

RISKS MANAGEMENT IN PUBLIC PROCUREMENT FOR INNOVATION: THE CASE OF NORDIC-BALTIC SEA CITIES

Tarmo Kalvet and Veiko Lember

Tarmo Kalvet, Ph.D., is a Senior Research Fellow in the field of technology governance at the Department of Public Administration, Tallinn University of Technology, Estonia. For many years, he was the founding head of the Innovation Policy Research Programme at Praxis Centre for Policy Studies, Estonia's leading policy think tank, as well as one of its board members. His recent research interests are innovation policy (especially in small states) and public procurement for innovation.

Veiko Lember, Ph.D., is a Research Fellow, Department of Public Administration, Tallinn University of Technology, Estonia. His main research interest is public-private partnerships with a particular emphasis on contracting-out public services and public procurement for innovation.

Correspondence: Tarmo Kalvet, Department of Public Administration, Tallinn University of Technology, Akadeemia tee 3, Tallinn 12618, Estonia. E-mail: tarmo.kalvet@ttu.ee.

Abstract

State support to innovation in enterprises has a long-standing history. One of the specific support measures is public procurement for innovation, which has only recently re-emerged in academic discussion as well as in the European policy discourse. While the spillovers from this kind of innovation policy measure may be substantial, the complex processes of supporting innovation via public procurement involves high risks. We take an exploratory approach in determining the state of practice regarding risk management in public procurement for innovation on the local level. Five case studies, which were selected as representative cases of the Nordic-Baltic Sea region in Europe, were analysed. We found that the cities were for the most part actively engaged in risk identification; the risks are being met mainly with mixed solutions in contracting strategies rather than comprehensive risk-management tools.

1. INTRODUCTION

State support to innovation – to “the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations (Organisation for Economic Co-operation and Development & Eurostat, 2005, p. 46; see also Schumpeter, 1934, p. 66) in enterprises – has a long-standing history (see, e.g., Reinert, 2007). One of the specific support measures is public procurement for innovation, sometimes referred to as “public technology procurement” (Edquist et al., 2000) or “innovation oriented procurement” (Rothwell, 1984), defined in the current article as that which occurs when a public agency acts to purchase, or place an order for, a product – service, good or system – that does not yet exist, but which could probably be developed within a reasonable period of time, based on additional or new innovative work by the organisation(s) undertaking to produce, supply and sell the product being purchased (see Edquist & Hommen, 2000, p. 5).

The United States, along with Japan, China and other Asian countries, has been using public procurement for promoting innovation since the 19th century (European Commission Working Group [hereafter ECWG], 2006; Ruttan, 2006). The Internet, GPS technology, the semi-conductor industry and passenger jets are perhaps the most prominent examples that resulted from government innovation-oriented procurement (Cabral et al., 2006; Ruttan, 2006). The potentially more important role of public procurement for innovation within the innovation policy mix has recently re-emerged in academic discussion (e.g. Edquist & Hommen, 1999; Edquist et al., 2000; Cabral et al., 2006; Edler & Georghiou, 2007; Rolfstam, 2009; Uyarra & Flanagan, 2010) as well as in the policy discourse (e.g. Kok et al., 2004; Currie, 2005; Edler et al., 2005; Aho et al, 2006; European Commission Expert Group [hereafter ECEG], 2005; ECWG, 2006; Nyiri et al., 2007; ECEG 2010).

We have provided a detailed research framework for including innovation policy in public procurement at urban level in Lember et al. (2011) and use it as a general framework also for the current study. In short, as innovation in the private sector is increasingly seen as an engine of economic development and competitiveness, it is suggested that public procurement should be employed to support this process (see also Rothwell, 1984; Geroski, 1990; Edler & Georghiou, 2007). While being an important tool to solve existing as well as emerging social challenges, public procurement can be used to affect the technology life cycle, promote clusters and innovation systems. Public procurement for innovation can create demand for new products or technologies, enhance providers’ innovativeness, create

and protect infant industry, and thus increase diversification of economic activities and average wages. As urban competitiveness can be viewed as a function of diverse economic activities, higher average wages, increasing returns, positive externalities and a high degree of cooperation, it can be expected that public procurement for innovation can positively affect these elements. However, unlike in regular procurement, where governments place orders for ready-made or “off-the-shelf” products, procurement for innovation involves procuring products that might need additional R&D work and thereby carry additional risks to all stakeholders.

In the current article we have based ourselves on ECEG (2010) who define risk as the measureable uncertainty (likelihood) for something to happen that decreases the utility of the outcome of an activity or reduces the achievement of certain goals (of an organisation, a project etc.). Accordingly, risk management in the public sector entails “having in place a corporate and systematic process for evaluating and addressing the impact of risks in a cost effective way and having staff with the appropriate skills to identify and assess the potential for risks to arise” (National Audit Office, 2000, p. 2). The usual risk-management tools in procurement like screening for abnormally low offers, screening suppliers through insurance schemes and different scoring rules (e.g. closest to the arithmetic average of all submitted offers) may outplay the most innovative offers (Cabral et al., 2006). Sound public procurement of innovation should therefore involve some kind of risk management, although it may not necessarily mean that a formal risk management structure is set up (Chapman & Ward, 2004).

There exists evidence that cities are becoming more involved every day in procuring innovative solutions in order to solve existing as well as emerging social challenges (e.g. Pohl & Sandberg, 2005; Edler et al., 2005; Binks, 2006) and increasing their competitiveness (Lember et al., 2011), but what is lacking are theoretical approaches and empirical evidence of how the risks are addressed and managed on the local level. The current study was undertaken to fill in the gaps by analyzing the risk-management aspects of public procurement for innovation. Therefore, we take an exploratory approach in determining the state of practice regarding risk management in public procurement for innovation on the local level. In order to fulfill the research agenda, we analyze five case studies, which were selected as representative cases of the Nordic-Baltic Sea region in Europe.

The article is built up as follows: the second section of the article analyzes risks and risk management from a theoretical perspective and introduces the method for case studies. The third section describes and analyses five cases of public procurement for

innovation from a risk-management perspective. The paper ends with a concluding discussion, policy implications and research challenges.

1. METHODS

1.1. Risk and risk management

Risk results “from the direct and indirect adverse consequences of outcomes and events that were not accounted for or that were ill prepared for, and concerns their effects on individuals, firms or society at large. It can result from many reasons both internally induced and occurring externally with their effects felt internally” (Kogan & Tapiero, 2007, p. 378). Based on a review of academic literature and case studies carried out, ECEG (2010) has identified five major types of risks in the case of public procurement for innovation.

