edler and

Georghiou, 2007; Edquist et al., 2015). Innovation-friendly procurement does not proactively seek development of a targeted innovation. On the other side, PCP has been strictly differentiated from PPI, although interconnected with each other (Edquist et al., 2015). Rigby (2013) defines PCP as an R&D purchase to spur innovation that may benefit the contracting party at a later stage by providing a basis for goods or services not currently available. It is labeled as a supply-side innovation policy and has even been criticised for naming as innovation, but suggested to be called "pre-competitive R&D program" (Edquist and Zabala-Iturriagagoitia, 2015). As the name implies, it is as an earlier stage in development of innovation when there is a focus on R&D development, without any commercial product as the output (Edquist et al., 2015; Rigby, 2013). This lack of immediate commerciality makes PCP consensually distinct from PPI and innovation, although their integration in public procurement toward innovation targets is an ongoing practical and theoretical stream. Thus, this paper lies within the borders of PPI and is not readily extensible into distinct concepts of innovation-friendly procurement or pre-commercial procurement (PCP).

Public procurement for innovation (PPI) has been emerged and developed in the context of the developed world, i.e. OECD and European countries, addressing their state of the art needs of innovation development with a focus on grand, environmental and societal challenges. Complementarily, by admitting failure of traditional supply-side STI policies in achieving economic development and in particular addressing the poor, the global innovation index (GII) has asked for broadening the rationales and instruments of the demand-side innovation policies to the developing world (Edler, 2016). Such a mental shift towards extending demand side innovation policies and instruments to benefit local needs and societal challenges of the own population of the developing world would help

their innovation systems better directed toward the ultimate goals of economic development. The present article takes first steps in this regard by conceptualising technology transfer-oriented PPI.

3. Methodology

This is a qualitative research and part of a PhD thesis, incorporating multi-case study strategy to reach an in-depth answer for different challenges and characteristics of technology transfer-oriented PPI as compared with PPI. Therefore, the research question was formulated as "*In conceptualisation and implementation of technology transfer-oriented PPI, what are the similarities and distinctions*?"

Data collection method included in-depth semi-structured interviews, literature review and document analysis. The authors' direct engagement with the case during the last year helped in selection of interviewees from the public procurer and academia, and also in deeper discussions.

4. Multi-case introduction

In 2015, Iranian Ministry of Petroleum (MoP) defined ten groups of strategic equipment and goods as a reference list for technology transfer and localisation of the oil industry. The following year, the ministry started to follow up technology transfer issues in tenders of the selected equipment by the aid of The Research Institute of Science, Technology and Industry Policy (RISTIP), affiliated with Sharif University of technology of Iran, as the intermediation structure. As a matter of fact, it should be clarified that the public body and the procurer was unaware of the concepts of public procurement for innovation, and pursued classic approaches of localisation, import substitution and local content policies. The intermediation structure was initiated by informal relations between RISTIP and the public procurer just as consultancy. It was the intermediation structure (RISTIP) that has

tried to redirect the tenders toward technological learning and new concepts of PPI and intermediation, sometimes after the start of the projects. It is noteworthy also that RISTIP has been the single intermediary of the all tenders in this regard so far, but via separate contracts.

Since these efforts began in parallel with national movements toward adoption of National Technology Annex, these multi-cases are somehow regarded as the first experiences of the country in implementing National Technology Annex aimed at technology transfer in foreign contracts. In the following, first, National Technology Annex is introduced due to its prominence in the STI policies of the country. Then, the oil industry's multi-case is briefly presented, followed by an overview on the intermediary.

4.1. National Technology Annex to public tenders

The high-level Resilient Economy Headquarter was directly established under the Presidential Administration of Iran in 2015 to follow up the resilient economy agenda announced by the Supreme Leader. Besides being a constant popular discourse in Iran during the last two decades, technology transfer is an important item of the 10-item resilient economy agenda. Consequently, one of the first and prominent efforts of the Resilient Economy Headquarter in 2015 was to develop and adopt a Technology Annex compulsory to all public tenders and procurements in a near future to put an end to unrealised technology transfer and catch-up cases. This has also become the focus of national research grants and a constant agenda of many public bodies, such as Iranian Vice-Presidency for Science and Technology, Supreme Council of Cultural Revolution (SCCR) and its dedicated centre for National Master Plan for Science and Education.

