DG Information Society and Media

Opportunities for Public Technology Procurement in the ICT-related sectors in Europe

Final Report

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RAMBØLL management

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Authors
Rambøll Management A/S
www.ramboll-management.com
Project manager: Janne Sylvest

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Directorate-General for Information Society and Media
Project officer: Oluf Nielsen, Unit F5

Preface

This is the final report of the study "Opportunities for Public Technology Procurement in the ICT-related sectors in Europe". The study was carried out by Ramboll Management for the European Commission, Directorate-General for Information Society and Media. The research for this study was carried out between May 2006 and September 2007.

The study has been supported and guided throughout by Commission staff from both the Directorate-General for Information Society and Media, and from several other Commission services, as well as external experts. Thanks are due to all. In particular, the study team would like to take this opportunity to thank the team of external reviewers, Professor Andrew Slade, Dr. Karl-Heinz Leitner, and Dr. Matthias Hinze, for constructive and enlightening advice, and Professors Charles Edquist and Leif Hommen of Lund University, who acted as sparring partners and sources of inspiration for the study team.

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List of abbreviations

FP7	Research Framework Programme 7
GPA	Government Procurement Agreement (WTO)
ICT	Information and Communication Technology
FDI	Foreign direct investment
IEA	International Energy Agency
IPR	Intellectual Property Rights
NSF	National Science Foundation (US)
PCP	Pre-Commercial Procurement
PFI	Private Finance Initiative
R&D	Research and Development
SBIR	Small Business Innovation Research
SBRI	Small Business Research Initiative
WTO	World Trade Organisation

Executive summary

Introduction

The study "Opportunities for Public Technology Procurement in the ICT-related sectors in Europe" was commissioned by the European Commission, DG Information Society and Media and carried out by Ramboll Management. The overall aim of the study is to explore, through the analysis of case studies, the hypothesis that technology procurement can be an effective but currently underutilised resource for driving technological innovation in Europe in the ICT domain.

The term "public technology procurement" can cover both procurements focusing on the early adoption and diffusion of new-on-the market technology (incremental innovation) as well as procurements focusing on the research and development of totally new technology (radical innovation).

The study investigates through case studies the way the stimulation of competition between suppliers as well as risk and/or benefit sharing between public and private partners are used as mechanisms to drive innovation in the ICT domain. The study has an ICT focus as well as a research policy focus, looking beyond public procurement as a tool for cost efficient government acquisitions, focusing on procurement as a driver for market development, including the considerations of users and first buyers.

Why public technology procurement?

First, there is a need for improved public services. The public sector in the EU, as elsewhere in the world, is faced with important societal challenges such as the ageing population, the fight against climate change etc. The quality and efficiency of public services could be significantly improved if public authorities would more rapidly adopt technological innovations available on the market[1]. However some of the improvements that are required in public services to address major strategic socio-economic challenges in a sustainable and affordable way are so technologically demanding that either no commercially stable solution exists yet on the market, or existing solutions exhibit shortcomings which require new R&D.

Secondly, there is a need to increase investment in R&D and innovation in Europe. Productivity growth continues to fall behind that of the USA, in particular because of a failure to capitalize fully on the application of ICT; R&D intensity in Europe has stagnated since the mid-nineties, being overtaken by Asian countries such as Japan, China and South Korea and remaining also at a lower level than in the US – with the major part of this gap caused by differences in private sector R&D; and Europe is locked into obsolete traditional (manufacturing) sectors with a relatively low share of ICT–related sectors, a structural trade deficit in high-tech manufacturing and under-investment in services R&D.

Technology procurement is seen as a possible instrument to address some of these lags and put Europe back at the forefront. Seen in a historical perspective, the procurement of technology has been a strong driver in innovation and take-

[1] For example, the application on ICT technology in the Healthcare sector (eHealth) today accounts for only 2% of the overall European healthcare expenditure, despite the very large efficiency and quality of service gains that it can offer, for example through reduction of hospitalisation costs thanks to home care and avoiding duplication of laboratory and radiology examinations thanks to telemedicine systems that allow the transfer and storage of scans.

up of new technologies. This has in particular been the case in the US, where a large number of significant innovations have first been developed and subsequently brought to the market through public procurement. Well-known examples of this include the Internet Protocol, the Global Positioning System (GPS) and key innovations in high performance computing and semiconductor technology. Government agencies with large procurement budgets such as the US military, the Department of Energy and others have played a key role in this.

Even though a significant part of the gap between the US and Europe in terms of research and technology procurement can be accounted for by the difference in spending on security and military issues, technology procurement may also play an important role in other domains of services of public interest such as health, energy supply, environment, transport, public safety etc. The Aho Report[2] recommended using public procurement in such areas to drive demand for innovative goods, while at the same time improving the level of public services. It expressed the need to explore further opportunities for how public procurement can be used to enhance innovation and growth in Europe and contribute to the creation of new lead markets.

However, there are a number of barriers to public procurement as a driver of innovation. One of the most significant barriers is the mindset of public procurers, who traditionally tend to favour low-risk procurement of proven technologies, focusing on price and track record rather than innovation. This is closely connected to the fact that the rewards for being innovative in the public sector are small compared to the negative political and financial consequences of procuring a project that fails. Further, the capabilities and competences required to successfully procure technologically complex projects are often in scarce supply within public organisations, in particular at sub-national level. There is also a widespread perception among public procurers – whether founded in reality or not – that the procurement regulation restricts the flexibility needed to engage in complex development projects.

Compared to other parts of the world, in Europe innovation is still not at the forefront of public procurement. It may be that a new way of thinking needs to be introduced. Traditionally, the public sector in Europe has supported innovation through research grants and other public support programmes rather than through procurement. Some cases in the study (e.g. the US high performance computing case) will show that in the US, government analysis has concluded the opposite, namely that public procurement is a more effective instrument for actively influencing the pace of technological development according to government needs as compared to grants, tax incentives or IPR related innovation policy measures, especially in those areas where government has a strategic interest in the technology developments because of their close connection to mission-critical tasks.

Figure 0.1 Overview of procurement cases and key success factors

Legend/colour code:

***POSITIVE IMPACT** on project:*	
***NEGATIVE IMPACT** on project:*	
***NO IMPACT** in particular:*	

[2] Aho Group (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, European Communities, p. 2.

			KEY SUCCESS FACTORS									
CASE	**Europe/US**	**Product/ service description**	**Proper risk sharing strategy**	**Long term planning, good business case**	**Close dialogue**	**Performance based flexible contract**	**Technically capable procurer**	**Organisationally capable procurer**	**Incentive/enabling structures in place**	**IPR Strategy**	**Multiple suppliers**	**Bundling of demand**
Care	EU	Service management system for municipality										
CUTE Fuel Cell Buses	EU	Development of fuel cell city busses										
DTES Digital Transport Enforcement System	EU	Digital system for monitoring traffic/parking violations										
HF Ballast	EU	High frequency energy saving ballast										
Oyster Card	EU	Public transport ticketing (smartcard)										
Public Safety Radio (Nødnett Norge)	Europe	Multi-agency public safety radio network										
Smoke Detection System	EU	Train-mounted smoke detection system										
Sundhed.dk	EU	Public eHealth Portal										
Tera10	EU	Supercomputer for simulation of nuclear testing										
VMS	EU	Digital road signs										
High performance computing	US	Development of high performance computing systems										
Internet Protocol	US	Development of Internet protocol										
iRobot	US	Development of Tactical Mobile Robots										
eVA	US	State-wide public e-procurement system										
Sub-Compact Fluorescent Lamp	US	Energy-efficient lighting										
IEA Tumble Dryer	US	Energy-efficient tumble drier										

The benefit sharing aspect is closely related to the **IPR** strategy. This varies considerably in the European cases. In some cases, contracts don't have IPR clauses. In some cases contracts define that the IPR is owned by the supplier, in others by the procurer – and in only very few cases, IPR ownership is formally shared between the supplier and the procurer. Many European procurers keep the IPR ownership rights, entering after the project into license agreements with the suppliers and/or sharing the IPR with other public authorities/organisations.

In the US cases, contract clauses were used where IPR rights were shared between procurers and suppliers (suppliers keeping non-exclusive ownership rights of their inventions, and procurers getting free usage rights on supplier-owned IPRs, as well as the rights to require the suppliers to license solutions to third party suppliers at market conditions). The case experiences seem to indicate that most benefits (including, not least, the incentive to take risks, to innovate and commercialise) may be obtained from letting the supplier keep IPR ownership rights.

The more **capable** and knowledgeable the procurer, the better equipped he is to choose the right supplier for the project, to foresee and rectify any shortcomings or pitfalls in the process, and to be a professional and equal sparring partner with the supplier. This is important both in organisational and technical terms, since both organisational capacities (such as a dedicated procurement team) and technical capacities (knowledge of the subject field of the development project) are vital to a successful project. The capability of the procurer is also related to the issue of benefit, since tapping into the knowledge and capacity of the supplier (e.g. knowledge of user needs, test capacity etc.) may also be counted among the benefits that the procurer can get from participating in public innovation projects.

Multiple suppliers (competitive development) in development projects do not seem to be a very common phenomenon in Europe. In several of the US cases, competing supplier development was used successfully. Among the EU cases studied, however, only very few had multiple (two) suppliers. Because many EU cases studied were large deployment rather than early stage R&D projects, the number of suppliers available for a project was often limited, and this may have restricted the creative innovation potential. Suppliers are often not inclined to invest time and money in a project where they cannot be sure if there is a commercial benefit for them. Suppliers are also reluctant to risk revealing their company knowledge to other suppliers working in parallel on the same project. Having multiple suppliers developing in competition as foreseen in the pre-commercial procurement concept can prove to be a catalyst in fuelling innovative projects, if each supplier can keep its own IPRs. It is, however, assessed that the multiple supplier's element is probably the most challenging part of the PCP concept. One possible solution to this problem could be to differentiate the risk sharing between project phases, with the procurer covering most or all of the costs in the first (solution exploration phase), and gradually increasing the risk taken by the suppliers selected for the following phases (in terms of investing in the project). In addition, the post-project business plan should be revised after each phase, gradually making the potential benefits more and more complete as the project develops.

Bundling of demand can be beneficial to the procurement process, especially in terms of reducing risks and costs for each individual procurer and in terms of knowledge-sharing. If the number of procurers involved represents a critical mass in terms of (potential) market for the products developed, there is a possibility that a lead market or de facto standard can be created on the basis of the project. In certain cases, the bundling of demand may also create a volume of demand for deployment (or the prospect of a "potential" market) that is large enough to attract suppliers from outside Europe who may be willing to locate (parts of) their R&D and possibly production activities in the EU. Bundling of demand is, however, not without drawbacks. In particular, the requirements for coordination among the different suppliers, reconciling possible differences in requirements to the product or service to be developed, selection of suppliers etc. may require much co-ordination, time and resources.

Although the **involvement of SMEs** in public technology projects is not a success factor in itself, the structure of European industry with a large number of SMEs with development potential and the often innovative nature of SMEs makes it important to consider how they can be more involved as suppliers in technology procurement. Barriers to SME involvement in major development projects can be high, in particular due to the limitations in financial capacity and human resources. However, there are a number of ways in which the main barriers to SME participation can be overcome: 1) Setting the scope and scale right; ideally the project should not be too large, or require a very broad range of different capabilities, 2) Reducing the risks of commercialisation, e.g. through the preparation of a solid business plan and linkage of a venture capital programme to R&D procurements, and 3) If the project is large, phasing the project in gradually increasing steps (with gradually increasing contract values) and organising those phases in such a way that there are defined tasks/roles of suitable size and complexity which can be undertaken by smaller enterprises, either alone or as part of a consortium.

The **contract** is an important, but not exclusive, tool for steering the project. A close **dialogue** between procurer and supplier is, however, even more important for the success of the project. Lack of flexibility during the contract phase may constitute a significant barrier to promoting innovation through public procurement. Some of the more successful projects amended the contract several times during the development phase in order to incorporate experiences gained during the project. Successful innovation requires interaction throughout the process. This may be addressed by dividing the project in phases with evaluations after each phase as is foreseen in the pre-commercial procurement approach.

Key issues in public technology procurement are the incentives and enabling structures influencing **the motivation of procurers** to initiate innovative projects. Based on the cases, the motivation of EU procurers to undertake technology procurement seems to be overwhelmingly to address their short term specific needs, whereas concerns regarding innovation, business and market development play a very small role. Procurers tend to focus on immediate tactical purchasing needs rather than strategic, longer term quality/efficiency constraints on public services. This is linked to the lack of an incentive structure for public procurers and rewards entrepreneurial behaviour and innovation. Often, the short-term needs defined by the procurers can be fulfilled by adapting existing technology and applying it to the new context; radical innovations are usually not strictly necessary to address these short-term needs and EU procurers thus tend to stick with projects where the risk is manageable. Contributing to finding solutions for mid-to-long term policy priorities for modernizing public services through radical innovation does not seem to be the primary concern of public procurers. Consequently also the observed unwillingness of *suppliers* to take risks in EU procurements could indicate that their own primary motivation to participate in such short-term focused procurement projects is primarily to do "paid work", with the possible added bonus that they may be able to develop their core business in small steps, rather than radical ones. This situation is different in a number of the US procurements where, due to the procurers' willingness to share R&D benefits and risks, more radical innovation projects can be initiated.