Technological risks are all those risks that lead to non-completion, under-performance or false performance of the procured service or product for reasons that lie in the technical operation. Technological risks could arise from suppliers not being able to find the solutions as promised, choosing the wrong or a suboptimal technology (it does not work as expected or is not fit for purpose, does not match standards, etc), choosing a technology prematurely, failing to acknowledge technological compatibilities or failing to develop the solution in-house or buy components and knowledge as claimed in the tender process.

Market risks refer to a situation where the private demand does not respond to the extent necessary or expected, public markets remain fragmented or there is a lack of companies delivering innovations. The reasons could lie in too radical requirements of the specifications, etc.

Organisational risks are all those risks for the procurement to fail or under-deliver for reasons situated within the organisation that procures. Indeed, there tend to be too many goals to follow in modern public procurement for the public administrators – cost savings, transparency, sectoral policies (e.g. environmental, energy, industrial etc.) – which often contradict each other (Cave & Frinking, 2007; Nyiri et al., 2007). This may lead to misallocation of resources, where agency goals conflict with wider policy goals. There is a dilemma between the micro cost effectiveness of a contract and the higher costs of R&D-based product/services in order to boost innovation (Cabral et al., 2006). The process itself – procurement for innovation – is a costly and time-consuming effort. Procurement for innovation demands strong coordination between stakeholders and constant evaluation and learning. But coordination and evaluation

always involves transaction costs, which have to be taken into account when implementing the process. Cave and Frinking (2007) have pointed to the fact that there exists the potential for expensive coordination failure. When the payoff is unclear, the innovative solution can be perceived as the more expensive solution (Brammer & Walker, 2007). Therefore, at the end of the day, under the current culture of public procurement, cost savings may still be perceived as the most important goal. Relatedly, societal risks are those related to a lack of acceptance and uptake by the users of the new or changed service delivered within society.

The financial risks in public procurement are mainly twofold, one related to the uncertainty in meeting target costs, the other to the ability to secure the funds needed in the first place.

Finally, turbulence risks are those that are mainly associated with large-scale projects. Risks emerge from a range of unforeseen events that lead various actors in the whole process to re-assess their priorities, to change their expectations, which may lead to further dysfunctional reactions by other actors in the process, and so forth. These risks may occur within organisations, but often are a result of the interplay of various actions and actors within the whole project.

Figure 1. Risk map in public procurement for innovation

Source type	Institutional/ societal	Financial	Market	Technological	Other	Source type
Stages in the Procurement cycle	Definition risk Failure to define needs & communicate to market	Financial planning risk Innovation far beyond initial budget	Supplier market risk Not enough capable bidders	Technical risk Solution not feasible or suboptimal	Turbulence risk Unforeseen events mainly associated with large scale-projects	Stages in the Innovation cycle
Planning and preparation	Legal/regulatory Changes in regulations, misalignment with & proc. objectives	Financial market risk Failure to secure funding	Supply chain risk Supplier taking hidden risks Supply chain deficient	Contract design/award/evaluation proc. not adequate for technology		R&D stage
Notification and pre-qualification	Adaptation risks Internal integration/external acceptance	Cost monitoring Poor cost controlling, and choice of payment modalities	Market spillover risk No spill over to private markets	Lack of complementarities with networks/standards		Adoption by public client
Tendering	Policy spill over No adoption/use by other services/policies		Market competition risk Dependency on few suppliers/ Distortion of competition	High cost of upgrade and maintenance		Diffusion in Public Realm
Evaluation			Technological Lock-in			Diffusion in Private Markets
Contract Award						Maintenance and updating
Contract Management					New cycle	
	Procurement Risks				Innovation Risks	

Source: ECEG, 2010, p. 39.

According to ECEG (2010), there are three major tasks for risk management: Firstly, to define and assess risks and rewards for all partners involved at the various stages of the procurement process, including the nature of risks, which may change during the various

procurement stages, the causes and source for risk, the likelihood of risks to occur, and the potential consequences of risk occurrence (additional costs, reduced rewards). Second, for each risk, to take action to avoid or reduce the likelihood of the risk to materialise and allocate responsibilities to take action to reduce the likelihood. Third, for each risk, to define actions to mitigate the potential consequences and allocate who bears the cost of mitigation and the reduced benefits (see also Ward & Chapman, 1991; Hood & Rothstein, 2000; Zhao & Duan, 2008).

Different specific risk-management methods exist to manage risks, including awareness measures, contract design, early supplier involvement, training schemes, etc. (ECEG, 2010). However, there is not much literature available on risk management on the local level. Nyiri et al. (2007) have stated, though, that lack of innovation orientation, budget and skills are considered to be the main barriers for local governments in implementing procurement for innovation. The shortage of proper know-how among procurement professionals about suitable procurement methods for fulfilling wider social goals seems to be a global phenomenon (see e.g. Brammer & Walker, 2007). Lack of awareness and readiness by public authorities to understand markets and technologies can be regarded as an additional barrier (Lember et al., 2011).

1.2 Method for case studies

In order to answer the research questions on risk management practices in procurement for innovation, the hypotheses were tested in the Nordic-Baltic Sea region, where a selection of cities was made. The region contains both highly developed cities (Helsinki) and emerging cities (Tallinn); it also contains relatively large cities (Stockholm) and clearly smaller cities (Tallinn). At the same time, all cities belong to a common European legal framework, which makes the comparison particularly interesting (although not all cities have implemented the new EU procurement guidelines).

Consisting of a thorough literature analysis and in-depth empirical data gathering, the study employed a three-step approach to gather the empirical data. First, a web-based questionnaire was delivered to the selected cities, which was designed to gain overall knowledge about procurement for innovation in the participating cities. An equally important goal was to find key cases and to find the people who were involved in those public procurement for innovation processes. The goal was to find two or three representative cases from each city. The contact persons from the partner cities were given a list of procurement- and innovation-related characteristics that the cases should match, and then the contact persons made the initial selection of possible cases, indicating the responsible persons

to be contacted. Due to the focus of the study – the implementation of a new or significantly improved technology –, not all cases were suitable for further analysis because the innovation aspect was missing, and regular procurement was carried out. As a second step, in-depth structured interviews were carried out with representatives of the cities, the provider organisations and field experts. The interviews were aimed at gaining specific information about procurement for innovation cases in the participating cities.¹ As a third step, a follow-up questionnaire was sent out to the representatives of the cities addressing specifically the risk-management issues, and additional interviews were carried out. Altogether, five cases were identified for the risk management study and 21 persons from three cities were interviewed. Empirical information was also derived from secondary sources like published and unpublished reports and documents. For addressing the issues related to risk management, we partly relied on the questionnaire and interview structure that was developed by ECEG (2010).