The main goals addressed in Iranian National Technology Annex circular include technology transfer during foreign contracts, transfer of maintenance skills, involvement

in knowledge-based entrepreneurship, export orientation, maximum employment of Iranian professional human resources, and joint R&D with domestic firms and research centres. It should be noted that the development of the operational details of Technology Annex in each sector is delegated to the public body in charge. In addition, public bodies have started stepping up the ladder based on the experiences and best practices of the multi-case. This has been started by semi-official discourse at national level, by developing manuals ordered by the Iranian Vice-Presidency for Science and Technology and other public bodies, and by initiating other similar procurements for high-tech and strategic products, such as the ongoing purchase of 10 mega-size container ships from Hyundai Heavy Industries Co., Ltd. (HHI).

As it is evident, PPI is starting to spread its roots in the country via procurement of high-tech, complex and strategic products, usually of multi-million dollar bid price. This is in total contrast with local, societal and grand global challenges used to be addressed by PPI in the developed world by any types of innovation, not just by highly technological innovations or the transfer. Of course, there are some discussions and contemplations about application of National Technology Annex and PPI in public services directly affecting the civil society, e.x. in services of Municipality of Tehran.

4.2. Ten strategic groups of equipment and goods in oil industry of Iran

The Iranian Ministry of Petroleum approved ten groups of equipment as strategic ones to have their technology transferred during oil and gas public procurement tenders. These groups include digging measurement tools, instrumentation, corrosion resistant alloy (CRA) pipelines, smart pipeline pigs, control and safety valves, anti-explosion electromotors, wellhead and downhole equipment and accessories, and wellhead and downhole pumps. The tenders of some of the strategic equipment have been started since

early 2016 and they are still in progress. The present multi-case study is based on the tenders of CRA pipelines, smart pigs and instrumentation since they progressed more.

5. Similar challenges

5.1. Intermediation

According to Table 2, Edler and Yeow (2016) suggested four roles of broker, performer, content expert and trainer for PPI intermediaries. It is now investigated if these roles are in place when intermediating PPI tenders oriented towards technology transfer.

The intermediary intensely and widely adopted performer role, since there has been a great internal disruption in the public procurer. The intermediary was unofficially asked to prepare all new tender documents, participate in mutual meetings between the public procurers and tenderers and even for dispute settlement or clarifications, give consultation on legal constraints and help tenderers in preparing new tender documents, besides its contracted roles of evaluation of tenderers and development of technology transfer roadmap. Generally, there has not been any difference between the three cases. Although the product (solution) procured under technology transfer-oriented PPI is by default unchanged and the same as the classic case when no technology transfer is intended, the multi-cases showed considerable disruption in intra-organisational relationships, duties and responsibilities. On the other side, bureaucratic structures of government and accountability requirements of public bodies was seen as an obstacle in front of the intermediary to have a complete performer role, although wished by the procurer to some greater extent. Therefore, it could be said that performer role should be an option in technology transfer-oriented PPI the same as routine PPI.

Internal and external brokering were unofficially pursued as intermediation roles in all the three cases of CRA pipeline and smart pig cases. External brokering was of a distinct prominence compared with internal one, since technology transfer-oriented PPI was mainly aimed at developing capabilities in the supply side. This focus accompanied by imperfect communications between the supply-side and the public procurer and public users seriously demanded the external brokering role. Of course, internal brokering, although not of the same focus, was a role of the intermediary for linking functions and constituencies within the public buying organisation, and also for support of the adoption process. The greatest miscommunication and need for coordination was seen between technological, commercial and legal departments, which had their established procedures not in line with new tendering process.