A European centre of gravity for R&D activities. PCP aims to foster innovation through competition amongst bidding companies. PCP is excluded from the WTO Government Procurement Agreement and restriction of the tender to bidders from the EU is therefore in principle allowed while respecting the basic Treaty principles of transparency and non-discriminatory fair competition. However, the Commission Communication on pre-commercial procurement does not

recommend to systematically using a restrictive approach. The Communication recognises that each case may be different and case-by-case analysis is advisable. Therefore it is proposed that a non-restrictive approach is applied, meaning that companies bidding for a pre-commercial procurement contract can be encouraged to locate a relevant "centre of gravity" of the R&D and operational activities related to the PCP contract in Europe, without mandating companies to be European or European-owned. Often, however, procurers are concerned with issues relating to national security of supply, national employment or national capacity building. For EU Member States to fully benefit from PCP it is important to address this issue of geographical discrimination of suppliers.

Summing up, there are many advantages to the PCP model compared to the traditional approach to technology procurement. PCP-like strategies have been applied successfully in the US. The difference in scale and long-term commitment between these US examples considered in this report and what is feasible in a European context must be considered, but it is clear that public authorities *can* foster innovation and industry development through acting as a demanding first buyer, in particular when resources are pulled together (bundled) and applied within the framework of a long-term strategy. There are, however, also a number of issues that need to be addressed, in particular that of risk and benefit sharing and how to ensure that the multiple suppliers' aspect can work smoothly in practice.

Recommendations

The findings and conclusions based on the analysis of the cases have led to a number of recommendations designed to address the potential barriers to technology procurement and thus promote the take-up of approaches such as pre-commercial procurement among European public authorities, with the view to address important mid-to-long-term challenges facing the public sector while fostering innovation and contributing to the creation of new lead markets at the same time.

In brief, the recommendations are:

1. Identify public sector priority challenges which could be addressed through pre-commercial procurement of innovative solutions (linking to Lead Market Initiative)

2. Establish specialised networks of public procurers within specific areas for exchange of information and best practices

3. Promote bundling of PCP demand at European level

4. Establish special support measures for public procurers (e.g. for networking, development of business plans)

5. Establish training courses/"continuing professional development" for PCP

6. Rethink incentives and enabling structures to encourage radically innovative procurements (e.g. funding)

7. Develop "PCP in practice" handbook for procurers

8. Link PCP to external funding (venture capital) schemes

In the table below, the linkage between the recommendations and the key success factors discussed above is shown.

The coloured fields in the table indicate which of the key success factors the implementation of the recommendations is expected to have an effect on. Some effects are direct – such as the direct effect of training of staff on organisational capability – while others will be more indirect, such as initiatives to promote bundling of demand, which may reasonably be expected to have a positive effect in terms of more projects with multiple suppliers.

Figure 0.2 Overview of recommendations and their coverage of the key success factors

Key Success Factor / Recommendation	Clear risk handling strategy	Long term planning, good business case	Close dialogue	Performance based contract	Technically capable procurer	Organisationally capable procurer	Incentive/enabling structures in place	IPR / project result handling Strategy	*Multiple suppliers*	*Bundling of demand*	*SME involvement*
1. Identify public sector priority challenges which could be addressed through pre-commercial procurement of innovative solutions (linking to Lead Market Initiative)		■	■		■		■				■
2. Establish specialised networks of public procurers within specific areas for exchange of information and best practices	■	■				■	■		■	■	
3. Promote bundling of PCP demand at European level									■	■	
4. Establish special support measures for public procurers (e.g. for networking, development of business plans)	■	■						■			■
5. Establish training courses/ "continuing professional development" for PCP	■	■	■	■		■		■	■	■	■
6. Rethink incentives and enabling structures to encourage radically innovative procurements (e.g. funding)							■				
7. Develop "PCP in practice" handbook for procurers	■	■	■	■	■	■	■	■	■	■	■
8. Link PCP to external funding (venture capital) schemes		■									■

1. Introduction

1.1 Background and rationale for the study

Although some progress has been made towards achieving the Lisbon goals, there are still many indicators pointing to the need to increase investment in R&D and innovation in Europe, including: productivity growth continues to fall behind that of the USA, in particular because of a failure to capitalize fully on the application of ICT[3]; R&D intensity in Europe has stagnated since the mid-nineties, being overtaken by Asian countries such as Japan, China and South Korea and remaining also at a lower level than in the US; and Europe is locked into obsolete traditional (manufacturing) sectors with a relatively low share of ICT–related sectors, a structural trade deficit in high-tech manufacturing and under-investment in services R&D[4]. A major part of the gap is caused by differences in R&D procurement expenditure by the public sector. Increasing the public demand for innovative products and services could help to close the first part of the gap by inducing extra private sector R&D.

Historically, *technology procurement* has been one of the strong drivers of innovation and take-up of new technologies[5]. The term public Technology procurement can cover both procurements focusing on the early adoption and diffusion of new-on-the market technology (incremental innovation) as well as procurements focusing on the research and development of totally new non-existing technology (radical innovation).

The Aho Report recommended using public procurement to drive demand for innovative goods, while at the same time improving the level of public services[6]. Similarly, the Information Society Technology Advisory Group (ISTAG) report on EU-wide initiatives[7] underlined the role of public procurement in stimulating innovation and supporting the deployment of new technologies and services.

Public procurement accounts for about 17% of GDP in Europe. Public technology procurement is thus seen as a powerful instrument that can play a key role in growth and competitiveness of the ICT sector and related sectors. Technology procurement can facilitate the research, development and first-user deployment of innovative technology-based products and services.

Thus, there is a need to explore further how public procurement can enhance economic growth in Europe through investment in innovation and the creation of lead markets.

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[3] Aho Group (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, European Communities, p. 2.

[4] Aho Group (2006), p. 2.

[5] Public technology procurement has been defined by Edquist et al. (2000) as occurring "*when a public agency places an order for a product or system which does not exist at the time, but which could (probably) be developed within a reasonable time period through R&D and / or innovation. Additional or new technological development work is required to fulfil the demand of the buyer."* For further discussion of the key concepts of public technology procurement and innovation cf. section 2.1 of this report.

[6] Ibid, p. 6.

[7] ISTAG Working Group on Europe Wide Initiatives (2004): "Building critical mass in cross-border innovation", European Communities

1.2 Objectives and scope of the study

In the following, the overall objectives of the study are outlined. However, dealing with a subject which is continuously being developed, the scope and focus of the study has undergone minor adjustments along the way; these are explained in the last part of this section.

1.2.1 Objectives and expected outcome

The following outlines the aims and expected outcomes of this study as stated in the Terms of Reference:

The aim of the study is to explore the hypothesis that public procurement, and in particular technology procurement, can be seen as an effective and currently underutilised resource for driving technological innovation in Europe in the ICT domain. It will consider risk taking and sharing in close collaboration between public and private sectors, to ensure that technology procurement acts as an effective driver for European technological innovation in the ICT domain. The study should have an ICT focus as well as a research policy focus, looking beyond procurement from a cost efficiency perspective, and instead focusing on procurement as a driver for market development, including the considerations of users and first buyers. Focussing on the ICT sector[8], the study will:

- Explore the links between technology procurement and technology development, and the hypothesis that technology procurement can be a stronger driver for innovation in Europe.
- Identify examples from the global procurement and technology arena, which show an effective utilisation of technology procurement as a driver of technology development in the ICT domain. In this context, it will outline next generation technology procurement processes that may trigger technological innovations and that may be most successful and effective for Europe.
- Study, assess, benchmark and evaluate high profile technology procurement process best practices in Europe, US and Asia (notably Korea), to identify possible approaches which can be taken up effectively in the European context.
- Identify barriers to effective interaction between technology procurement and technology development and ICT innovation policies, and highlight ways to overcome these barriers.
- Identify opportunities for further symbiosis in technology procurement and technological development activities at the European level
- Provide a series of recommendations to the Commission in this context.

[8] This focus has subsequently been expanded; compare section 1.2.3 below.

1.2.2 *Study focus development: Introducing the pre-commercial procurement concept*

At the National ICT Research Directors Forum[9] meeting in October 2005, a working group was set up with the objective of preparing a discussion paper on Public Procurement in support of Research and Innovation in Information and Communication Technologies (ICT). Their report[10] introduced the concept of *pre-commercial procurement* which has come to play an important role in this study.

Since then, the Commission has continued to further refine (incl. in legal terms) the concept. This work is part of an ongoing European effort, aiming to put the Lisbon Strategy into practice. In September 2006, the Commission published a Communication on "A broad-based innovation strategy for the EU"[11]. This document pointed to the importance of public procurement in stimulating innovation, and specifically to pre-commercial procurement as an as yet "untapped opportunity" for public authorities in Europe. The European Parliament's resolution of June 2007 on the transposition and implementation of public procurement legislation[12] encouraged the wider use of pre-commercial procurement in the EU. This was followed in December 2007 by a Commission Communication on "Pre-commercial Procurement: Driving innovation to ensure sustainable high quality public services in Europe"[13], accompanied by a Staff Working Document[14] providing further details of the approach.

Thus, the pre-commercial procurement concept has taken centre stage, and in the early phase of the present study it was agreed with the Commission that an important focus of the study should be on the issue of pre-commercial procurement, rather than only on the procurement of innovative products and services in general. This means that the perspective of "how to decrease the first buyer risk of procuring R&D that is needed to find better value-for-money solutions that can improve the quality and effectives of public services and at the same time trigger innovation", which was already emphasised in the Terms of Reference (cf. objectives of the study, above), was to be a central issue in the study.

Thus, it was attempted to identify examples of PCP in practice, which was reflected in the selection criteria for the case studies conducted for this study. However, as no clear-cut completed PCP cases could be identified in Europe to date, an important portion of the study addresses innovative public technology procurement cases containing PCP *elements* in order to expose how innovation is promoted in public procurement in Europe.

The implications and meaning of pre-commercial procurement will be discussed in more detail in section 2.3 of this report.

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9 The National ICT Research Directors Forum brings together national Directors responsible for research in Information and Communication Technologies (ICT) to discuss key policy and implementation issues related to the development of a European Research Area in the field of ICT. http://www.cordis.lu/ist/about/era.htm

10 Report of an independent expert group for a National ICT Research Directors Forum ad hoc Working Group on Public Procurement in Support of ICT Research and Innovation (2006): 'Pre-commercial Procurement of Innovation – A missing link in the European Innovation Cycle'. March 2006

11 European Commission (2006): Putting knowledge into practice: A broad-based innovation strategy for the EU, COM (2006) 502 final.

12 EP 2006/2084(INI)

13 COM(2007) 799 final

14 SEC(2007) 1668

1.2.3 *Study focus development: ICT and ICT-related sectors*

The ICT sector includes the production of ICT goods and ICT services and is commonly recognised as an important source of growth[15] with a value added in year 2002 at EUR 450 billion[16]. It employs about 6% of the workforce and makes up about 8% of EU GDP[17]. Most economists now agree that the ICT sector has a broader impact on the economy as a whole[18], as ICT drives about half of EU productivity gains in the private sector[19]. However, as pointed out above, the failure to capitalize fully on the application of ICT technologies in Europe explains much of the lag in European productivity growth compared to that of the USA.

As stated in the Terms of Reference for this study (cf. section 1.2.1, above): the focus of the current study was intended to be on technology procurement in the ICT sector, which has been defined by the OECD as *"…a combination of manufacturing and services industries that capture transmit and display data and information electronically[20]".* This definition was made operational by including companies in related industries such as Manufacture of office machinery and computers, Manufacture of electrical machinery and apparatus, Telecommunications and Computer and related activities[21].

While the above definition of the ICT sector is widely accepted, it also raises a number of demarcation questions: Is the medical instrument industry (scanners, IRM, radiography apparatus, etc.), which largely relies on ICs, part of the ICT sector[22]? Is the development of embedded ICT in sectors such as automobile manufacturing going to take place as a backward vertical integration (the car company sets up subsidiaries that produce ICTs)? This would make it more difficult to capture the development in the ICT sector when looking at the narrowly defined sectors mentioned above.

Furthermore, many of the best cases of technology procurement were expected to be found in other sectors than the narrow ICT sector, including transport, energy, etc. It was therefore agreed that a broader view should be taken, including ICT *intensive* sectors in both manufacturing and services, referring to sectors where a critical threshold of diffusion and concentration of ICT has been reached. Thus, for the purposes of this study, we have chosen to designate this combination of the ICT sector and ICT intensive sectors with the rather broad term *ICT-related sectors*.

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[15] Home page of the European Commission, Enterprise Directorate General, Technology for innovation / ICT industries and E-business, http://europa.eu.int/comm/enterprise/ict/index_en.htm. April 2006.

[16] European Commission, Directorate-General Enterprise and Industry, European Competitiveness Report 2006

[17] Home page of the European Commission, Enterprise Directorate General, http://ec.europa.eu/enterprise/ict/index_en.htm (April 2008)

[18] Viviane Reding, Member of the European Commission responsible for Information Society and Media, The ICT industry as driver for competition, investment, growth and jobs – if we make the right choices, Presentation of EITO 2006, Brussels, 23 February 2006. Reference: SPEECH/06/127

[19] Home page of the European Commission, Enterprise Directorate General, http://ec.europa.eu/enterprise/ict/index_en.htm (April 2008)

[20] OECD 2002: Measuring the information society, Annex 1

[21] For the full list of NACE codes relating to the ICT sector, see OECD 2002: Measuring the information society, Annex 1

[22] G. Dang Nguyen & C. Genthon, 2006: Has the European ICT sector a chance to be competitive? College of Europe, Bruges European Economic Policy Briefings no. 14. Page 3

1.2.4 *Study focus development: SMEs*

Apart from the sector focus, the Terms of Reference for this study do not mention any particular type of companies to be focused on. However, given the importance of small and medium-sized enterprises (SMEs) to the European economy, and the barriers which their size often poses for their involvement in major R&D projects, special – though not exclusive - emphasis has put on exploring how SMEs can overcome these barriers.