2. CASE STUDIES

Earlier research has shown that public procurement for innovation is not at the top of the agenda on the Nordic-Baltic Sea and is still rather modestly implemented by the cities in the region. When it comes to the strategic level of public procurement and innovation, only Helsinki and Stockholm have developed a policy strategy linking procurement and innovation in their region, but it is still far from using the tool to its fullest extent (Lember et al., 2011). Therefore, in order to find out what the current situation is in public procurement for innovation and related risk-management aspects, a representative case-study approach was applied. The next sections give an overview of the current situation on the risk-management aspects of public procurement for innovation; we start with the procurements for more radical innovations.

2.1 Ethanol-fuelled Pickup Trucks, Stockholm

Overview of the case

The current case refers to a recent phase of an ongoing procurement project of environmentally friendly cars started already in 1992 (see also Pohl & Sandberg, 2005; Birath, 2007). Environmental issues are considered an important concern in Stockholm, and the E85 ethanol-based Ford Focus is (largely due to previous public procurement projects) very popular in Sweden (9 out of 10 are fueled by E85 ethanol). There is also an infrastructure existing in the form of 1,000 filling stations. However, as there are no ethanol-based light-duty

vehicles available, while there is much company interest in such technology, the city of Stockholm organized cooperative procurement to show the existence of this market to the car producers. In a way, it is also an example of catalytic procurement, as buying those trucks for the city of Stockholm was a minor goal. The main goal was to create a market for such vehicles.

The request to express interest in using ethanol-fuelled pickup trucks, vans carrying 2-5 m³, and vans carrying 6-18 m³ was sent to 5,000 legal entities that had light-duty vehicles in use. 41 local governments/municipal companies/county councils and 186 privately owned companies (a total of 227 units) expressed interest in purchasing vans carrying 2-5 m³. The procurement process was initiated, and specifications were drafted in cooperation with the interested buyers. Stockholm Environment and Health Administration, City of Stockholm, strongly co-operated with the Procurement Bureau and also had an expert for technical evaluation.

Information regarding procurement was sent to all automobile manufacturers from the very beginning of the project. A separate letter to manufacturers was sent to their Swedish head offices in late 2005. Manufacturers were invited to a meeting after buyer interest had been determined and the specifications finalised.

As it was impossible for the City of Stockholm to independently carry out the procurement on behalf of so many other municipalities and companies, the Stockholm Environmental and Health Administration contacted Kommentus (currently SKL Kommentus AB), a company that arranges coordinated procurements in which municipalities, county councils, municipal companies and other local government agencies may participate.

Two tenders were received. One, for a 2-5 m³ van from Volkswagen, was accepted; the other, for a 6-18 m³ van and a 1-tonne flatbed/pickup from Ford, was rejected due to the unacceptably long delivery time. Delivery was not possible until 2010, so procurement for the larger vehicles was postponed. For the 2-5 m³ van, Volkswagen AG submitted a bid based on the Volkswagen Caddy. Volkswagen AG did not have any ethanol-based vehicles in production at that time. The accepted tender was for one of the three requested classes: a 2-5 m³ van. Volkswagen was awarded the general contract and will be supplying a VW Caddy 1.6 BioFlex for SEK 132,920 (excluding VAT) in early 2008.

According to the signed framework agreement, the entities are entitled to place orders for some 2,500 vans. Payment on delivery.

Risk-management aspects

For the City, there were no real risks associated, because it is not specified that buyers should really buy vans – there is just a reference that at least 2,000 customers are there. The only direct cost the city has had is associated with pooling the demand and carrying out the procurement process. Nevertheless, the city of Stockholm had to bear the risk that the attempt to create the market fails either because of technology failure and non-delivery or because of small interest of potential buyers. In order to cope with the potential risks, the city of Stockholm hired SKL Kommentus AB, which was made responsible for carrying out the procurement process, including technology specifications and making risk-scenarios. It was a performance-based consultancy contact, where the consultancy company was not guaranteed any income. The consultants were to be paid only a special fee consisting of a percentage of the purchase price for all vehicles sold during the contract. If no bids came in, there would be no vehicles and no money for the consultancy company. Similarly, if there was a delay and no car at all was actually delivered, there would be no money for the consultancy.

The representatives of the City claimed that this is a common practice in Sweden and did not consider this particular case to be different from “regular” public procurement procedures. To initiate the project a special, central governmental environmental investment fund was used. In this particular case, the initiators relied heavily on different technology standards in order to specify the expected results but at the same time to leave the providers with the opportunity to come up with novel solutions. As there was no direct contractual relationship between end-users and providers before delivery of the product, no insurance schemes could be used.

In sum, the risks were managed well by a thorough feasibility study, pooling of demand, etc. However, trust risk was not considered ex ante: if delivery fails, it influences the image of the city government.

2.2 Journey Planner for Public Transportation, Helsinki

Overview of the case

Journey Planner gives advice to a commuter on the best public transport connection door-to-door within the Helsinki Metropolitan Area. The fastest route can be found by entering the street addresses of the departure and arrival places into the Web browser. Besides timetables, commuters also have access to means of transportation, travel instructions and a route map to help follow the route. The service covers bus, tram, metro, commuter train and ferry routes. The search features of Journey Planner can be tailored, for example by giving one’s own walking speed or favorite means of transportation.

The Finnish version of Journey Planner also includes Helsinki City Transport's 'Own Departures' service, which offers on-demand online timetables regularly used by commuters. Own Departures timetables are available for bus and tram stops, commuter train and metro stations as well as for ferry harbors. Commuters can sign in to the service and edit their preferences both by browsers and mobile phones.

The procurement was initiated in 2000, after the first attempt had failed 4 years before. No similar product combined into one service was on the home or World market at that time. The specifications were based on the somewhat similar services from other countries, combining their best features. All bidders had a functional journey-planner software product available that needed considerable improvements to fit the client's needs.

The procurement was carried out by the Helsinki Metropolitan Area Council (YTV), and the service has been delivered by Diptec.com OY (currently part of Logica). The development of the product began in the start-up company, and Journey Planner was a critical project for success – a credible reference. The company has become a part of larger companies (sold 6 times), and now the new product line based on the original product has also been developed.

A three-stage competition was organized. Altogether 10 bids were initially received, 6 were selected for the first qualification, and then 3 were chosen for demonstration implementation. The unique aspect in this particular procurement process for innovation is that 3 bidders were asked to realize the demonstration service using the real data before the final selection. The price of the product was EUR 160,000.

The main criterion for selection was to fulfill the functional requirements. Functional requirements included maintenance, data structure etc. Five main groups of criteria were elaborated: user and usability, output of the plans, managing and configuration (regarding maintenance), actual trip-planning and algorithm (quality of results so to say), ability to configure the trip-planning, update process for the data (the company had to update the database of the service continuously).