The third role theorised by Edler and Yeow (2016) is content expert, which has been broken into two cases of supplying specialised market knowledge and differentiating business case internally across the organisation. This intermediation role was defined as not linking actors but as providing the necessary intelligence for public bodies to define needs and inform their business case and interactions (Edler and Yeow, 2016). Although the intermediation role of content expert is relevant in technology transfer-oriented PPI, its orientation considerably differs from usual PPI. Since there is no complexity associated with definition of needs or development of solutions due to being readily available in the market the same as in a classic public procurement, the focus of content expert role turned toward monitoring and evaluation of technological, manufacturing and organisational capabilities of suppliers during tendering and also during the implementation of contract. Since public procurers classically used to determine winners of tenders based on quality, cost and control (QCD) criteria, introduction of technological

capabilities of suppliers as the core of tenderers' evaluation put a huge burden on the public procurer, which required content expert role of the intermediary. The content expert role of the intermediary was twofold, one about characterisation of the technologies and manufacturing processes, and the other about identification of the technological and manufacturing capabilities of domestic and foreign tenderers. Implementation and adaptation support is also relevant here, but directed toward technological learning and implementation of the supply-side, and not the demand-side or procurer as is the case for usual PPI.

The last role suggested for PPI intermediation is training. Training public procurer employees and managers for future procurements is of importance in both usual PPI and technology transfer-oriented PPI. Here, the supply-side again makes a complementary distinction in technology transfer-oriented PPI, since training suppliers is in line with the main goals of PPI in technology transfer cases. Due to this orientation, the intermediary held several meetings with suppliers, but nothing was requested from the procurer side. The intermediary is considering the option of training public procurer and user's employees and managers in future cases in charge.

5.2. Monitoring and evaluation (M&E)

Monitoring and evaluation has been stressed as a challenge in PPI tenders and contracts (Edquist et al., 2015) and also as requisite of evidence-based approach to PPI (OECD, 2017). Monitoring and evaluation could contribute to a better functioning relationship (cooperation) between the client and the supplier/vendor/contractor, reduce Failure costs/additional work, prevent miscommunication and align mutual expectations, and strengthen a customer oriented attitude of suppliers (EAFIP, 2017). Evaluation of tenderers and picking the winner, i.e. development of new tendering process, and

qualification and selection criteria oriented toward innovation/ technology transfer is a similar challenge for both PPI and TT-PPI. But, monitoring he level of technology transferred to and from tender winners during the contract is distinctly required in TT-PPI, as compared with the monitoring of targeted innovation achieved in usual PPI.

5.3. Success determination

Factors determining the success of procurement for innovation rests on organisational culture and leadership (OECD, 2017). But, determining the success of a technology transfer itself is a burden on public procurer which could be delegated to an intermediary. Due to the novelty and complexity of demand-based innovation policies and measures, the reasons for success or failure will be only minimally understood. The same concerns are raised in usual PPI regarding success of innovation development, i.e. to understand and delimit when the PPI implementation could be considered as a successful case. Here again, the reasons underlying failure or success of a case are a matter of second-order knowledge and much more difficult to assess. Although defining explicit success criteria at the onset is helpful, the monitoring of tender contractors should also be partially direct toward success determination and its details and roots. Additionally, in both cases of PPI and TT-PPI, it is the linking of success criteria with payments and clearances which makes the point. Without such a linkage, there would not be enough incentivization to make the technology transferred or the innovation developed.

5.4. Risk management

Risk-aversion of public managers in the granting contracts and of public procurer's employees in changing their established tendering procedures and winner selection criteria besides overcoming legal barriers and inconsistencies (Edquist et al., 2015), make risk management approaches a necessity for success of PPI cases (Yeow et al., 2017).

Risk aversion has been repeatedly cited as a key barrier to PPI success (e.x., Edquist et al., 2015; Uyarra et al., 2013) or as an obstacle toward integration of policy and implementation (e.x., Selviaridis, 2016). Incentivization is a solution in this regard, which would be approached from two viewpoints, including incentivization of public procurers to innovate (in cases of PPI) or transfer technology (in cases of TT-PPI), and also incentivization of suppliers to provide innovative solutions (in cases of PPI) or to try to adsorb the technology by the receiver and also to transfer it by the technology owner (in cases of TT-PPI) (for just PPI: (Jaakson, 2017)).