1.2.5 *Study focus development: Exclusion of purely military applications*

It is a fact that many – if not most - major technological innovations in the 20th century, in particular those originating in the USA, first saw the light of day as military applications, many of which have since been applied in civil society. Defence has historically dominated US federal expenditure in R&D. Thus, in 2001, defence accounted for just over 50% of US public R&D expenditure, versus 14.5% in the EU[23].

When looking at public procurement as a specific source of R&D expenditure, the US spends approximately 20 times more on R&D procurement than the EU. Most of the gap is indeed due to the larger defence budget, but even in non-defence areas (such as energy, health etc) there is still a gap of 4 times in R&D procurement expenditure.

Given the *relatively* small significance of defence-related R&D in Europe, as well as the fact that defence procurement is in some cases exempt from the provisions of the procurement Directives[24], it was decided that this study should try to find primarily opportunities for Europe in non-military public sector domains. However, given the difficulties in finding relevant case examples from the US which did not somehow have a military origin, this was later adjusted to focusing on the development of products and services which have significant civilian applications.

1.2.6 *South Korea*

Finally, the Terms of Reference required the research team to look for interesting technology procurement approaches in the US and Asia, in particular South Korea. As will be seen later, a number of US cases have been investigated in order to deduct any experiences that we can learn from.

The study team also attempted to identify relevant cases in South Korea. However, it soon turned out that the procurement processes in South Korea are of little relevance to the issues focused on in this study. The research conducted for this project with the objective of understanding the Korean innovation system and identifying relevant cases showed early in the process that the Korean projects mainly concern procurement of adapted off-the-shelf products with few innovative elements. This is typically done through partnerships between government and private entities or the establishment of joint ventures[25,26,27].

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[23] Source: EUROSTAT, quoted in Nyiri, L. et al. (2006): Public Procurement for the promotion of R&D and innovation in ICT, European Commission, Joint Research Centre, February 2006

[24] The exemption only applies to a number of 'military' defence type products belonging to a list agreed upon in the scope of the procurement Directives. Procurement by defence agencies of products that are not directly military related is not exempted from the procurement Directives.

[25] Mani, Sunil, 2005: Keeping pace with globalisation innovation capacity in Korea's telecommunications equipment industry, CDS

1.3 Methodology

The methodology for this project is qualitative, based on case studies supplemented with interviews and desk research of other technology procurement approaches. The detailed methodology for this study will not be described here, but can be found in Annex I to this report.

[26] Ministry of Information and Communication (MIC): www.mic.go.kr

[27] Ministry of Information and Communication: IT 839 Strategy: A leap to advanced Korea based on IT

2. Key concepts

This study revolves around a number of key concepts, notably innovation, public procurement in general and pre-commercial procurement in particular. Given that these are complex and, in the case of pre-commercial procurement, new concepts, a brief introduction to each of these key concepts is provided in this chapter.

2.1 Innovation, R&D and technology procurement

Innovation is a concept for which a number of definitions exist. For the purposes of this study (focusing on "technology" procurement), the following understanding of the concept was found to be useful:

> *Technological innovation: the transformation of an idea into a marketable product or service, typically encompassing a technological R&D and a commercialisation phase.*

R&D covers up to "original development[28] of a first product or service:

> *Original development may include limited production or supply in order to incorporate the results of field testing and to demonstrate that the product or service is suitable for production or supply in quantity to acceptable quality standards. It does not extend to quantity production or supply to establish commercial viability or to recover R&D costs. Therefore, R&D does not include commercial development activities such as integration, customisation, incremental adaptations and improvements to existing products or processes.*
>
> The difference between commercial development and R&D for a procurer lies in the degree of technological maturity: commercial development comprises activities for which the technological development risks can be quantified. R&D, on the other hand, inherently includes a non-zero risk of failure that is not predictable.

[28] The definition of 'original development' which demarcates the boundary between R&D and commercial development originally stems from WTO GPA, article XV.

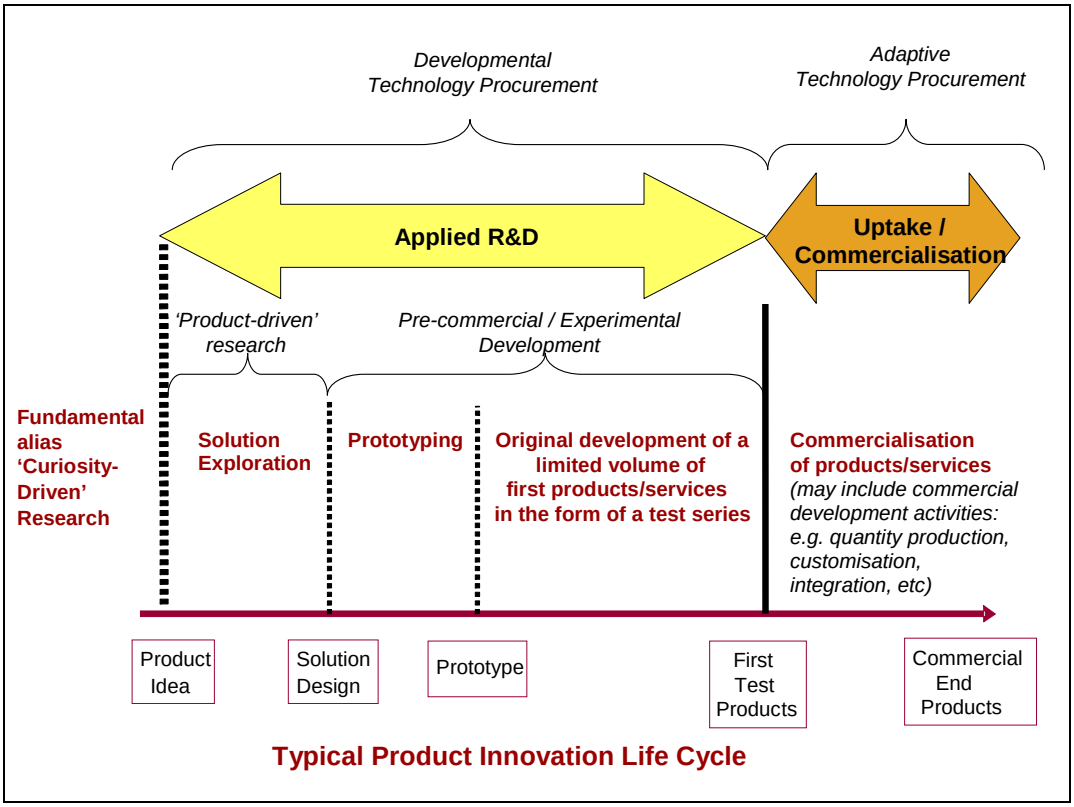


Figure 2.1: Typical product innovation life cycle consisting of an R&D and a Commercialisation phase (the latter of which may include commercial development activities)

Technology procurement[29] occurs:

> *when a public agency places an order for a product or system which does not exist at the time, but which could (probably) be developed within a reasonable time period through R&D and / or innovation. Additional or new technological development work is required to fulfil the demand of the buyer.*

Technology procurement can thus concern technological development work in the R&D phase or in the commercialisation/diffusion/take-up phase or both. Edquist and Hommen's[29] considerations that public procurement can play an important role in both the development and the diffusion of new technologies have lead to the distinction between 'developmental' and 'adaptive' public technology procurement. *Developmental* public technology procurement corresponds to cases where "completely new products […] or systems are created". In contrast, *adaptive* public technology procurement occurs in cases where the product or system "is not new to the world but still new to the country of procurement" or to the particular buyer, and therefore still "needs adaptation to specific local conditions, and this involves innovation". In other words, technology procurement does not necessarily involve R&D developing new technology (radical innovation); in some cases technology procurement may simply involve adaptation of existing technology to facilitate take-up (incremental innovation).

[29] Edquist, C., Hommen, L. and Tsipouri, L. (eds): Public Technology Procurement and Innovation. Kluwer Academic, 2000.

In the context of this definition of technology procurement, pre-commercial procurement is thus a subset of developmental technology procurement. More specifically, it is a particular approach to procure applied R&D (applying a few principles such as competitive development in phases and risk-benefit sharing at market conditions).

Initially, the research carried out for this study attempted to focus on radical innovation (developmental technology procurement) since this type of innovation would present more possibilities for substantial impacts of public technology procurement activities. However, in practice, it has turned out that very few cases with this degree of innovation can be identified in Europe. Thus, most of the EU case studies analysed in this study concern adaptive public technology procurement (incremental innovation)[30] rather than radical innovations. In the US cases, more examples of radical innovation were found.

2.2 Public procurement of R&D services and the procurement Directives

Public procurement is subject to specific Community and international rules, notably the EU public procurement Directives and the WTO Government Procurement Agreement (GPA), the fundamental principles of the EC Treaty, the State Aid rules and the jurisprudence of the Court of Justice. Under these rules, public procurement must follow transparent open procedures ensuring fair conditions of competition for suppliers (including non-discrimination of foreign suppliers). Not all public procurement is, however, subject to these obligations. Some purchases (e.g. military equipment for the defence sector) are excluded and smaller purchases (below thresholds) must respect the principles of the EC Treaty only.

The current EU legislation on public procurement is contained in the public procurement Directives (2004/17/EC[31] and 2004/18/EC[32]), which were amended in 2003/2004 through a legislative package intending to simplify and modernise the Directives and adapting them to modern administrative needs. One of the changes introduced with the legislative package was: more scope for dialogue between contracting authorities and those who tender in order to determine contract conditions.

Since this study focuses on technology procurement, which covers innovation both in the sense of R&D and take-up of new technological developments, the rules on public procurement of R&D are of particular interest. There are three types of possible R&D contracts: R&D works, R&D services and R&D supplies contracts, with specific rules and procedures applicable to each.

2.3 Pre-Commercial Procurement (PCP)

[30] Cases discussed cover both process and product innovation. Process innovation involves the implementation of a new or significantly improved production or delivery method. Product innovation, involves the introduction of a new good or service that is new or substantially improved. This might include improvements in functional characteristics, technical abilities, ease of use, or any other dimension.

[31] Directive 2004/17/EC of the European Parliament and of the Council of 31 March 2004 coordinating the procurement procedures of entities operating in the water, energy, transport and postal services sectors.

[32] Directive 2004/18/EC of the European Parliament and of the Council of 31 March 2004 on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts.

14 December 2007 the Commission published a Communication[33] and associated Staff Working Document[34] on pre-commercial procurement. The aim of the Communication is to draw the attention of Member States to the underutilised opportunity of pre-commercial procurement. The Associated Staff Working Paper provides, by way of example, one implementation of pre-commercial procurement in line with the existing legal framework.

In the abovementioned Commission documents pre-commercial procurement (PCP) is referred to as an approach to procuring R&D services, applying risk-benefit sharing between procurers and suppliers at market conditions, that does not constitute State aid.

Pre-commercial procurement covers only the applied R&D part of the typical product innovation life cycle (see Figure 2.1) in between fundamental curiosity-driven research and mass commercialisation of new technology innovations, covering the process from solution exploration via prototyping to original development of a pre-commercial volume of first products in the form of a test series.

Main characteristics of PCP

Pre-commercial procurement is based on:

- Risk-benefit sharing according to market conditions
- Competitive development in phases
- Separation of the R&D phase from deployment of commercial volumes of end-products

Risk-benefit sharing according to market conditions
Unlike in exclusive development contracts, in pre-commercial procurement the public purchaser does not reserve the R&D results (e.g. IPRs) for exclusive use in conducting its own affairs, but shares R&D results and benefits with suppliers and external stakeholders (e.g. other public procurers) in such as way as to optimize the conditions for exploitation and take-up of the newly developed solutions.

A shared risk-shared benefits approach is central to the PCP concept. The procurer shares benefits with the supplier (e.g. through letting the supplier keep non-exclusive ownership rights over supplier generated IPRs resulting from the development project, whilst keeping free usage rights and the right to license to third parties). The assumption is that this provides an incentive for the supplier to share the risk, in particular development costs, by charging a lower price for the development effort than if the procurer kept all rights and benefits (also known as exclusive development).

Pre-commercial procurement challenges suppliers with technologically demanding mid to long term public sector needs in advance of the rest of the world market, and shares R&D benefits in a way that optimizes commercialization success and shortens time to market. This is expected to help both the public sector improve its efficiency and effectiveness by introducing innovations faster, and is expected to help industry arrive first on the market to exploit those newly developed solutions and turn them into new global lead markets, starting with the public sector as the first "home" market.