The duration of the procurement process was ten months. It started in August 2000 and was finalized in April 2001. The original contract was for 5 years. The Metropolitan Council has extended the service with a new negotiated contract.

The service has become extremely popular: the average number of daily visits to Journey Planner is 90,000; on the busiest days, there are 100,000 visits (2008). Calculations of time savings accrued through more effective itineraries and personal trip-planning as well

as growth in the use of public transportation have shown benefits worth 5 mln EUR in 2002 (Laine et al., 2003). The system has been used in Finland for several other transport systems like national journey planner, Tampere, Oulu, etc. The product has been sold to several cities in the U.S. and other players around the world.

Risk-management aspects

When starting with the project, the city of Helsinki defined four important risks to be addressed during the procurement process. These were potential procurement cost overrun, raised costs for system maintenance, non-delivery and technology failure. The risk management tools applied involved simultaneous (pre-selection) testing of three prototypes with real data; promoting competition by translating the tender documents and searching pro-actively for possible contacts and making the calculations for future maintenance and running costs part of the tender evaluation. This particular case can be regarded as involving medium-level risks for the public sector as the city of Helsinki was involved in the development of the pre-commercial product. By taking the responsibility for financing field-testing of the three final prototypes, the city took off some risks which are usually left with providers and addressed through financial penalties in purchase contracts.

Also, one of the risks was the possible lack of public acceptance if the service were to include personal travel data tied to a concrete person; however, the system was introduced as an anonymous service, so this problem was avoided.

The procurement case was clearly seen as different compared to “regular” public procurement by the officials. This was not only because complex multi-sourcing (having several suppliers active in parallel) and multi-stage sourcing (having two or more qualification rounds) tendering procedures were used, but mainly because prototype testing was employed. As admitted by the representative of the city of Helsinki, the procurement case was unique because ‘multi-stage selection and pre-selection test implementation, especially by several suppliers, were used for the first time and have rarely been used since’.

There were no technology standards used which would help mitigate the problems stemming from detailed technology specifications. According to the officials, they searched for standards, but found none that were applicable. At the same time, the city of Helsinki tried to diminish the perceived risks by introducing insurance schemes. The companies competing for the contract had to pass the company viability qualification by means of financial documents, they had to

offer financial guarantees for the delivery and warranty period. Further the source code for the technology was held in escrow in case of failure to fulfill contractual obligations.

Although Metropolitan Area Council as a single authority carried the risks, the services of one consulting company were used during the entire process (from the market study to the acceptance of the service). The company was also responsible for drafting the technical specifications.

In sum, risk-management tools applied included a thorough feasibility study, promoting competition, field-testing of the three final prototypes, detailed calculations on future maintenance and running costs, and linking payments to performance quality, and the case is a good example of proper risk management and successful procurement of innovation.

2.3 The Environmental City District Hammarby Sjöstad, Stockholm

Overview of the case

The Environmental City District Hammarby Sjöstad was initiated by the city of Stockholm in 1998. The objective was to rebuild an old industrial area in the city using a unique method for integrated and sustainable planning of infrastructure as well as for the implementation of innovative technology for energy, water, and waste management. As of 2009, more than 30 catalytic public procurements for innovation have been carried out, involving both incremental and radical innovations.

The plan included building 15,000 apartments and 10,000 offices, the initial completion date of the project is 2012. The budget for the national government subsidy program in Stockholm (Stockholm local investment program, LIP, managed by the City of Stockholm): 634 mln SEK; 60 mln SEK for public procurement for innovation.

Similar projects had been undertaken before. In Sweden, during annual exhibitions for building companies, city exhibition areas have been similarly rebuilt. A couple of years before this case, the city of Stockholm included environmental goals in rebuilding a small district. However, the Hammarby Sjöstad case was the biggest and most diversified building programme (buildings, infrastructure and technical support) ever in Sweden, both in scale and in ambition – a holistic ideology.

One example of the procurement for innovation is the procurement for a technology for individual metering. It was aimed at developing a new technology for cost allocation of energy and water

consumption in family houses. The idea was to create a system monitoring the energy consumed, enabling the distribution of the costs for each apartment respectively. The project was carried out in 1999-2000, a time when this type of technology was missing on the Swedish market. There were 10 different housing companies in the buyers group. Using external experts, the group determined the technical requirements. The company selected as the technology provider installed meters in 500 apartments. IPR was left to the supplier. However, the firms creating the product were unable to enlarge the market and, thus, did not get enough orders from other parts of the country or the world.

Another example, co-operative procurement, is the following: procurement for energy-efficient windows. The requirements demanded that these windows had to have a better efficiency value or be improved windows, e.g. weight or aesthetics. Offers came from three to four window-producing companies. These kinds of windows were already produced in Sweden but at 30-40% over the desired price. The buyers group included all the big construction and housing companies in Hammarby Sjöstad, so a rather substantial production volume was created. The group got the new windows at the same price as conventional ones, resulting in a substantial price reduction. There were no technical improvements, but improvements in production (more efficient, rational) took place (process innovation).

Hammarby Sjöstad is visited by more than 10,000 decision-makers and specialists in the field every year, making it one of Stockholm's most important destinations. It has become one of the world's highest profile examples of sustainable city development, mentioned in specialist publications worldwide. It is the Winner of the World Clean Energy Award in the Construction Category, 2007. Regarding procurement success, results are mixed: some of the most innovative procurements (fuel cells, common internet) failed; some procurements (e.g. individual metering) were only partly successful; technology procurements with incremental improvements (e.g. energy-efficient windows) were most successful, leading to market increase and lower environmental impact, both locally and nationally.

Risk-management aspects

As the project was launched to upgrade the technology used in the buildings, the main risks identified by the city were the ones associated with technology failure and non-delivery as well as the risk of disinterested stakeholders. Depending on the particular procurement, non-delivery and technology failure had different emphases. Sometimes the failure resulted from stringent requirements (e.g. a very high risk in the procurement of fuel cells

that ended, indeed, with the delivery of a non-functional product). In some cases, sub-optimal technologies were chosen (e.g. construction of a local area network with some specific services was procured, but the Internet and services already available turned out to be superior). Disinterested providers were not considered as a risk *ex ante*. However, there were cases when there were no bids. For example, although a more environmentally friendly asphalt and asphalt-laying process were looked for (product and process innovation), there were no offers from the companies. One-half year later, the existence of an asphalt cartel was revealed in Sweden.