5.5. Legal barriers

In PPI, legal constraints and prerequisites if not addressed hamper collaboration of public body and suppliers and hinder redesign of tendering toward innovation (Edler et al., 2012; Edquist et al., 2015; Jaakson, 2017; OECD, 2017; Rainville, 2017; Yeow et al., 2017). Relaxation of new contracts for the purpose of real technology transfer or development of innovative solutions and a certain degree of legal flexibility is a necessity for successful implementation of both PPI and TT-PPI (Yeow et al., 2017). The new public procurement directives adopted by the European Parliament (2014/23/EU, 2014/24/EU and 2014/25/EU) which replaced the classic and utilities directives, demonstrates the importance of renewing the legal framework associated with PPI and removing the legal barriers which make public procurers highly risk averse and demotivated. The same applies to TT-PPI area (EAFIP, 2017; Edquist et al., 2000; Edquist and Zabala-Iturriagagoitia, 2012; European Commission (EU Com), 2014; Izsak and Edler, 2011).

6. Distinct challenges

6.1. Definition and conversion of needs

PPI needs definition of needs (and not products) and then translation of them into functional requirements (the first step in PPI) (Cunningham, 2009; Edler, 2013; Edler and Yeow, 2016; Edquist et al., 2015), while there is fortunately no such step in TT-PPI since the solution (product) is known, specified and readily available in the market. Formulation of needs and then translation of them into functional or technical requirements are the first steps in usual PPI. Having an unchanged high-tech product compared with classic public procurement indicates that these two steps are relaxed or even not of relevance in technology transfer-oriented PPI. In technology transfer-oriented PPI, the technological product is known, not only functional but also technically. Apparently, this negates any discussion about mission and needs of public procurer. But the cases revealed that technology selection is always an important and complicated part of technology transfer process, which brought the issue back in technology transfer-oriented PPI at a strategic level, but not as a technical or solution issue. In other words, in technology transfer-oriented PPI, one is confronted with decision making about which products and technologies to be procured and from which technology owner, but not worry about the shape and specification of the solutions which are readily available in the market.

6.2. Capability building on supply-side

Although the need to have a look at technological capabilities of supply-side has been stressed in some PPI cases (e.x., Uyarra et al., 2014)), it could be regarded as the distinctive feature of technology transfer-oriented PPI. As it could be seen from the previous section, a focus on technological, manufacturing and organisational capabilities

of supply side made the difference between technology transfer-oriented PPI and routine PPI, since technology transfer demanded for a focus on promotion of capabilities of tenderers, and in a more general view of the whole supply chain. Thus, technology transfer-oriented PPI could be counterintuitively named as a supply-side oriented PPI, in which PPI is itself known as a demand-side innovation policy. Not paying enough attention to supply-side capabilities have been stated as a shortcoming in PPI, too.

Promoting supply side capabilities required putting up evaluation roles by intermediaries to determine tenders' winners and also to characterise strengths and weaknesses of suppliers as a reference point. It then was complemented by monitoring capability promotion of suppliers up to the end of the contract. Capability promotion of suppliers is not a side or optional goal in technology transfer-oriented PPI, but its existence philosophy. Since the public procurer was not used to deal with technological capability of local suppliers' due to just procuring products without technology transfer issues, such a new knowledge and communication task calls for intermediation by content expert and external brokering roles.

6.3. Adsorption capacity of public bodies

In the first glance, no internal disruption was expected in public procurers and consumers in cases of technology transfer-oriented PPI, since the products and solutions deliverable to public bodies do not change. This was the supply side, both foreign technology donor and local technology receiver, which experienced major disruptions in technology transfer-oriented PPI cases. But, the cases revealed that although use of solutions does not stimulate any change, the changes inducted into procurement process within public procurer and also in connection with supply side makes the difference. In fact, there is much newness to tendering and contract implementation processes in cases of technology

transfer-oriented PPI, e.x. incorporation and quantification of technological and innovation capabilities into tendering criteria beside classic ones, or adopting new monitoring and evaluation tools and methods which are in general more qualitative, interdisciplinary and specialised. Therefore, if we distinguish between public user and public procurer, it could be claimed that internal disruption is considerable in public procurer and not user in technology transfer-oriented PPI.