Competitive development in phases

[33] COM(2007)799 final, pre-commercial procurement: driving innovation to ensure sustainable high-quality public services in Europe, 14 Dec 2007

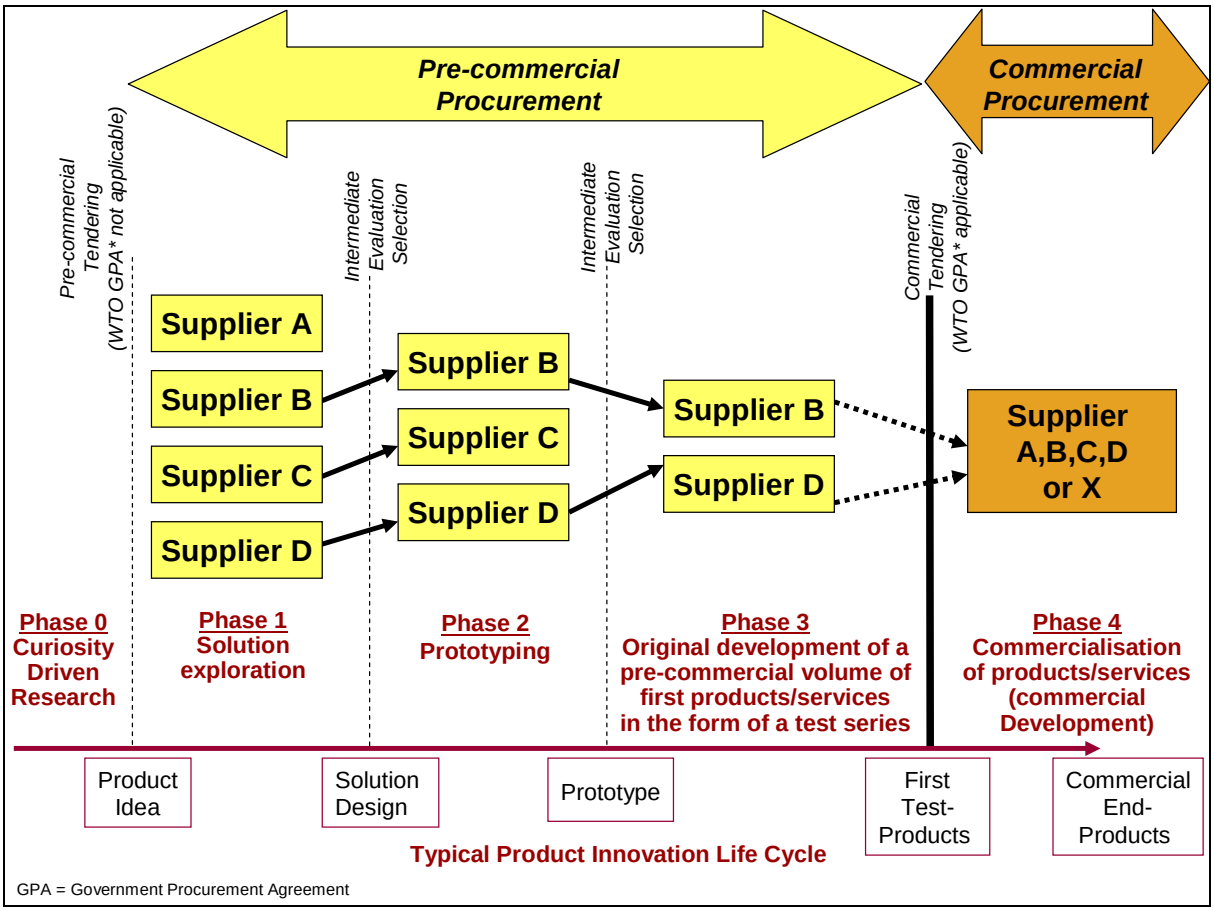
[34] SEC(2007)1668, Example of a possible approach for procuring R&D services applying risk-benefit sharing at market conditions: pre-commercial procurement,14 Dec 2007,

Pre-commercial procurement challenges a number of suppliers to develop in competition, according to the procurers' needs, new solutions for a specific public sector problem which cannot be addressed through the purchase of commercially ready products and services.

An example showing how R&D services can be procured using the PCP concept is illustrated in the figure below.

Figure 2.1 Pre-commercial procurement example

A phased shared risk-shared benefit approach



Source: Commission Staff Working Document SEC (2007) 1668

The PCP approach is based on a phased process[35], each stage with multiple suppliers in competition:

- Phase 1: Solution Exploration
- Phase 2: Prototyping
- Phase 3: Original development of a limited batch of first products/services validated through a field test

At the end of phase 1 and phase 2 an evaluation filters out the best projects based on their performance in the previous phase and the quality of the project proposal for the next phase.

The 'quality' criterion for awarding the contracts would typically include the project's technological quality and innovativeness, its ability to address the problem of public interest posed in the tender, and the 'added value for society/economy of the proposal'[36]. For each of the three phases of the pre-commercial procurement process a maximum price is predefined in the initial tender publication. The approach sets out all the phases in one tender and assumes that the total value of the services over all the phases in question exceeds the value of products covered by the contract. Technically speaking, the three-stage pre-commercial procurement process is implemented as a single public procurement procedure (one framework contract with specific contracts per phase) – of the type 'Public service contract for R&D services' – with two intermediate evaluation points.

Separation of the R&D phase from deployment of commercial volumes of end-products
As depicted in figure 2.1, after the pre-commercial procurement is finished, a separate tender is published for follow-up procurements for commercial roll-out of final end-products. This separation of the R&D phase from the deployment phase enables public purchasers to filter out technological R&D risks of competing solutions before committing to procuring a large scale commercial roll-out. Indeed, due to the inherent risk of failure in R&D, technological success may not always be the case in R&D procurements. It is only at the end of the R&D phase that the public purchaser has comparative test evidence that proves whether any of the solutions developed in the pre-commercial procurement truly outperform other solutions available at the same time on the market. Reopening competition at the deployment phase thus ensures that the procurer ultimately gets the best value for money products.

Legal framework for PCP

The main signatories of the WTO GPA have exempted public procurement of R&D *services* (not of R&D products or R&D works) from both the WTO national treatment and non-discrimination obligations.

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[35] The figure above depicts a splitting of the R&D process into three phases to show a splitting into the basic phases matching the rudimentary technology readiness levels of a typical product innovation life cycle. More elaborate Technology Readiness Levels (TRLs) are used widely in the defence/space sector, e.g. by NATO. The TRLs delineate the distance the R&D results are still away from the final TRL 'ready for commercial operation' (http://www.saclantc.nato.int/trl.html). Depending on project complexity, NATO uses 9 phases which can be mapped as sub-phases onto the 3 basic phases of the figure shown here.

[36] Besides cost aspects, the 'added value for society/economy' criterion can also take into account the added value the proposal brings with regards to improving public services and the associated benefits for the whole society and economy, cf. the Commission Staff Working Document SEC(2007) 1668, p. 10.

Pre-commercial procurement is an approach to procure R&D services that is, due to the application of risk-benefit sharing, also exempted from the public procurement Directives under the circumstances laid down by article 16 (f) of the public procurement Directive for public authorities (2004/18/EC) and article 24 (e) of the public procurement Directive for utilities (2004/17/EC): "This Directive shall not apply to public service contracts for research and development services other than those where the benefits accrue exclusively to the contracting authority for its use in the conduct of its own affairs, on condition that the service provided is wholly remunerated by the contracting authority".

It should be noted, however, that the single market rules and the fundamental principles of the EU Treaty are still applicable; in order not to distort competition, while sharing R&D benefits the contracting authority would have to respect the fundamental principles of the Treaty, treating suppliers equally in a non-discriminatory and transparent manner. According to the Community Framework for State Aid for Research, Development and Innovation, public procurement normally does not involve State Aid when conducted in a competitive and transparent way according to market conditions/at market price[37].

In order to ensure that the risk-benefit sharing in pre-commercial procurement is done according to market conditions, any R&D benefit shared by the public purchaser with a participating company should be compensated by the company to the public purchaser at market price. This can be done through, for example, a price reduction that reflects the market value of the benefits received (e.g. IPR ownership) and the risks assumed (e.g. cost for filing and maintaining the IPRs) by the company

As pre-commercial procurement concerns the procurement of R&D services and these services are excluded from the WTO Government Procurement Agreement, restriction of the tender to bidders from the EU is in principle allowed. Public purchasers can decide on a case by case basis on the degree of openness to worldwide offers and on the relevant conditions, taking into account the full potential of the European Research Area. Allowing companies from anywhere in the world to make offers regardless of the geographic location of company head offices or their governance structure would be an open and effective way for Member States to promote the creation of growth and jobs in Europe without excluding non-European firms. The procurement process could be organised so as to stimulate companies to locate a relevant portion of the R&D and operational activities related to the pre-commercial development contract in the European Economic Area or a country having concluded a Stabilisation and Association Agreement.

[37] "Public authorities may commission R&D from companies or buy the results of R&D from them. If such R&D is not procured at market price, this will normally involve State aid within the meaning of Article 87 (1) EC Treaty. If, on the other hand, these contracts are awarded according to market conditions, an indication for which may be that a tender procedure in accordance with the applicable directives on public procurement has been carried out, the Commission will normally consider that no State aid within the meaning of Article 87 (1) EC Treaty is involved."

3. Framework conditions impacting public technology procurement

The framework conditions under which public institutions and suppliers operate have an impact on public procurement and its ability to support and foster innovation.

This chapter briefly presents selected framework conditions that influence innovation through public procurement. However, it is not to be considered as an exhaustive list of framework conditions that impact European industry and public procurers. The purpose is to set the scene for the following analysis of different experiences with technology procurement in Europe.

3.1 Willingness to take, manage and share risks

Traditionally public institutions in Europe are focused on low-risk procurements that can deliver value for the public sector in the short term. Price is often mentioned as the most important selection criterion in public procurement and aspects such as long-term potential and innovativeness are factors that are prioritised lower than price. Procurement of proven technologies with a solid track record and a good business case may often, in the public eye, be preferred. This limits the willingness of public institutions to take risks. This unwillingness may result in public procurement of less innovative products and services and, in the medium to long term, hamper innovation among European companies.

In an international context, European procurers are often characterised as relatively risk averse compared to for example the United States. It can be argued that the innovativeness of technology procurements in the US may be higher due to a larger willingness to engage in higher-risk higher-value projects and more experience in applying risk-management and risk-sharing techniques in procurement. We shall attempt to shed more light on this aspect later in this report, since the full picture may be slightly more nuanced.

3.2 Market structure (The internal market)

The market structures arisen from the introduction of the European internal market greatly affect the framework conditions under which public procurers and European suppliers act. The implementation of the new EC procurement directives are the latest examples of guidelines and regulations impacting public procurers' ability to procure technology.

The structures put into place by European internal market legislation are intended to create transparency in procurement and a level playing field for companies to compete for public works and service contracts. The European legislation is based, among other things, on the prevention of State Aid, the free movement of goods and labour, and freedom of establishment. The basic underlying principles in the legal framework in other parts of the world are similar but may be practiced and enforced differently; as an example the U.S. State Aid rules are different from those of the European Union.

The European market is made up by a large number of small and medium-sized enterprises and a limited number of very large corporations. This market structure also has an impact on public technology procurement and innovation.

3.3 Knowledge and technology transfer

The European license and patent setup impacts the way enterprises innovate and commercialise their innovations, and puts special constraints on IPR and risk sharing between procurer and supplier when developing new technologies together. In particular, there is not yet a common Community Patent which makes it complicated and expensive to exercise IPR rights throughout Europe. A major effort has gone into agreeing on a common framework, but so far without success. However, it must be expected that this framework condition will change in the future.

Employee mobility between the scientific communities and industry is also affecting the way public technology procurement takes place in Europe today. Traditionally industry and the scientific community have found it difficult to transfer knowledge and human capital smoothly.

3.4 Quality in public demand and public administration

Public procurement represents a large proportion of the total procurement volume in Europe. The innovative capabilities of suppliers participating in public procurements are therefore affected by the quality of public procurement.

Especially within public technology procurements it can be essential to the boost of the suppliers' innovative capabilities that the public procurers are themselves open to innovation and able to act efficiently.

4. Analysis of technology procurement experiences

4.1 Introduction

Public technology procurement practices have been explored in a number of European and American case studies. The purpose of this chapter is to discuss and analyse the experiences of these technology procurement case studies in order to shed light on experiences, barriers and success factors. The analysis of the cases is based on a selection of key aspects (analytical themes). The types of impacts produced by the cases are also reviewed. Finally, based on the lessons learnt from the studied case projects, a number of key success factors for public technology procurement are developed.

The identification and selection of cases for in-depth study were based on a number of selection criteria. First, a number of general criteria were applied:

- That actual **procurement** took place (i.e. the acquisition of goods or services at the best possible total cost of ownership, addressing a concrete problem specification by a public authority, not just the pursuit of increasing innovative activity in industry, and not research grants, seed capital etc.)

- That the case was **not too old** (preferably not more than 15-20 years), in order to reflect current experiences

- That the case was **far enough in the innovation process** to be able to draw on sufficient experience and learn from concrete results.

Secondly, for a case to be interesting for this study it needed to include at least 2 or 3 – and preferably more - of the following elements, which have mostly been inspired by the PCP concept:

- The project should address a **public sector need**. The concrete problem to be addressed as well as the targets to be achieved in the development project should be specified by the public authority, not the supplier.
- "**Technical dialogue**" or similar interaction between procurer and potential supplier(s) has been applied. By facilitating a deeper understanding of the available options such a dialogue can help to better clarify the market gaps with respect to actual procurement needs.
- **Functional or performance-based specifications** applied instead of prescriptive technical specifications in the tender material. The use of functional specifications enables the public procurer to formulate the object of the tender as a problem to be solved without prescribing a specific solution approach to be followed.
- **Competing development** used by the public procurer to stimulate competing companies to come up with the best possible value for money designs and avoid single-supplier lock-in.
- **Geographically split R&D** between European and non-European R&D facilities (e.g. Europe/US). Simulating the creation of growth and jobs in Europe through R&D procurement is an issue of interest when setting up PCP projects
- **Risk sharing** between supplier and procurer

- **Sharing of benefits (e.g. IPR rights)** between procurer and supplier
- **Bundling of demand** - several procurers bundle their orders to establish "critical mass" to justify development costs
- **R&D from SMEs**; involvement of SMEs is as such not a defining characteristic of PCP but improving access to the procurement market for SMEs is an essential part of EU innovation and industrial policy
- The creation of **lead markets** for the products/services developed

In the following section, the case studies are briefly presented.