Considerable institutional risks were revealed. Firstly, lack of integration: The procurement of technologically innovative products was not integrated with the overall planning process, making implementation of some of the solutions difficult or in some cases impossible (e.g. solar panels). Also, legislative risk: The Act on Public Procurement did not make things easier; rather, the opposite was the case – particularly for cooperative procurement. As the law was not very clear on this issue, a discussion ensued regarding whether or not this kind of cooperation was acceptable. Although not clear at the start of the project, one positive side of the act has become the ability to include environmental impact as a selection criterion. Through the project legislation, interpretation regarding regulating the field became clearer. In addition, strong political backing was helpful in handling all uncertainties and question marks. Political risks were not considered very much, although for such a wide-scale and long-run project, political changes can take place, and this risk materialised with the current project. During the initiation of the project, the Social Democrats were in power and supported the project, guaranteeing funding. During the implementation of the project, the right-wing party came to power in the city of Stockholm, and there were some discussions about cancelling the project.

Several solutions were used by the city to address the risks. Feasibility studies were out – due to the unique nature of the project, the procurement was different from every-day procurement practices. Compared to “regular” procurement, an emphasis was put on a thorough study of the market and technology prerequisites. Various technology standards were used where applicable. An extensive mix of different public procurement procedures was used (from extended negotiation procedures with successive stages of discussion and multiple feedback loops to multi-sourcing tendering (having several suppliers active simultaneously)). In many cases, market dialogue to select the most suitable technology and procurement process was used. A special public investment fund was used for covering 100% of the public procurement for innovation costs. On several occasions, prototype testing was used before making the final purchase.

Consultants were hired who were responsible for risk analyses (risk scenarios) and technology specifications. Some procurements required interdisciplinary teams. The complex projects were divided into separate components, which enabled the buyers to diminish the risks. In many cases, the procurement of radically new and risky technologies was avoided to lessen risks related to non-delivery and technology failure.

In sum, the risk management has included explicit ex-ante risk management regarding many operational risks (mostly technology failure and non-delivery) but also institutional and market risks. Spreading risk to include most of the relevant parties was the main management principle. Methods applied included feasibility studies, use of technology standards, mix of different public procurement procedures (from extended negotiation procedures with successive stages of discussion and multiple feedback loops to multi-source tendering that had several suppliers active simultaneously), prototype testing, hiring of consultants and division of complex procurements into separate components.

2.4 Mobile ticketing for public transport, Helsinki

Overview of the case

The mobile ticketing service works on all mobile phones that can send and receive SMS (Short Message Service). All major mobile network operators in Finland have provided access for the SMS ticket service. The service uses standard SMS text messages and a unique validation method to provide mobile tickets. The ticket arrives in real-time showing the validity time and area, identification number and consigner number. The price of the ticket is charged automatically to the customer's phone bill.

The service was procured by HKL Enterprise, a unit of Helsinki City Transport, and the technology was developed by Plusdial Ltd in cooperation with Add2Phone Ltd. A joint development project was started in 2001, and the first mobile tickets were sold and tested in Helsinki City Transport's trams, metros and ferries on the International Car Free Day in August 2001. This was the first mobile ticketing service for transportation in the world accessible to the wide public. The actual mobile ticketing pilot started in trams and metros in 2002. The production contract was signed with Plusdial Ltd and Helsinki City Transport in 2003.

Currently, mobile ticket sales can be considered to be isolated given that for the time being, the service is only available inside the Helsinki city area, but in tram traffic, the share of mobile tickets exceeds 55 percent of all single tickets sold (2006). By October 2006,

already 9 million mobile tickets had been delivered to passengers' mobile phones in Helsinki City Transport's vehicles. The sales still show a steady annual growth, and passengers have frequently expressed the wish for the service to be expanded into the wider Helsinki Metropolitan area.

The company Plusdial Ltd has already introduced its mobile ticketing service to Germany, Italy, Great Britain and Sweden. The mobile ticketing service has also raised much international interest, and similar services by other companies are widely applied in several countries not only for transportation but also for other mCommerce (mobile commerce) purposes.

Risk-management aspects

The main risks of this particular procurement case as identified by the city were technology failure and non-delivery of the product. The main risk management tools applied by the city included detailed specification of technology requirements and strict financial sanctions introduced in the contract. The tender process was perceived as different from regular procurements as extended negotiation procedures were used with successive stages of discussion and multiple feed-back loops. In this case, no insurance schemes were used; however, technology standards were consulted and performance agreements were introduced.

2.5 ID-ticket for the Public Transportation System, Tallinn

Overview of the case

The ID-ticket is an electronic ticket in the public transport system (bus-tram-trolley), which is sold to the user via the electronic payment collection system and which the user proves with his or her personal identification document (national ID-card). Thus, it will be sufficient to carry one's ID-card along when using public transportation that needs to be presented to the controller, who has a special machine for controlling the validity. ID-tickets can be purchased via the Internet bank, a mobile phone or from sales points.

Estonia started issuing national ID-cards in January 2002. Without the existence of this infrastructure, several innovative public services in Estonia (for example, e-voting²) would not be possible. In addition to being a physical identification document, the card has advanced electronic functions facilitating secure authentication and a legally binding digital signature for public and private online services. An electronic processor chip (a "smart card reader" is needed for operation) contains a personal data file as well as a certificate for authentication. Certification Center Ltd is the key organization,

which was established as a 100% privately owned company in 2001, and as of 2007 is the only certification authority, providing certificates for authentication and digital signing of Estonian ID-cards.

Since September 2002, the Tallinn City Government has had a working group that included representatives from the Tallinn Transport Department as well as Registrikeskus (citizen registration center) and was looking for ways of how to increase the number of people officially registered as residents of Tallinn. Discounted public transport tickets were seen as one way. Also alternatives to the ID-card were considered (e.g. a separate magnetic card to be used only in Tallinn). The procurement process generated bids from six applicants; one was a joint tender AS Certification Center, AS EMT (mobile telephone operator) and AS Eesti Ühispank (bank), which was ultimately selected as the vendor. The service was introduced successfully in 2004.

There was no fixed price agreed upon. The price was to be formed on the turnover of tickets sold: 4.49% of returns to the benefit of the procuring company. As a result, the company was interested in developing the application to work as efficiently as possible.³ The ID-ticket was not planned to replace the old channels of distribution, but to create additional ones. Also, it has turned out to be a very efficient service, especially from the standpoint of controlling the usage of tickets: (1) the ticket is personalized, so it is not possible to “share tickets” or employ other methods of avoiding payment, as was the case with paper-based tickets; and (2) enforcement mechanisms to control the validity of tickets in public transport is streamlined. The ID-ticket was one of the services that generated interest towards obtaining a national ID-card. Today, a similar service has also been launched in Tartu, Estonia. The intellectual property remained with the Certification Center.