6.4. Development and evaluation of innovative solutions

As it was stated in the first subsection, definition of needs and conversion of them into functional requirements is not needed anymore in technology transfer-oriented PPI. In alignment with that, there would also be no need for development and evaluation of innovative solutions, since products are already present in the market. Instead, the focus of monitoring and evaluation efforts would be on the supply-side and tenderers who should have their technological, manufacturing and organizational capabilities promoted. While identification and promotion of supply-side capabilities is an issue in usual PPI, it is not usually a focus of it, but a side factor in achievement of the ultimate goal of innovation development.

7. Discussion and conclusion

Public procurement of innovation (PPI) has been at the focus of Europe as a promising demand-side innovation policy during the last decade. Public procurement of innovation (PPI) rests on the purchasing power of governments to stimulate innovation demand and market. As a multi-case study of the Iranian oil industry, the present article attempted to extend and customise the concept of public procurement of innovation (PPI), which has been grown up based on needs of the developed economies to spur cutting-edge innovation and technology, to technology transfer needs of the developing world.

The products procured, including smart pigs, instrumentation and corrosion resistant alloy (CRA) pipelines, were characterised as strategic high-tech complex goods or services, which were routine to both the procurer and the users. But, there were significant internal disruptions in public procurers and users due to the changes of the tendering criteria, process, evaluation and monitoring, and new skills and knowledge needed. The results confirmed similar significant challenges such as insufficient organisational and knowledge capabilities, legal constraints and inconsistencies, risk management, unwillingness of foreign tenderers in real technology and knowledge transfer, and design and implementation of new procedures and criteria for monitoring and evaluation of consortiums of foreign and domestic tenderers in both usual PPI and technology transfer-oriented PPI.

Although at the first glance, technology transfer does not get along with the innovation soul of PPI, the intertwinedness of real transfer of technology and tacit knowledge with ongoing and further incremental development of technology and innovation reconciles them. In addition, the challenges were found to be mostly similar during the cases studied, as compared with usual PPI. One of the major distinctions was found to be the should-be focus of intermediaries on evaluation, monitoring and promotion of technological, manufacturing and organisational capabilities of the domestic supply-side in technology transfer-oriented PPI. Here, technology and innovation development are not the goals, but it is the identification and promotion of capable suppliers to benefit from building up consortium with foreign/domestic technology owners matters. In contrast, promotion of supply-side capabilities is usually taken as a side goal in PPI, although being stressed as an important barrier.

The second distinction unexpectedly refers to intra-organisational disruptions and changes within public procurers in technology transfer-oriented PPI, and not changes in the user of a product. In fact, the changes are not associated with innovative products or new technologies as is the case of usual PPI, but associated with legal procedures, tendering process, technological and manufacturing requirements, and monitoring and evaluation of tenderers regarding their capabilities and the level of technology transferred during milestones of the contract.

Finally, it was distinctly found that formulation of needs and conversion of them into functional or technical specifications are not needed anymore. In contrast to development of innovation and technology in which the specifications of the product could not be determined, here the product is present in the market, its specifications are known, and possibly the public procurer and user have used to work with a similar foreign product so far. Thus, the two first steps of PPI regarding formulation of needs and translation of them into functional requirements of tenders could are not a step here.

In sum, the distinctions portray technology transfer-oriented PPI as a procurement of innovation focused on supply-side capabilities, and promotion of their technological and manufacturing capabilities as the main goal. Having product specifications and the solutions in hand at the start, and even having public users and procurers get used to them, makes technology transfer-oriented PPI much simplified in comparison with usual PPI. But counterintuitively, the challenges raised in the PPI literature were still typically in place in the cases studied, including intermediation, risk management and risk aversion of public entities, championing, evaluation of bidders and monitoring bid winners, supply-side capabilities, legal issues and political powers.

Theoretically, the article has taken preliminary steps toward conceptualisation of "technology transfer-oriented PPI" (TT-PPI), based on the established concept of "public procurement for innovation" (PPI). Locally, the results could help customise and localise literature advancements in alignment with technology transfer needs and bottom-up implementation of the National Technology Annex recently adopted in Iran. It highlighted the functions toward technological and innovation learning and technology transfer needs of developing countries. The extension of the concept of public procurement of innovation (PPI) to the developing world could additionally provide insights into some current challenges of advanced economies, e.x. how to determine a tender winner and innovation development success based on a supply-focused M&E system as it was the case of Iran's oil industry. Capturing economic benefits and externalities of such practice in the developing world is another essential step forward, e.x. by impact assessment, which may be approached qualitatively until empirical evidences allow quantitative, survey and econometric analyses.