4.2 Presentation of case studies and analytical themes

4.2.1 Overview of case studies

The table below contains an overview of the main project cases on which the following analysis is based. Detailed case descriptions are contained in Annex III, and abstracts of several of the cases are also presented in textboxes throughout this chapter.

For more information on the process and criteria for selection of cases, please refer to the methodology description in Annex I.

Table 4.1 Overview of case projects

Case name	Product/service description	Country	Procurer	Supplier	Starting date
CARE	Service management system for municipality	DK	Municipality of Aalborg	Ramboll Informatics A/S (DK)	1995
Digital Transport Enforcement System (DTES)	Digital system for monitoring traffic/parking violations (mainly in bus lanes)	UK	Transport for London	SEA (UK)	2002
HyFLEET:CUTE	Development of fuel cell city busses	DE	City of Hamburg	HYSolutions (DE)	2002
HF Ballast	High frequency energy saving ballast (device required to start and operate fluorescent lamps)	SE	Swedish National Board for Industrial and Technical Development (NUTEK)	Helvar (FI)	1991
London Oyster Card	Public transport ticketing system (smartcard)	UK	Transport for London	TranSys consortium (Cubic/US, EDS/US, Fujitsu/JA-UK, WS Atkins/UK)	1998

Case name	Product/service description	Country	Procurer	Supplier	Starting date
Nødnett Norge	Multi-agency public safety radio network	NO	National Police Directorate, Directorate for Civil Protection and Emergency Planning, Directorate for Health and Social Affairs	Siemens (NO)	2005
Smoke Detection System	Train-mounted smoke detection system (hardware and software)	DK	Danish Railways	Bravida Denmark	2000
TERA-10 Supercomputer	Supercomputer for simulation of nuclear testing	FR	CEA (Commissariat à l'énergie atomique)	Bull (FR)	2000
Variable Message Signs (VMS)	Digital road signs	UK	The Highway Agency	VMS Ltd. (UK) and COLAS (UK)	2002
Sundhed.dk	Public eHealth Portal	DK	Danish Regions with other Danish authorities and associations	Consortium led by Acure (DK)	2002
Environment-friendly tumble drier	Energy-efficient tumble drier	International/ NL	International Energy Agency/ Netherlands Agency for Energy and the Environment	AEG (DE)	1996
eVA	State-wide public e-procurement system	US	Commonwealth of Virginia	American Management Systems (now CGI)	1999
Sub-compact Fluorescent Lighting	Energy-efficient lighting	US	Dept. of Energy/Pacific Northwest National Laboratory	Various suppliers	1997
High performance computing[38]	Development of high performance computing systems	US	Department of Energy (and NSA, DoD)	IBM, Cray, DEC/HP, SUN, Silicon Graphics	1950s-today
iRobot	Development of Tactical Mobile Robots	US	DARPA	iRobot Corporation (US)	2001
Internet (mini case)[39]	Development of Internet Protocol	US	DARPA	BBN, UCL, Stanford Univ	1973

[38] This case study does not concern a specific project, but rather describes the whole development of the US government procurement efforts which were instrumental in developing the US high performance computing industry.

[39] Despite numerous attempts, the research team did not manage to arrange an interview with any of the key people involved. The case is thus presented as a "mini case" based exclusively on desk research.

Two aspects regarding the cases from Europe deserve a few comments:

First of all, there is quite obviously a geographical bias in the cases represented here, with most cases originating in North-West Europe. A considerable effort has been made to identify cases in Southern and Eastern Europe, but met with little success.

For Eastern Europe (the new Member States), the main explanation probably lies the transition period that these countries have gone through in the recent past (and the economic and political restrictions before that). Thus, it may very well be that in those countries most of the energy and resources have been spent on getting "the basics" in order, both in the years leading up to EU accession and the period since then. Thus, technology procurement is not likely to have been at the top of the agenda for these countries. This is not to say that it does not take place; some potential projects were identified but did not make the list, usually because they did not match the selection criteria.

For Southern Europe, no obvious explanations can be pointed to, other than that there may possibly be less of a tradition for (non-military) public sector-led innovation than in the North, at least until recent years.

Secondly, there are few large, "high-profile" European cases. The Galileo project and the French TGV were considered and even investigated as pilot cases. However, they ended up not being included as case studies for different reasons; apart from the fact that the Galileo project is still not completed and implemented as a public-private partnership rather than a pure procurement, it is exceptional for its size, its complexity and its political sensitivity. The TGV project was considered to be outdated, as it was initiated in the 1960s under conditions very different from those present in Europe today (in particular with respect to public procurement rules). Thus, neither project was included for in-depth analysis, although the Galileo project is referred to in a few instances in the analysis.

4.2.2 Analytical themes

The analysis of the case studies is structured according to a number of analytical themes related to technology procurement.

The selection of themes has taken as a point of departure the specific characteristics of the pre-commercial procurement process which also formed the basis for selection of cases, supplemented with a few overall themes which are seen as generally impacting the outcome of technology procurement.

Table 4.2 Analytical themes

Analytical themes
Degree of innovation
Project complexity
Risk sharing
Sharing of benefits (e.g. IPRs)
Multiple competing suppliers
Bundling of demand
Procurer capability and involvement
SME involvement
Contract set-up and dialogue
Phasing of projects

The analytical themes represent factors that impact the outcome of public technology procurement. In this way the analytical themes should be seen as elements of public technology procurement that need attention in order to support a successful outcome of public technology procurement.

In the following, each of the themes will be analysed on the basis of the evidence from the case studies.

4.3 Degree of innovation

Whereas technology procurement is by definition concerned with innovation, the degree of innovation – incremental, radical or something in-between (cf. section 2.1 in the "Key concepts" chapter) – may differ. Some projects represent an adaptation or modification of existing technology, whereas others represent radical breaks (paradigm shifts). The degree of innovation has an impact on many aspects of technology procurement and, naturally, on the potential to create lead markets etc.

The research conducted for this study has clearly shown that the large majority of public technology procurement in Europe is adaptive, not developmental (cf. chapter 2.1). In other words, the innovation brought about through public technology procurement is typically incremental rather than radical. There are a number of well-known US examples of radical innovations procured by the military (and space) sectors. Most EU public authorities however, seem averse to the perceived risk of procuring radical innovations.

Cases with a **relatively low level of innovation** are for example Oyster Card, Care, Public Safety Radio, DTES, and HF Ballast (all EU cases). These cases represent incremental innovation based on existing proven technologies.

The *CARE* service management system for the municipality of Aalborg was based on previous less advanced citizen care systems. The technological challenges of the system was found more in the system interfaces with other ICT systems than in the system itself.

The *Public Safety Radio Project* was also characterized by incremental innovation. The procurer (the Norwegian public sector/Nødnett Norway) had limited financial means and the Public Safety Radio project was a large project with considerable administrative costs. Hence, in order to avoid re-inventing the wheel and to keep costs down, the procurer looked for similar projects in other countries and tried to reuse as much of this knowledge as possible. In general, the procurer from the Public Safety Radio project believes that it is too costly to start from scratch in a single country. However, had the project taken place in a multi-country context (e.g. at EU level) with the possibility of increased bundling of demand and sharing of costs, it might have been possible to support the development of a more radical innovation.

Other examples are the *Oyster Card and DTES projects*. The smartcard technology used for the Oyster Card already existed but was to be further developed and form part of a comprehensive transport system. Similarly, in the DTES project, the supplier relied on existing solutions which were then integrated in a new way into a new complex system.

Incremental innovation may also, as with radical innovation, require a breakdown of existing technology barriers. The case of the *HF Ballast* is such an example. The product already existed on the market, but the aim of the project was to push the technological barriers, so it was an incremental innovation that improved the standard of the product by increasing the efficiency of the product. The project resulted in a product that created a lead market in Sweden (and, later, in other countries) because of the improved efficiency.

An example of a **slightly higher degree of innovation** can be observed in the *Smoke Detection System case*. The development of the smoke detection system is viewed as a large modification of existing technologies because the system is the first of its kind with train-based smoke detection systems. The supplier had developed a more traditional smoke and fire detection system for public housing

but the requirements for train-mounted technologies are very different from systems built into houses etc. The fact that the project was not within the current core competences of the supplier meant that extensive discussions on system requirements had to be conducted between the supplier and the procurer prior to and during project development.

The *IEA (International Energy Agency) case* also represents a "medium" degree of innovation. The objective was to create more energy-efficient technology for tumble driers, which posed considerable technological challenges. The innovation was based on technology that had already been developed, but had not been brought to the market. Although several potential suppliers competed for development of the technology, only one (AEG) succeeded – however, the innovation eventually ended up not being very successful in commercial terms because the production costs and thus the market price of the appliance was too high.

The *eVA e-procurement system* (US case) procured by the Commonwealth of Virginia, US, is a good example of adaptive technology procurement. When the project was first conceived, none of the e-procurement systems which existed were comprehensive enough, or suitable for the public sector. Furthermore, the Commonwealth wanted an internet-based service – a concept which was still in its infancy at the time (2000), at least when it came to systems as complex as the eVA. Thus, in the words of the procurer, the project was not only at the cutting edge, but at the "bleeding edge" of what was possible at the time, even though the system was built around core components which had already been developed by the supplier. The system is still, 6 years after it was implemented, quite unique in the US.

The *TERA-10 project* (EU case) is an example of a "medium degree" (not quite incremental, not quite radical) innovation. The concept of a super computer was well known before the project but the technical solution developed for the TERA-10 computer moved the boundaries for computer power and computer development. The result was a product that was ten times faster than what had been developed before.

The case studies also provide **examples of radical innovation** where the existing paradigms to a lesser or greater extent have been changed due to the technological output of the project.

The *iRobot case* (US case) is an example of radical innovation, where several companies, including iRobot, were contracted under DARPA's tactical mobile robotics program to develop in competition robots that could walk autonomously through urban environments. All companies came up with the traditional Cartesian (very computationally complex) algorithms. However, iRobot came up with a computationally very simple but revolutionary heuristic algorithm. Winning the procurement eventually led to the development of the iRobot PackBot which in the mean time has been a huge success in both military and civilian applications (e.g. autonomous vacuum cleaners) around the world.

The *Internet Protocol development* (US case) is another example of a radical innovation breakthrough triggered through R&D procurement. The objective behind the initial procurement project was to come up with a solution that would enable the US government to save communication costs of interconnecting different scattered government computer networks across the US. DARPA awarded parallel R&D procurement contracts to three different parties to develop a common "internet work protocol" that could hide the differences between computer network implementations of different government departments. The result was

the development of the TCP/IP protocol stack, which has become the underlying protocol for the Internet worldwide.

At a more comprehensive level, the case of the US High Performance Computing illustrates a long-standing effort by the US government to spur continuing technological progress by demanding ever higher levels of technical performance. Since the 1950s, the US government has regularly awarded high-end computing contracts which resulted in significant technological innovations, followed by mass commercialisation and the creation and further development of world-leading companies such as IBM, CDC, SUN, and many others.

Different degrees of innovation have an impact on the process and outcome of technology procurement. The more innovative an R&D project is, the greater the risk (uncertainty of outcome). When asked about their willingness to undertake high-risk innovation projects, the public authorities interviewed for this study invariably state that since they are accountable to their taxpayers, they cannot afford to take extreme risks. This is particularly true for authorities at sub-national levels, who do not have the budgets to engage in high-risk projects. Thus, they tend to opt for *adaptive* rather than developmental technology procurement to meet their needs for products and services which are not available in the market.

US public authorities are often claimed to be more willing to take risks – and thus be more innovative - than their European counterparts. The case of US high-performance computing is a good illustration of the willingness of public authorities to dedicate massive resources at the national level to find new, innovative solutions to their problems and needs. However, when looking at development projects at lower levels, i.e. not of national strategic importance, the message from US authorities at both state and federal level is often the same as that of European public authorities: that they are less inclined to undertake high-risk, radical innovation projects[40]. If so, it is done through a part of the procurement budget dedicated to R&D (a percentage of the procurement budget which is known up-front to be dedicated to projects which may bring radical instead of incremental improvements, but may carry higher risk).

The willingness to take risks will be further explored below (section 4.13), where the significance of the motivation of public procurers for the character of technology procurement is discussed.

4.4 Project complexity

Innovative procurement projects can also be characterised by their level of complexity. This complexity may be *technical* (often related to the degree of innovation) but can also be, in very broad terms, *organisational*, if a project is characterised by multiple suppliers and/or procurers, or has many different components which individually may not be particularly technically complex, but which taken together constitute a complex project.