Risk-management aspects

Initially the financial risks in terms of R&D and production costs were left entirely with the provider. However, by guaranteeing the minimum level of returns per year for the provider, the city took some of the financial risks in terms of future returns off the provider. The technological risk was considered small by the representatives of the city, as the technologies developed relied on already existing and functioning electronic ID-card-based infrastructure. The provider had already run field-tests of the prototype, which meant that they already had a working reference for the city. Therefore, the main concern was whether the provider would succeed in integrating the existing prototype in the local context (technology failure) and how the new

service would be welcomed by the users (societal risk). The city organized this tender as any other procurement process, and no specific measurements were undertaken to address the risks via a tendering process. The tender documents did not refer directly to any specific technology standards, but as the whole system was to be based on electronic ID-card infrastructure, it can be said that existing standards were referred to indirectly. The city also demanded the providers to submit financial guarantees against non-delivery. However, there were no specified performance guarantees. This was dealt with in the form of the contract. The contract as written had little upfront investment by the city with the promise of participation in the profits of the project after implementation. Though not strictly speaking a performance-based contract, it certainly contained elements of this technique.

3. Discussion

Table 1 in the annex summarizes the results of the case studies. Based on these results, we can make the following observations.

First, cities can successfully implement the procurement-for-innovation instrument, and risk management is an important aspect to succeed in this kind of procurement. It seems that the cities were for the most part actively engaged in risk management. Though one can argue whether some had thought about longer-term risks in the form of technology decay and maintenance of technological innovations, it is evident that the cities were prepared to meet the challenges involved in more complex procurements.

Second, cities had identified significant risks for most of the projects examined. Technological risks were seen more often as project risks than other risks, incl. financial risks. With regard to technological innovation, indeed, cost may be less of a concern. Another explanation is that these projects were regarded as so important to the effective delivery of government services that cities were willing to bear some cost risk but less technological risk. To manage technological risks, early stage intelligence gathering was carried out; also, a considerable share of risks was shifted to the suppliers. Also, involvement of all possible stakeholders already in early phases of the procurement turned out as a fruitful measure to manage market risks as well. Studies also emphasize prototype testing that should become an important part of public procurement for innovation (ECWG, 2006, p. 92). There are already signs of cities using this tool to overcome technology and non-delivery failure. The city of Helsinki employed simultaneous prototype testing using real data before making the final purchasing decision on a web-based journey planner.

One of the major means to manage technological risk is contract design, since different contractual modes offer different incentives for the contractor to deliver quality and not to run excessive costs. The approach of cities to contracting in this area is seen as significantly different from other types of contracting. Again, cities seem to understand the fundamentally different nature of this type of contracting and apply different rules and procedures. With regard to the types of contract mechanisms for risk management, performance contracts seem to be used in about the same number of instances as insurance/bonding. There were some very unique solutions in this area, such as Helsinki's escrowing of the source code and Tallinn's contract structure with small upfront payments and profit participation.

It seems that at least in our studied cities, the challenge of this sort of innovation contracting is being met with new solutions in contracting (or implicit) strategies and not with comprehensive risk-management strategies explicitly aiming at reducing technology or innovation-related risks for providers. We think this is the case because as of today, local authorities do not act like risk-taking sides as expected in theory when promoting innovation through public procurement. Except Stockholm, the studied cities do not have the policy to influence economic growth through public procurement – the cities are not ready to take further steps reducing the risks of providers associating with investments for R&D, production or field-testing. As the cities do not engage with high risks procurement, it is therefore too early to say whether the employed new contracting strategies are sufficient for meeting the risks emerging from public procurement for innovation.

It follows from the case studies that in spite of some negative experiences in the past, the cities were applying public procurements for innovation, and more emphasis was placed on explicit risk management. For instance Stockholm's alternative-fueled cars procurement and Tallinn's electronic ID-based ticket system did not actually produce the expected results after the first attempts, but the gained experience was turned into successful results in later attempts. An outstanding exception includes the City of Helsinki – in the journey-planner procurement case, the city reduced some of the financial risks of the bidders by awarding the three finalists monetary prizes. It is interesting to point out here that the City of Helsinki used the prototype testing because the previous attempts to buy this technology had failed. As the representative of the city of Helsinki admitted 'The previous negative experience was the one which pursued the need to carry through firstly a market study and then in the final stage an implementation of demo versions.' Still, as said by the representatives of the City of Helsinki, and as came out from the

other cases, the cities rarely use public procurement of pre-commercial solutions, which includes higher risks for public procurers, but would be more rewarding in terms of innovation impact.

It is still too early to say whether all the risks as described in the second part of the paper have been overcome or not. It can be argued that in the short run, all the cases have proven to be successful in terms of innovation generation and have brought along many positive spillovers (see also Lember et al., 2011). But, as all the cases are rather recent ones, the long-term innovation impact in terms of adaptation and diffusion is still somewhat unclear. This, in turn, demonstrates the significance of the political risks involved with public procurement for innovation. It may not be politically rewarding to launch a (technologically) risky project, whose benefits are not immediately clear (Stiglitz and Wallsten, 1999). The presence of the political risk may explain why the Nordic Baltic Sea cities only seldom engage in public procurement supporting innovation. In general, there is a lack of awareness among city officials about the connection between procurement and innovation (see Lember et al., 2011 for further discussion on this issue), including risk management. In several cases, the capacities of the cities to administer such complex procurements were limited, and neither did they have explicit risk management strategies to tackle the innovation-related issues. Thus, the use of external consultants was applied in several cases and proved highly reasonable.

Still, the empirical evidence points to the fact that the cities are capable of identifying and managing process risks when procuring innovative solutions. It can be seen from the cases that in order to successfully implement public procurement for innovation, the public sector has to be able to deal with all possible process risks. This is illustrated by identification and management of:

- technology risks (e.g. prototype testing in the case of Helsinki's journey planner);
- market risks (e.g. demand aggregation in the case of Stockholm's ethanol-fuelled lorries);
- financial risks (e.g. securing funds with the help of national grants in the case of Stockholm's environmental city district regeneration or using profit-sharing schemes in the case of Tallinn's ID-tickets);
- organizational risks (e.g. employing consultants in various cases);
- societal risks (e.g. pooling of potential users in the case of Stockholm's ethanol-fuelled lorries);

- turbulence risks (e.g. making risk-scenarios and spreading risks among stakeholders in the Stockholm cases).

The case-studies exposed a variety of possible solutions that cities have in hand when looking for practical solutions in public procurement for innovation risk-management. These solutions can be well exploited also by other cities, however, it should be beared in mind that all the cases reviewed represent more or less success-stories, which means that there will be more information needed on the factors critical for failures.

4. CONCLUSION

Public procurement for innovation is potentially a powerful innovation policy tools that can contribute to urban, regional and national competitiveness and economic development. It is also a policy tool that the scientific communities as well as many governments are currently rediscovering. Compared to traditional public procurement of ready-made goods and services, public procurement of innovative products entails more risks, which need to be identified and managed. So far, little is known whether and how cities – economic players with growing importance – address the question of risks in public procurement for innovation.