8. References

Aho, E., Cornu, J., Georghiou, L., Subira, A., 2006. Creating an innovative Europe. Rep. Indep. Expert Group RD Innov. Appoint. Hampton Court Summit 1, 1–25.

Cunningham, P., 2009. Demand-side Innovation Policies (Policy brief No 1). PRO INNO Europe.

EAFIP, 2017. European Assistance for Innovation Procurement (EAFIP) Toolkit: Module 2: Annex 5. EAFIP.

Edler, J., 2016. Local Needs, Global Challenges: The Meaning of Demand-Side Policies for Innovation and Development, in: The Global Innovation Index (GII) 2016. pp. 97–102.

Edler, J., 2013. Review of policy measures to stimulate private demand for innovation. Concepts and effects. NESTA Compend.

Edler, J., Georghiou, L., 2007. Public procurement and innovation—Resurrecting the demand side. Res. Policy 36, 949–963.

Edler, J., Georghiou, L., Blind, K., Uyarra, E., 2012. Evaluating the demand side: New challenges for evaluation. Res. Eval. 21, 33–47.

Edler, J., Yeow, J., 2016. Connecting demand and supply: The role of intermediation in public procurement of innovation. Res. Policy 45, 414–426.

Edquist, C., Hommen, L., 1999. Systems of innovation: theory and policy for the demand side. Technol. Soc. 21, 63–79.

Edquist, C., Hommen, L., Tsipouri, L., 2000. Public technology procurement and innovation. Kluwer Academic Publishers, Boston, MA, USA; Dordrecht, Germany; London, UK.
Edquist, C., Vonortas, N.S., Zabala-Iturriagagoitia, J.M., Edler, J., 2015. Public procurement for innovation. Edward Elgar Publishing.
Edquist, C., Zabala-Iturriagagoitia, J.M., 2015. Pre-commercial procurement: a demand or supply policy instrument in relation to innovation? RD Manag. 45, 147–160.
Edquist, C., Zabala-Iturriagagoitia, J.M., 2012. Public Procurement for Innovation as mission-oriented innovation policy. Res. Policy 41, 1757–1769.
European Commission (EU Com), D.-G. for E. and I., 2014. Public Procurement as a Driver of Innovation in SMEs and Public Services, Guidebook Series: How to support SME Policy from Structural Funds. Belgium.
Izsak, K., Edler, J., 2011. Trends and challenges in demand-side innovation policies in Europe. Themat. Rep. 2011–2012.
Jaakson, P., 2017. Innovation procurements –monitoring and proportion in all procurements in Estonia in 2015, Innovation studies (26). Ministry of Economic Affairs and Communications of the Republic of Estonia, Tallinn, Estonia.
OECD, 2017. Public Procurement for innovation: Good practices and strategies. Paris.
Rainville, A., 2017. Stimulating a More Circular Economy through Public Procurement: Roles and Dynamics of Intermediation. Working Paper. DOI: 10.13140/RG. 2.2. 19675.77608.
Rigby, J., 2013. Review of pre-commercial procurement approaches and effects on innovation. Compend. Evid. Eff. Innov. Policy Interv. Manch. Inst. Innov. Res.
Selviaridis, K., 2016. Public procurement and innovation: a review of evidence on the alignment between policy and practice. Presented at the International Purchasing & Supply Education & Research Association (IPSERA).
Uyarra, E., Edler, J., Garcia-Estevez, J., Georghiou, L., Yeow, J., 2014. Barriers to innovation through public procurement: A supplier perspective. Technovation 34, 631–645.
Uyarra, E., Edler, J., Gee, S., Georghiou, L., Yeow, J., 2013. UK public procurement of innovation: the UK case. Public Procure. Innov. Policy Int. Perspect. Lond. Springer-Verl. 233–258.
Yeow, J., Rigby, J., Li, Y., 2017. The Effect of a Government Target for the Procurement of Innovation: The Case of the UK's Small Business Research Initiative, in: Global Public Procurement Theories and Practices. Springer, pp. 113–135.