The higher the complexity, the larger the need for control and procurer/supplier interaction during project execution (as well as in the pre-contract phase). A

[40] Interviewed authorities include departments with small operational departments (i.e. with relatively small procurement needs/budgets), such as the US Departments of Agriculture, and a number of state and city governments, that mainly stimulate innovation through grants. Exceptions to this include departments with high innovation ambitions as well as large operational (procurement) responsibilities such as the US military and space authorities and the Department of Energy which procure many radical innovation projects.

high level of communication and close collaboration between procurer and supplier give projects with a high degree of technical complexity more flexibility to counter any technical or organisational setbacks arising from this complexity.

Among the cases, projects with rather low technical complexity include VMS, CARE, and HF Ballast. A good example is the development of the CARE citizen care system for the municipality of Aalborg which was neither organisationally nor technologically complex because the software and hardware involved in the development was well tested and already had an operational track record from other projects not related to the public care sector. Another example of a rather low technical complexity is the HF Ballast project. The technology developed in this project was not complex; however, the procurer was faced with the challenge of overcoming the technical barriers for this type of product under development before the actual R&D work could progress. In general, the level of collaboration between procurer and supplier in these cases was not particularly high.

Other cases represent a high level of technical complexity, especially the cases of the Smoke Detection System, DTES, the Public Safety Radio, and the eVA procurement system.

The smoke detection system for the Danish Railways needed to be able to operate under difficult conditions where sensitive software and hardware sensor often experience difficulties. The technological complexity of the project meant that rigorous testing had to be conducted to secure the robustness of the system. The tests consumed a large proportion of the R&D budget and put increased pressure on the communication between supplier and procurer. Because of safety issues the procurer had to monitor and often facilitate all testing which meant that the procurer had to interact with the supplier in all aspects of development and testing. A more traditional arms-length procurement approach was hence not possible.

The Public Safety Radio project is rather technologically complex, with the task of creating a new shared digital radio system for the three Departments for Emergencies (Police, Civil Protection and Health). In addition, the project is also organisationally complex with the need to take into account the different demands of the stakeholders involved.

The eVA e-procurement system was both technically and organisationally complex. The requirements to the system pushed the boundaries of what was technically possible at the time. In terms of organisation, the project was also highly complex. It needed to take into account the requirements of a large number of stakeholders with different needs, and involved hundreds of institutions and agencies, as well as the whole community of suppliers of a very wide range of products (all products and services procured by the various types of state institutions and agencies). Thus, on the procurer side the process involved both a broad group of stakeholders and a full-time core team, representing different capabilities and experiences, which worked closely with the supplier throughout the development process. The core team has stayed in place after the initial implementation and continues its close collaboration with the supplier. Thus, the degree of complexity – both technical and organisational – to a large degree influences the requirements for interaction between procurer and supplier, in particular in terms of communication and contract issues.

The Internet protocol, iRobot and high performance computing cases were technically very challenging. The demanding procurers' requirements to the system pushed the boundaries of what was technically possible at the time. Especially in the high performance computing case a series of progressively more demanding

requirements led to a number of waves of innovation. Those provided the US federal departments with the best computing systems available worldwide, and simultaneously opened up a true global lead market for the industry involved in the developments.

4.5 Risk sharing

When procuring technology, the degree of risk sharing between procurer and supplier is an essential part of the development of the contractual framework. Also the actual development work can be greatly influenced by the chosen risk sharing strategy. The cases show that it is by far the most common in Europe for the procurer to bear the full financial risk of the development project, although there are exceptions, as we shall see below.

Besides the risk of investing in the actual development effort (i.e. the risk that the investment does not yield the expected benefits), there are risks related to the subsequent marketing (commercialisation) of the product or service developed. Although the supplier will often have the main responsibility for this, the procurer may also invest manpower and/or money in the commercialisation phase. Furthermore, all development projects obviously incur technical and operational risks, which may or may not be shared between supplier and procurer.

The financial risk (the investment) related to the development may be shared with the supplier and other types of reward-on-performance risks (e.g. payments conditional on the achievement of certain goals) may be implemented in the procurer-supplier relationship. The uncertainty inherent in R&D and technology procurement calls for well-thought-out risk sharing schemes that try to balance the risks between the two parties and especially tries to balance the two following aspects: on the one hand, the procurement must be financially interesting enough to attract relevant suppliers; on the other hand, the procurer will have an interest in not carrying all financial, technical or operational risks.

The case studies developed for this project show different approaches to risk sharing.

Risk sharing was discussed in the case of the *CARE system* case in the sense that the supplier could directly fund some of the R&D costs themselves. The development was more a customisation of existing technology to the needs of the procurer than an actual product development. The procurer did not have the market insight to assess the after-project commercialisation value of the custom-made system. The after-project sales potential for a customised solution to a specific municipality was viewed up front as rather limited (this later turned out not to be the case). The supplier shared this view and a co-funding approach was abandoned.

Financial risk sharing did not occur in the cases of the *TERA-10* or the *smoke detection system*. In the case of the smoke detection system a financial risk sharing scheme was not viewed as an option. A scheme where the supplier would have to carry some of the R&D costs would make the project unattractive for the supplier. This unattractiveness was primarily found in an unclear business case for the following commercialisation of the product. Because there was no clear market potential for the products the suppliers needed a clear short-term economic incentive to enter the project.

In the development of the Oyster Card the supplier bears the main risk via the Private Finance Initiative model, financing the development phase and operating

the "product" until it is (presumably) paid off at the end of the contract period. The risk borne by the procurer is mainly related to whether they get what they expect. An interesting point to be noted here is that the procurer came to feel that transferring the full risk to the supplier happened at the cost of innovation and, to some extent, dialogue, since the main interest of the supplier was to finish the development of the product as quickly and as efficiently as possible.

The HF Ballast case represents an interesting alternative model for handling risks. The Government shared the risks with the private sector by forming a buyers' group of private companies. If the project were to fail, the financial risk would be shared between the private companies (buyers' group), who in turn would receive a grant from the Government, meaning that if the project was a success the companies would gain a financial benefit. The risk for the supplier was low as the buyers' group guaranteed an order of 26,000 HF Ballasts from the offset and the supplier also received a small grant for the development of the prototype.

Textbox 4.1 Case abstract: HF Ballasts

Procurer: NUTEK, Sweden

Supplier: Helvar, Finland

The project background stems from the Swedish Governments activities in the 1980's where the aims were to phase out nuclear power; reduce energy consumption; and provide safer energy. In early 1991 NUTEK and a group of private and companies formed a *buyers group* and the Swedish Government contributed with funding for experts and administration of the buyers group. This group drafted the performance specifications for the HF Ballast. A Finnish supplier, Helvar, won the contract and developed and delivered the HF Ballasts. The buyers group guaranteed a direct purchase of 26.000 HF electronic ballasts, which would replace the traditional ballast in fluorescent lights.

Learning Points:

- The buyers group functioned to gain and spread knowledge from and to as many important buyers as possible, thereby aiming at assuring a commercial market for Helvar afterwards
- The risk for the supplier was reduced before the contract was signed as the supplier was made aware that a Government campaign would promote the product on the Swedish market. This was a very successful campaign and Helvar increased their supply of ballasts to the Swedish market by more than 10 times the previous amount. The HF Ballast is today the leading product on the Swedish market for energy efficient lighting.
- The project is a good example of how the public sector can procure an innovative product by pushing the technology barriers while at the same time reducing the risks by using bundling of demand to secure economies of scale.

The IEA case (tumble drier) was also based on the concept of a buyers' group, but with considerably less commitment on the part of the buyers. The project was carried out as a competition, where the potential suppliers were to develop the product at their own risk, and where the buyers' group would simply commit to *consider* buying the winning products, and declare these intentions publicly in order to create public interest for the products; however, there was no commitment to actually buy the product.

In the US high performance computing procurements risk-benefit sharing between the government buyer and suppliers is successfully used.

As illustrated above, different risk sharing schemes have been applied to different procurement and grant scheme setups. Among the factors that influence the risk sharing scheme are dimensions like SME involvement, technical complexity,

degree of innovation and the degree of knowledge held by the procurer. Several cases show that the willingness of suppliers to share R&D risks is linked to the willingness of the procurer to share R&D benefits (which is inevitably linked to the business case of the project).

A key factor in the suppliers' willingness to charge procurers less than the total cost of exclusive development is the business case for post-project commercialisation, which in many case studies was not sufficiently explored by the procurer. In a number of the cases studied, the public procurer had only a vague idea of the market potential for the product or service developed. A greater effort on the part of the public procurer to identify the market demands before procuring the development effort might help attract more suppliers interested in sharing the development risks. In relation to SMEs as suppliers the procurer must be aware of the often more vulnerable economic situation of many SMEs, which does not give them the economic manoeuvrability to take (large) risks.

4.6 Sharing of benefits

As already mentioned in the previous section the willingness to take *risks* in development projects is closely related to the business case of the project, i.e. the opportunity to reap *benefits* from the project. One of the key benefits that may result from breakthrough R&D work is **Intellectual Property Rights (IPRs).** Assignment of IPR ownership is therefore an important issue in technology procurement. One of the new "innovation stimulating" features of the 2004 Public Procurement Directives is to allow procurers to negotiate contractual arrangements with suppliers e.g. for sharing or transfer of IPRs.

In the case projects, very different IRP strategies have been observed:

- In some cases, the IPRs are owned by the **supplier** (CARE, HF Ballast, eVA). In the fuel cell buses project (HyFLEET: CUTE), the supplier retains the IPR, but there are legal obligations in the contract to secure knowledge transfer to the procurer.

- The most common arrangement is for the IPR rights to remain with the **procurer**, usually with agreements in place for the supplier(s) to exploit the IPRs in other projects for a (modest) fee: DTES, the Norwegian Public Radio Safety System, the Smoke Detection System, the TERA-10 Supercomputer and the VMS.

- Finally, there are IPR **sharing** strategies. In such procurement projects, the IPR rights are not owned only by the supplier or only by the procurer. There is a contractual agreement that specifies which IPR rights can be exercised by the procurer and which by the supplier over time. A clear-cut example of this is the *Oyster Card*, where the IPR is owned jointly by the supplier and procurer during the contract period, but handed over to the procurer at the end of the contract (total contract length 17 years, including a 13-year implementation period). The supplier does not have any current plans to utilize the IPR in other projects (the procurer does have plans, but these are confidential at the moment).

The Intel high end computing case is another interesting example where the sharing of IPR rights between procurer (in this case, a private procurer) and supplier was coupled to an evaluation of the market value of the IPRs that resulted in a price reduction for the procurer. This is described in the text box below.

Textbox 4.2 Case abstract: High end computing - Intel

Procurer: NCC, Japan

Supplier: Intel, USA

In 1969, Intel financed the development of the world's first single chip microprocessor with a $60,000 contract from the Nippon Calculating Corporation. NCC's demanding technical requirements for electronic calculator chips helped Intel's engineers come up with the revolutionary design for the Intel 4004, the first programmable chip on the market for use in a variety of products.

Intel offered NCC a lower price for the chips in return for securing intellectual property rights to the microprocessor design and the rights to market it for non-calculator applications. Intel's business today is largely based on this product's successors. The first processor on a chip was the beginning of a revolution in personal computing, ultimately impacting practically every electronic device made. The decision to abandon the memory business and focus all its energy on its booming microprocessor business propelled Intel into becoming the largest semiconductor manufacturer in the world.

Learning Points:

- The case is an example of a successful IPR risk-benefit sharing deal in R&D procurement.
- The cost reduction in return for IPR rights reduced the risk for the procurer to a level acceptable to undertake the procurement.
- The rights to exploit the design also in other markets gave Intel access to a new booming lead market

In the case of the health portal Sundhed.dk, the IPRs are formally owned by the supplier; however, the royalties for using the IPR in other projects are rather high: 30% of the contract sum if the content being commercialised is developed by the supplier and an additional 15% if the content is developed or co-developed by the procurer. Thus, in theory, there is a considerable *sharing* of IPR benefits, although the application of this IPR scheme is still to be tested in practice.

The VMS case is a good example of the procurer owning the IPR but sharing it with others. There is a clause in the contract allowing the two suppliers to apply for commercial exploitation of the IPR, paying only a symbolic fee for the use of the rights. The procurer (responsible for highways in England) has shared the IPR freely with other UK Government agencies, resulting in the system being "copied" in the other UK countries (Scotland, Wales, and N. Ireland). Of the two suppliers, one was not concerned that the IPR was in the public domain since the development costs were covered by the procurer, whereas the other supplier expressed some concern that a lot of technical knowledge is made available to competitors (both because two suppliers were involved and through the free sharing of IPRs with other Government agencies).

A similar arrangement is found in the DTES case. Here, the supplier and procurer are currently promoting the product developed in the project separately, but are also talking about a joint effort in order to promote the product in a better way.

Textbox 4.3 Case abstract: Digital Transport Enforcement System (DTES)

Procurer: Transport for London (TfL), England

Supplier: SEA, England

Commissioned by TfL, the DTES will replace the labour-intensive analogue video cameras and CCTV system. The aim is to reduce the cost of collecting, processing and storing evidence while improving the quality and reliability of future operations. The supplier, SEA, developed a system part of which has been fitted into a Smartcard and is now operating in London to capture evidence of illegal parking on red bus routes. The key difference between the old analogue system and DTES is that the new system will only store images of offences and thereby reduce the burden on storage and the time it takes to find the right piece of evidence.