The current study, focusing on the region of Nordic-Baltic Sea, revealed that in general the cities are capable of procuring innovative products and that the cities were for the most part actively engaged in risk management. The study demonstrated that the public sector needs to be able to deal with different kinds of process risks (from technology to turbulence risks). At the same time, as the cities still seldom engage in high-risk procurement of radical innovation, there are no signs of addressing these risks via comprehensive risk-management strategies explicitly aiming at reducing technology or innovation-related risks for providers. Instead, we could notice that more implicit strategies were used in terms of new approaches in contracting strategies. However, if the cities aimed at fully exploiting the potential of public procurement for innovation – meaning that they engaged in high-risk projects and socialize greater share of technology and innovation-related risks – the use of more comprehensive risk-management tools would become unavoidable.

We think further studies are needed in documenting how the public sector meets the risks when using public procurement for promoting innovation. Also, further research is needed for building coherent theoretical models addressing this issue.

5. ACKNOWLEDGEMENTS

Information on the case studies was gathered when the authors worked on the research report on public procurement for innovation in Baltic Metropolises for BaltMet Inno; we are grateful to all interviewees and Kenneth Kriz for his contribution to an earlier version of this article. The usual disclaimer applies.

Involvement in the work of the European Commission Expert Group on Risk Management in Public Technology Procurement greatly enhanced our understanding of risk management and enabled us to work further on the case studies.

Research for this study was partially supported by the Estonian Science Foundation (grants ETF8423, ETF7441 and ETF8418).

ANNEX

Table 1. Risk management in Nordic-Baltic Sea cities

	Stockholm	Helsinki	Stockholm	Helsinki	Tallinn
Procured innovative solution	Ethanol-fuelled lorries	Journey planner	The Environmental City District Hammarby Sjöstad	Mobile ticketing for public transport	Electronic ID-tickets for public transportation
Goal of the procurement	Market creation (for cleaner environment)	New service (more efficient and effective public transport)	Development of an environmentally friendly city district (integrated and sustainable planning of infrastructure as well as for the implementation of innovative technology for energy, water and waste	Service innovation (easier and more comfortable access to the service resulting in an increased usage of public transport rather than individual	Service innovation (to simplify collection of payments, attract people to register as local residents)

			management)	cars)	
Nature of innovation (in terms of local market)	Radical	Radical	Mixed	Radical	Adaptive
Level of risk for procurer	Low	Medium	Low/medium	Low	Low
Risks identified by cities	Market failure; non-delivery; technology failure	Procurement costs overrun; raised costs of system maintenance, non-delivery; technology failure	Technology failure; good will of stakeholders	Non-delivery; technology failure	Non-delivery; technology failure; non-adoption by users; unknown running costs
Risk management tools applied by the cities	Performance contract with consultants; special public funds used for procurement preparations; risk-scenarios	Simultaneous (pre-selection) testing of three prototypes with real data; promoting competition (translated documents, pre-active contacts); projected maintenance and running costs included in tender	Special public investment funds used for covering 30% product costs; prototype testing; consultants responsible for risk-analyses (risk-scenarios) and technological specifications;	Detailed specifications; financial sanctions in contract	Financial sanctions; performance payments combined with guaranteed minimum payments for the provider; R&D and maintenance costs carried by the provider

		evaluation; multi-sourcing and multi-stage sourcing	division of a complex project into separate components		
Deviation from regular tendering procedures	No	Yes – as prototype testing was included	Yes – extensive use of mix of procedures (extended negotiation procedures with successive stages of discussion and multiple feed-back loops; multi-sourcing (having several suppliers active in parallel). Through study of market and technology prerequisites	Yes – extended negotiation procedures with successive stages of discussion and multiple feed-back loops	No
Technology standards referred to	Yes	No (although looked for)	Yes (when possible)	No	Yes

Insurance schemes	No	Yes – company viability qualification by financial documents; financial guarantees for delivery and warranty period; source code held in escrow in case of failure to fulfill contractual obligations	No	No	Yes – financial guarantees for delivery period
Performance agreements	Yes (with consultants)	No	No	No	Yes
In-depth market study	Yes	Yes	Yes	Yes	No

NOTE

¹ For results on the first and second steps, see Lember et al. (2011), where also the question of innovation impact resulting from public procurement is analyzed.

² E-voting as remote Internet-based voting in nationwide elections – which involves technological, institutional (legal and political) and societal risks – demands complicated risk management and can, as such, be considered one of the most, if not the most, ambitious field of application of ICTs. For the argument that Estonia's e-voting success story lies in the country's explicit and effective risk management and in addressing all expected risks by enhancing the capacities of the procurer, carrying out in-depth risk analyses and endeavoring to generate trust through consistent dialogue and openness, see Kalvet (2009).

³ In the case of a turnover below EEK 53 mln (in sum 150 EEK mln for the whole period), the Tallinn City Government was obliged to compensate unrealized returns to some extent and based on the percentage agreed upon before. E.g. if returns had been 0, the Tallinn City Government would have been obliged to pay about EEK 7 mln in 3 years, which in turn was equal to 4.49% of planned returns.

REFERENCES

- Aho, E., Cornu, J., Georghiou, L. & Subira, A. (2006). *Creating an Innovative Europe: Report of the Independent Expert Group on R&D and Innovation Appointed Following the Hampton Court Summit and Chaired by Mr. Esko Aho*. Luxembourg: Office for Official Publications of the European Communities.
- Binks, J. (2006). *Using Public Procurement to Drive Skills and Innovation: A Report for the Department of Trade and Industry: Local Futures*. [On-line]. Available at www.berr.gov.uk/files/file28573.pdf. [Retrieved March 1, 2010].
- Birath, K. (2007). *Ethanol-powered Transport Vehicles: A National Procurement*. Stockholm: Miljöbilar Stockholm.
- Brammer, S. & Walker, H. (2007). Sustainable Procurement Practice in the Public Sector: An International Comparative Study. *University of Bath School of Management. Working Paper Series* 2007.16. [On-line]. Available at www.bath.ac.uk/management/research/papers.htm. [Retrieved March 1, 2010].
- Cabral, L., Cozzi, G., Denicoló, V., Spagnolo, G. & Zanza, M. (2006). "Procuring Innovations." In N. Dimitri, G. Piga & G. Spagnolo (Eds). *Handbook of Procurement* (pp. 483-528). Cambridge: Cambridge University Press.
- Cave, J. & Frinking, E. (2007). *Public Procurement for R&D*. [On-line]. Available at www2.warwick.ac.uk/fac/soc/economics/staff/faculty/cave/publications/pp_for_rd.pdf. [Retrieved March 1, 2010].
- Chapman, C. & Ward, S. (2004). "Why Risk Efficiency Is a Key Aspect of Best Practice Projects." *International Journal of Project Management*, 22: 619-632.
- Currie, I. (2005). *Using Canadian Government Procurement to Improve Technology Diffusion, Adoption and Adaptation: Maximising Benefits and Managing Risks*. A Discussion Paper prepared for the Prime Minister's Advisory Council on Science and Technology (PMACST).
- Edler, J. & Georghiou, L. (2007). "Public Procurement and Innovation: Resurrecting the Demand Side." *Research Policy*, 36: 949-963.
- Edler, J., Rufland, S., Hafner, S., Rigby, J., Georghiou, G., Hommen, L., Rolfstam, M., Edquist, C., Tsipouri, L. & Papadakou, M. (2005). *Innovation and Public Procurement: Review of Issues*