Learning Points:

- In terms of a risk handling strategy, TfL held two risk workshops, one internally with a risk advisor, and one with the supplier and an external risk advisor in order to allocate responsibility for possible risks that might occur in the project. This does not minimise risks directly in financial terms, but it will ease the process if any of the identified problems should occur.
- Although it was important for TfL to get as many suppliers interested in the project as possible, in order for them to be able to benchmark the suppliers against each other in terms of technological abilities and price, the number of competent suppliers in this specialised field is very limited, as commercialisation opportunities will be limited. The lack of competent suppliers in specialised fields can be seen as a barrier to the PCP multi-supplier model.
- The procurer kept the IPRs, which is standard procedure for TfL. Being a two-stage project; TfL decided to keep the IPRs in order to have the possibility of engaging another company for the second phase. Suppliers may commercialise the product developed against a license fee to the procurer.

In the smoke detection case the procurer had all ownership rights to both technology and documentation, and in case of a post-project commercialisation of the technology the supplier agreed to pay royalties to the procurer, based on volume of sales. This scheme was proposed by the procurer in the draft contract and was not contested by the supplier. The procurer saw ownership of IPR as a reasonable compensation for taking on the financial risk of the project. The IPR scheme selected made it clear that the procurer anticipated some kind of post-project commercialisation. However, since the post-project business case was unclear, the supplier agreed to these terms. Otherwise a financial risk sharing scheme might have been applied. In addition, the supplier saw a better business case in maintenance of the existing smoke detection systems than in the sales of new systems to other clients.

In the Public Safety Radio project, the procurer owned the technical components which were needed to implement the network while the supplier had the responsibility for the quality of the network. The procurer had the full IPR and can in principle give it to other suppliers. However, since the project is very large and high-profile, the marketing value of having participated in the project was in itself an incentive for the suppliers.

In the case of the CARE system, IPR sharing was not discussed because the procurer did not think they would be able to attract any relevant suppliers if an IPR sharing scheme was part of the project. In addition, the supplier found no

reason to share the IPRs with a public procurer (a municipality) that had no competences or capabilities to support and exploit any IPR rights. The procurer argued that shared or split IPR rights would mean that the municipality would have to spend resources developing IPR management capabilities. This function was not seen as a task for a municipality that should focus on servicing the public. In addition, building up such capabilities would require high-skilled and expensive human resources - an investment that would be speculative and might not be recouped.

The supplier of HF Ballast kept the IPR for the product they developed, and subsequently had considerable success with commercialisation of the product. Similarly to the CARE case, the procurer (NUTEK) was not interested in the IPR; as a general policy, NUTEK always leaves the IPR with the supplier.

The Commonwealth of Virginia did not want to own the IPR for the eVA e-procurement system. The intellectual property rights emanating from the project stayed with the supplier, including the rights stemming from the contribution of the Commonwealth to the common development process. This was a deliberate strategy on the part of the procurer in order to make the product more marketable and thus contributing at a more general level to the development of e-procurement. It was also a natural choice for two reasons: firstly, the system integrated existing software components, the rights to which were owned by different subcontractors and, secondly, the Commonwealth did not wish to own and operate the system themselves; from the beginning, they wanted only to buy the *service*, with the new system hosted and operated by the supplier.

As mentioned above, in the case of the fuel cell buses, the IPR also stayed with the supplier, but knowledge transfer from the supplier to the procurer has been secured through legal obligations in the contract. These obligations have ensured that the procurer now has sufficient knowledge to further develop the fuel cell buses.

A general principle that could be applied to the considerations regarding who gets the IPR could be that the rights belong to the party that generated the idea/intellectual property. In most cases, this would be the supplier; however, it may also be that the procurer during the development process comes up with an idea which is patentable.

There are a number of factors to take into consideration, and many of these points in the direction of leaving IPRs with the supplier.

From the perspective of the procurer, the decisive factors are their needs and their capabilities. The basic needs that most procurers of R&D services have are (1) the right to apply the newly developed knowledge for use within the public authority without having to pay licenses on IPR protected parts, and (2) the right to license the new knowledge developed and protected to other suppliers to ensure a competitive supply for their needs at all times. To achieve these two objectives procurers do not need to own the IPR rights themselves: procurers can also obtain the right to license out IPRs generated by suppliers in R&D procurements to other suppliers without owning the IPRs, by stipulating in the R&D procurement contract that procurers have *non-exclusive* rights to the IPRs generated in the development contract.

Especially the CARE system, where the supplier kept the IPR, illustrates that procurers with limited size, limited financial backing and limited internal R&D operations are often in a weak position to exploit and protect IPRs and may be better served by leaving the IPRs with the supplier and getting a favourable

license – or licence-free use - agreement. The possibility of procurers to exploit IPR ownership and the attractiveness of such ownership compared to a favourable license agreement with the supplier very much depend on the organisational set-up; the size and capabilities of the procuring institution are decisive for how the IPR issue is handled most effectively.

However, as the cases also show, many procurers keep the IPRs and handle them fairly well, entering into license agreements with the suppliers and/or sharing the IPR with other public authorities/organisations. It is difficult to generalise about the type of procurer able to do this; but it can be seen that the IPR-owning procurers in the cases analysed here are large, professional public institutions and public-owned companies with a certain specialisation; whereas a relatively small municipality seemed to find the ownership and management of IPR rights incompatible with their core activities, as discussed above in connection with the CARE case.

From the point of view of suppliers, and the desire to promote innovation, several other considerations speak in favour of the supplier holding the IPRs, as put forward in a Commission report[41]:

"By forcing the purchasing body to take on intellectual property ownership even when (as is most often the case) the need of the buyer is as end-user only, the government is forcing the end-user to pay the price of exclusive development. The cost to the supplier is of not even being able to re-assign people involved in the contracts to related projects because of the risk of inadvertently breaking intellectual property rights. The disadvantage of this approach is that the supplier is no longer (legally) allowed to re-use the developed products/services to other (potential) customers. This traditional viewpoint is not compliant with the needs of an innovative Europe. Suppliers should be able to broaden their commercial possibilities within the EU, without being hindered by a historic viewpoint. Thus expensive customisation can be kept at a minimum or provided at reasonable cost if the supplier can consider it to be an investment in intellectual property, which could be re-applied later as a building block for other projects. While there are occasions where IPR ownership by the purchaser can be necessary, closer analysis will likely reveal that this should be the exception rather than the rule."

4.7 Multiple competing suppliers

Having multiple suppliers developing a technology in parallel is a strategy that has been pioneered by the US military and later also applied in other government agencies, such as the Department Of Energy (e.g. in the high end computing case). The reasons for applying this strategy include security of supply, prevention of monopolies, and fostering better value for money (high quality products at lower price) and creativity through competition.

This tactic has been applied very successfully. E.g. in the US high-performance, computing procurement case.

[41] Wilkinson (2005): Public Procurement for Research and Innovation, European Commission, DG Research

Textbox 4.4. The benefits of competition in procurement

Government analysis before starting the **high-end computing procurements** showed that committing to only one firm would increase the risk of giving a single vendor the possibility to exercise market power and set a price above marginal cost. Therefore a competition instead of a sole sourcing approach was chosen, based on experiences from the military. Analysis of competitive US defence R&D procurements[42,43] shows that the threat of losing business to a competitor is an effective performance inducement that results in increased innovation, performance and quality improvements, net cost savings and steeper learning curves for all competing suppliers.

Competition has the distinctive effect of improving value for money[43]: during the R&D phase it leads to lower cost designs, evidenced by a lower first-unit cost; during the later production time, it lowers the final cost-per-unit, especially for large production runs. Analysis of more than 60 years of defence procurement cases[42,43] show average unit cost savings of 20 to 30 percent when competitive sourcing is used in the R&D phase (when multiple suppliers develop in competition in the R&D phase) compared to single sourcing cases. When competition is maintained during the production phase an additional net saving of 12-50 percent is observed compared to single sourcing (substantially larger cost reductions for larger volume orders). These are real cost savings, from which the costs for establishing a competitive framework have been deducted. As the latter are non-recurring costs, the competition approach is found to be particularly effective for large volume production projects, whereas single sourcing may be a more effective approach for selected "few of a kind" systems[43].

Another example of multiple suppliers from a well-known US technology development project is the development of the TCP/IP (internet protocol) in the early 1970s[44], which is presented in the text box below.

Textbox 4.5. Mini case: The Internet Protocol (IP)

The development of the internet protocol suite goes back to the US in the early 1970s where DARPA, the Defense Advanced Research Projects Agency, built the pioneering ARPANET, which was the first packet-based network in the world as well as the foundation for today's Internet. ARPANET was the first of a number of data transmission control protocol technologies (TCP). An array of different actors have contributed to the development of the Internet protocol, which was driven by a public sector need, namely the ambition of enabling government computer networks across the US and obtaining costs savings.

The initial development of the ARPANET was led by the *Network Measurement Center* at DARPA, which consisted of a group of UCLA graduates, among those Vinton Cerf, the developer of the existing ARPANET Network Control Program and Robert E. Kahn

[42] For a historic overview of the benefits of competitive sourcing across a series of US acquisitions: 'Competitive Dual Sourcing', Jacques Gansler, former US Under Secretary of Defence for Acquisition, Technology, and Logistics, Professor at the Centre for Public Policy and Private Enterprise, University of Maryland, 7/10/2007

[43] For more detailed economic analysis of cost savings of introducing competition during development and maintaining it during production in US defence procurements, see Annex G of 'International Armaments Cooperation in a era of coalition security', report of the Defence Science Board, August 1996.

[44] A limited amount of information on the multi-supplier aspect of the development of the internet protocol is available from desk research, but it has not been possible to reach any of the people involved for interviews.

from BBN Technologies who together worked on an open-architecture interconnection model[45]. Their collaboration resulted in a reformulation of the existing protocols where the differences between network protocols were hidden by using a common internet work protocol.

In 1973, DARPA awarded *parallel procurement contracts* to three different research groups; BBN Technologies, Stanford University, and University College London, who were contracted to develop operational versions of the protocol on different hardware platforms. These organizations were supposed to come up with solutions enabling to save costs of interconnecting different scattered government computer networks across the US.

Subsequently, 4 versions were developed; TCP v.1, TCP v. 2, TCP v.3/IP v.3 and TCP/IP v.4, which is still the standard protocol in use on the Internet today. Later, in 1982, DARPA awarded a procurement contract to implement TCP/IP on the ARPANET. . In 1983 a full switchover to TCP/IP on the ARPANET took place and in the same year the US DoD made the TCP/IP standard for all military computer networking.

Based on its advanced networking expertise BBN booked another few notable successes in the field of computer networks: the first person-to-person network email sent and the use of the @ sign in an email address; the first Internet protocol router (then called an Interface Message Processor); the Voice Funnel, an early predecessor of voice over IP.

In recent years the US has triggered a large exercise to rethink the Internet architecture. Today, work is ongoing to develop the next generation Internet. 35 years after developing the first Internet protocol, BBN Technologies is again one of the leading companies in the race to develop the future Internet architecture.

Another example is the **iRobot** case, where several companies, including iRobot, were contracted under DARPA's tactical mobile robotics program to develop in competition robots that could walk autonomously through urban environments. iRobot won the procurement contract, which eventually led to the development of the iRobot PackBot, Tactical Mobile Robots which have been delivered to a broad range of military and civilian customers around the world (and were followed up by more civilian products based on this technology in the years after).

The use of multiple suppliers is a key feature of the pre-commercial procurement approach, and was consequently one of the aspects that the research team was looking for in potential cases. However, very few projects applying this approach have been identified in Europe. A number of barriers are at play: (1) limited numbers of suppliers in many sectors; (2) suppliers nervous that their business secrets will be revealed to competitors; and the (3) initial higher costs (and/or smaller funding per supplier) associated with having multiple suppliers developing in competition in parallel, in particular when the projects are not very large (cf. above).

Analysis from US cases shows however that, with regards to the third barrier, the initial higher cost of hiring more than one supplier can be recuperated when the competition between firms results in higher value for money products, as described above in textbox 4.4 on the benefits of competition in procurement.

Applying risk-benefit sharing (giving suppliers IPRs rights in return for cost reduction for the procurer) in combination with competition also helps alleviate the second barrier.

[45] Cerf and Kahn are often highlighted as the inventors of the Internet and in 2005 they were awarded the Presidential Medal of Freedom for their contribution to American Culture.

The *first* barrier – the limited number of suppliers - remains difficult. The more specialised the field, the more limited the number of suppliers will usually be. In several of the case projects it was extremely difficult to find suppliers within the EU. Only one supplier (a consortium, with most of the R&D carried out by non-European companies) submitted a satisfactory proposal for the Oyster card project. Given the size and the importance of the project, this left the procurer in a position where they needed to assess whether the consortium's proposal represented value for money. The procurer undertook a cost comparator exercise, benchmarking the proposal from the consortium against the cost of developing a similar product themselves. In order to do this the procurer had to buy expertise from the private sector in order to challenge the proposal.

There are examples of procurers having to spend a lot of time spreading the news about their project to potential suppliers (DTES, VMS). Especially if the innovation required is not at the core of the suppliers' business, the need for information to the suppliers is high. In the DTES case, this process lasted for two months.

There are UK and NL R&D procurement experiences with multiple suppliers developing in competition[46] but those were too recent to provide detailed analysis. The only European case example studied in detail with multiple suppliers doing R&D in parallel is the VMS project, where two suppliers were selected to develop a prototype and subsequently had to sign another contract for the supply and maintenance of the finished products. Both suppliers were awarded a contract for both the development and supply phases, which could be done because both products fulfilled the output specifications. In this respect, it should be noted that the procurer financed the development phase. The risk for the suppliers of taking part in a project with more than one supplier was thus small. However, as pointed out by one of the suppliers, being part of a project with more suppliers working in parallel with publicly owned IPRs (cf. the section on IPR, above) may mean that a lot of the company's technical knowledge is made available to competitors. Risk-benefit (IPR) sharing as in pre-commercial procurement could have alleviated this issue, but was not considered at the time.