- at Stake. Study for the European Commission (ENTR/03/24).*
Fraunhofer: Fraunhofer Institute Systems and Innovation Research.
- Edquist, C. & Hommen, L. (1999). "Systems of Innovation: Theory and Policy for the Demand Side." *Technology in Society*, 21: 63-79.
- Edquist, C. & Hommen, L. (2000). "Public Technology Procurement and Innovation Theory." In C. Edquist, L. Hommen & L. Tsipouri (Eds.) *Public Technology Procurement and Innovation*, (pp. 5-70). Norwell: Kluwer Academic.
- Edquist, C., Hommen, L. & Tsipouri, L. (2000). *Public Technology Procurement and Innovation*. Norwell: Kluwer Academic.
- European Commission Expert Group. (2005). *Public Procurement for Research and Innovation: Developing Procurement Practices Favourable to R&D and Innovation*. [On-line]. Available at ec.europa.eu/invest-in-research/pdf/download_en/edited_report_18112005_on_public_procurement_for_research_and_innovation.pdf. [Retrieved March 22, 2010].
- European Commission Expert Group on Risk Management in Public Technology Procurement (L. Tsipouri, J. Edler, E. Uyarra, H. Bodewes, M. Rolfstam, J. Sylvest, T. Kalvet, S.-E. Hargeskog, D. Waterman, D. Banciu, I. Vass, S. Creese, P. Thevissen) (2010). *Risk Management in the Procurement of Innovation. Concepts and Empirical Evidence in the European Union*. Luxembourg: European Commission, Directorate-General for Research. [On-line]. Available at ec.europa.eu/invest-in-research/pdf/download_en/risk_management.pdf. [Retrieved March 22, 2010].
- European Commission Working Group. (2006). *Pre-Commercial Procurement of Innovation: A Missing Link in the European Innovation Cycle*. Working Group Report [On-line]. Available at ec.europa.eu/information_society/research/key_docs/documents/procurement.pdf. [Retrieved March 22, 2010].
- Geroski, P. A. (1990). "Procurement Policy as a Tool of Industrial Policy." *International Review of Applied Economics*, 4 (2): 182-198.
- Hood, C. & Rothstein, H. (2000). *Business Risk Management in Government: Pitfalls and Possibilities*. [On-line]. Available at www.lse.ac.uk/collections/CARR/pdf/BusinessRiskManagementInGovt.pdf. [Retrieved March 22, 2010].

- Kalvet, T. (2009). "Management of Technology: The Case of e-Voting in Estonia." In editors. *Proceedings of the International Conference on Computer Technology and Development (ICCTD 2009)* (pp. 512-515). IEEE: Computer Society Press.
- Kogan, K. & Tapiero, C. S. (2007). "Supply Chain Games: Operations Management and Risk Valuation." *International Series in Operations Research & Management Science*, 113.
- Kok, W. (chair). (2004). *Facing the Challenge. The Lisbon Strategy for Growth and Employment*. Report from a High Level Group. Luxembourg: Office for Official Publications of the European Communities.
- Laine, T., Pesonen, H., Moilanen, P. (2003). *Joukkoliikenteen internet-reittineuvontapalvelun vaikutusten ja kannattavuuden arviointi. [An assessment of the effects and cost-effectiveness of a public transport journey planner.] FITS Publications 22/2003*. Helsinki: Ministry of Transport and Communications.
- Lember, V., Kalvet, T. & Kattel, R. (2011). "Urban Competitiveness and Public Procurement for Innovation." *Urban Studies*, in press.
- National Audit Office. (2000). *Supporting Innovation: Managing Risk in Government Departments. Report by the Comptroller and Auditor General*. London: The Stationery Office.
- Nyiri, L., Osimo, D., Özcivelek, R., Centeno, C. & Cabrera, M. (2007). *Public Procurement for the Promotion of R&D and Innovation in ICT*. Institute for Prospective Technological Studies. Luxembourg: Office for Official Publications of the European Communities.
- Organisation for Economic Co-operation and Development (OECD) and Eurostat. (2005). *Guidelines for Collecting and Interpreting Innovation Data, Oslo Manual*. 3rd edition. Paris: OECD Publishing.
- Pohl, H., & Sandberg, T. (2005). *Clean Vehicle Procurement: A Rear View and Guideline. Trendsetter Report No 2005:24*. Stockholm: City of Stockholm Environment and Health Administration.
- Reinert, E. S. (2007). *How Rich Countries Got Rich and Why Poor Countries Stay Poor*. London: Constable & Robinson.
- Rolfstam, M. (2009). "Public Procurement as an Innovation Policy Tool: The Role of Institutions." *Science and Public Policy*, 36 (5): 349-360.

- Rothwell, R. (1984). "Creating a Regional Innovation-Oriented Infrastructure: The Role of Public Procurement." *Annals of Public & Cooperative Economics*, 55 (2): 159-172.
- Ruttan, V. W. (2006). *Is War Necessary for Economic Growth? Military Procurement and Technology Development*. New York: Oxford University Press.
- Schumpeter, J. A. (1934). *Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle*. Cambridge, MA: Harvard University Press.
- Stiglitz, J. E. & Wallsten, S. J. (1999). "Public-Private Technology Partnerships: Promises and Pitfalls." *American Behavioral Scientist*, 43 (1): 35-51.
- Uyarra, E. & Flanagan, K. (2009). "Understanding the Innovation Impacts of Public Procurement." *European Planning Studies*, 18 (1): 123-145.
- Ward, S. & Chapman, C. (1991). "Extending the Use of Risk Analysis in Project Management." *International Journal of Project Management*, 9 (2): 117-123.
- Zhao, Z.-Y. & Duan, L.-L. (2008). "An Integrated Risk Management Model for Construction Projects." *PICMET 2008 Proceedings, July 27-31, Cape Town, South Africa*.