Textbox 4.6 Case abstract: Variable Message Signs (VMS)

Procurer: The Highway Agency, UK

Supplier: VMS Ltd., UK, and COLAS, UK

The message signs on roads in England were out-dated towards the end of the 1990's and the increased usage of cars meant that the Highway Agency decided to make changes in order to minimise congestion. The Variable Message Signs (VMS) project was commissioned and funded by the Highway Agency (HA) in 2002. The aim of the project was to communicate information and advice to drivers about emergencies, incidents and network management, aimed at improving safety and minimising the impact of congestion. The production cost for the development of the prototype was covered by the Highway Agency, including the test phase. Two suppliers, VMS Ltd. and COLAS were awarded a contract to develop the variable message signs.

Learning Points:

- The project had two suppliers all the way through the process from developing the prototype to the supply and maintenance of the finished product. This was done to spread the risk, but the development phase was funded 100% by the Highway Agency. Both companies are market leaders within the variable message signs field. One of the suppliers did not see it as a problem that more than one supplier were involved in the prototype phase, mainly because the costs were covered by the procurer. However, the other supplier mentioned that when the IPRs are in the public domain when more than one supplier is involved a lot of technical knowledge is passed on to the competitors.

[46] For more info, see Annex II

- The availability of traffic messaging sign suppliers interested in developing for the UK Highway Agency is rather limited and one of the main reasons is that there is a difference in the specifications in each country, so the price of using a company unfamiliar with the UK system would be expensive compared to a local supplier. The Highway Agency is currently working with agencies in other countries in order to try and use the same specification for very similar systems.
- The Highway Agency highlighted that involving experts and industry in the early stages of the project provided them with the tools to asses the suppliers.

The eHealth portal project Sundhed.dk employed a different strategy to try to foster competition in the development activities. The procurer selected a consortium of suppliers which had overlapping competencies in the anticipation that these overlaps would promote competition between the different firms in the consortium and thus give more options to the procurer. However, in practice, this did not work out as intended. Despite the efforts of the procurer, the development work within the consortium tended to apply proprietary standards based on individual firm capabilities. This made it more difficult for the procurer to play off the individual consortium members against each other in the bid for development of the best elements of the portal.

Finally, there is an alternative model for involving multiple suppliers, namely the project competition applied by the IEA in the case of the energy-efficient tumble drier, where the suppliers take on the full development risk in the hope of winning the award which carries with it both a (limited) financial compensation as well as access to a buyers' group with some degree of commitment to buy the winning product(s). A similar approach has been employed by the US Department of Energy for promoting the commercialisation of a number of energy-efficient products. After refining their approach through several projects, the DOE (through the Pacific Northwest National Laboratory) abandoned the award/prize competition approach and opted for working with all interested suppliers in the case of the Sub-Compact Fluorescent Lamp. This caused several suppliers to successfully introduce new, cheaper and more efficient products to the consumer market. The result was a drastic reduction in price and increase in quality which completely changed the market situation, shifting consumer demand away from the older products.

As the US cases and the UK VMS case show, it is possible to have multiple suppliers develop technologies in parallel. There are several advantages, particularly increased innovation capacity and cost savings. However, there are also a number of barriers. One is the above-mentioned concern - in the case of VMS - of competing suppliers regarding the risk of disclosure of company-specific knowledge to competitors when IPRs are kept with the procurer. Furthermore, a limited number of qualified and interested suppliers – perhaps just one - to choose may limit the creative innovation potential and is, as we shall see later, particularly critical in relation to the pre-commercial procurement process.

4.8 Procurer capability and involvement

The more capable and knowledgeable the procurer, the better equipped he is to plan the project, choose the right supplier(s) and deal with problems or changes that may arise during the execution of the development project, or even participate in the actual development work. Several of the case projects had a very active and capable procurer which contributed to the project's success, while other projects experienced difficulties stemming from the fact that the procurer

was not knowledgeable enough and therefore not involved enough in the development phase.

The best examples of the procurer taking a very active role through organisational commitment and through challenging suppliers technologically are the US cases analysed. In the high performance computing case the Department of Energy's continuing demand for improved computing performance drove innovation forward in the sector. Beyond setting generic milestones for increased computing speed, the DoE identified concrete software and hardware problems in the most advanced computing systems available on the market and challenged companies to address them in the next round of R&D procurement. The Internet Protocol development and iRobot cases are also examples of public procurers setting the requirements for procurement contracts far beyond what was technologically feasible at that time.

The eVA e-procurement case is an example of strong organisational commitment from the procurer's side. A permanent project office was set up with a core team including the director of procurement, the director of information systems and the agency controller. The core team was to work together for the whole lifecycle of the project and is still in function, overseeing the implementation and further development of the system. Both the procurer and the supplier state that the co-operation went extremely well, not least due to the fact that the procurer and supplier had "mirror project teams" matching each other throughout the process. Another key success factor was that there was strong political backing for the project combined with a willingness to delegate decision-making to the core team. The result was an effective development process and an extremely successful system which has now run for 7 years with very good results.

Interesting lessons can be learnt from the European cases as well. In the case of HF Ballast, NUTEK had good in-house knowledge about the product and was thus able to form a buyers group (the subsequent procurer) and to be involved in the research and development phases. Here, the procurer could moreover benefit further from sharing ideas and knowledge with the numerous companies in the buyers group.

In the Digital Transport Enforcement System (DTES) case, the procurer Transport for London (TfL) has a large R&D department, but in this case they still needed to arrange several workshops in order to gain sufficient knowledge about the product. Thus, this project is an example of a procurer realising the complexity of the project, and taking the necessary steps to obtain the knowledge needed to be a good partner to the supplier. Several people from the procurer were involved in the development of the product, mainly securing the quality and making sure that the supplier understood the specifications.

In the Public Safety Radio case the procurer used bundling of demand to pull together the resources and the ability to understand the technical and financial possibilities for a public safety network as well as the supplier. The procurer did this in order to be able to match the supplier in all aspects and thereby be better equipped to keep costs down. In addition, this strategy also implied that the procurement process was carried out in a very professional way and that the potential suppliers felt that they had an equal and professional partner throughout the process.

While the cases above were examples of projects where the procurer had sufficient capacities and willingness to be thoroughly involved in the project, the following cases illustrate what insufficient procurer involvement *can* do to a complex project.

Lessons have been learned in the TERA-10 project from the predecessor TERA-1 (cf. above). In the case of TERA-10, the procurer CEA (the French Nuclear Energy Commission) had experienced problems in a previous project (TERA-1) because they were not equipped to properly assess the feasibility of the work plan of the selected supplier. This resulted in the project becoming seriously delayed. When TERA-10 was conceived, CEA still did not have the technical ability to fully understand the technical needs for the project, but relied instead on extremely detailed functional specifications, with a list of 258 questions regarding the functionality of TERA-10. The choice of supplier was based on their ability to comply with these output-based specifications. These questions may have hampered innovation in the TERA-10 project to some extent, as well as preventing the procurer from finding the best supplier to the project, as there is no guarantee that the questions asked by a supplier not fully knowledgeable of the project are the right questions.

Textbox 4.5 TERA-10 Super Computer

Procurer: CEA (Commissariat à l'énergie atomique), France

Supplier: Bull, France

The TERA-10 is a supercomputer developed for computer simulation of nuclear testing. In 1996, the French President decided to stop nuclear testing and the French Nuclear Energy Commission known as CEA was asked to set up a computer-based program that would guarantee the safety and reliability of deterrent weapons. The program, funded by the French Ministry of Defence, will run for 15 years, until 2010. The simulation program fulfils two essential requirements, a) it can replace current weapon systems when they come to the end of their life, b) it will maintain the advanced scientific capability in order to guarantee the reliability and safety of current systems and future systems.

Learning Points:

- The tender specifications contained a list of 258 questions regarding the functions of the TERA-10. CEA did not have the technical ability to set out the technical specifications as the product was not yet developed, so the majority of the specifications were functional. The choice of suppliers was based on their ability to answer the output-based specifications. The TERA-10 project showed the importance of understanding the technology in the project, in order for the procurer to be able to assess the suppliers' proposals before the contract is signed.

The Oyster card project presents an example where lack of procurer preparation delayed the selection and evaluation of proposals. In the Oyster card project the procurer (Transport for London) had not conducted comprehensive pre-studies and therefore spent much time on evaluating the proposals from the suppliers. The Oyster card project was a Private Financing Initiative (PFI) project, which means that the supplier will have to finance the whole project. The procurer sent the tender to individual companies, but none of the suppliers could finance the project individually, so the procurer had to ask the companies to form consortia and submit a new proposal. It is likely that if the procurer had spent more time on assessing the scope in the early stages of the project, they would have realised that the financial requirements were too high for a single supplier.

The last case represents a project where the procurer was not very involved in the development phase, but where a strong supplier steered the project. In the fuel cell buses project, although the procurer was a large entity (nine cities together) it was not very involved in the development of the buses. Later on, the German procurer hySOLUTIONS was more involved, but the main development of the buses had already taken place. Thus, the involvement of hySOLUTIONS is

mainly to ensure that the buses support the strategy of achieving a cleaner environment in the city of Hamburg as well as to support the technical development in the area through integrating the energy and the transport clusters present in the vicinity of Hamburg. This is done by combining the forces of two suppliers, Vattenfall (energy) and EvoBus (transport).

Textbox 4.6 Clean Urban Transport for Europe (CUTE) Fuel Cell Busses

Procurer: hySOLUTIONS, primarily founded by Hamburger Hochbahn AG, Germany

Supplier: EvoBus, subsidiary of DaimlerChrysler, and Vattenfall, both Germany

CUTE was initially a European Union project initiative to introduce zero-emission fuel cell busses in nine cities in Europe (Amsterdam, Barcelona, Hamburg, London, Luxembourg, Madrid, Porto, Stockholm and Stuttgart). The aim of the project was to demonstrate the feasibility of an innovative, highly energy-efficient, clean urban public transport system which should ultimately contribute to the reduction of overall CO2 emissions and elimination of NOx, SO2 and particulate emissions to improve health and living conditions in urban areas. The outcome of the project was also expected to be an improved public acceptance of the H2 fuel cell transport system, a more secure energy supply for the EU and the realistic application of renewable energy sources. After the testing of the fuel cell buses in Hamburg, the Municipality of Hamburg was so pleased with the results that they decided to do a follow-up project. The goal for the city of Hamburg is - in addition to get a cleaner environment - to support the general technology development in the area through a cluster strategy.

Learning Points:

- The fuel cell bus project is a good example of bundling of demand, as nine cities have joined forces in order to participate in the development of the fuel cell buses and thereby created a larger market for commercialisation afterwards. However, industry has so far not been sufficiently impressed with the development possibilities of the project. The remedy taken in this case was to develop very specific business cases. In order to do this, it is however essential for the procurer to be very knowledgeable about industry trends, and in this connection, the CUTE network can prove to be beneficial.

In sum, a certain level of procurer capability and involvement appears to be an advantage – or even necessary - for complex projects as this helps the procurer to be better prepared to choose the right suppliers for the project and to foresee and rectify any shortcomings or pitfalls in the process. In addition, good preparation enables the procurer to be a more professional and equal sparring partner for the supplier, as could be seen from the case of Public Safety Radio and, in particular, the eVA e-procurement system.

Procurer size and capability is not always proportional with the level of procurer involvement. In the predecessor project to the case of TERA-10 the procurer was the French Nuclear Energy Commission, which was still not properly equipped to assess the feasibility of the work plan of the selected supplier. Here, the procurer's limited technical capabilities resulted in a delayed process and an outcome that could have been better had the procurer known more about the technical specifications from the beginning.

On the other hand, having a strong supplier on the technical side can free resources for the procurer to focus on other, more strategic issues for the project, as can be seen from the Fuel Cell Buses project where the procurer helped in further developing the cluster strategy of Hamburg through the project. However, this requires a high degree of trust between the procurer and the supplier.

Making the right decisions to conduct the procurement process requires technological, economic and legal competences. A solution may be for the procurer to make use of external experts in the preparation phase of the procurement as well as during the selection/evaluation phases. For example, involving external investors (e.g. banks, venture capitalists) as economic experts in the evaluation panel helps the procurer to get a better insight into the project business case; in addition it can help companies involved in the procurement (in particular SMEs) to attract additional resources to finance further company growth. Involving expertise on technological state-of-the art (e.g. colleagues from government R&D and innovation agencies) can help the procurer get a better insight into the technological maturity of upcoming promising technologies; in return it can help R&D and innovation agencies collect early customer feedback on projects they are financing through grant programmes etc to develop further technologies that are still in the early research phases.

4.9 SME involvement

The rationale for special attention to SME participation in technology procurement is clear; first and foremost, this is an opportunity for SMEs with potential to grow large(r) but, secondly, many SMEs are innovative, flexible and creative in a way that can be difficult to sustain in a large organization. Thus, in many cases, SMEs may be able to provide unique solutions to procurers.

However, the barriers to SME involvement in public procurements are often seen as high; if for nothing else, and then the basic limitations in financial capacity and human resources often put SMEs in a poor position to participate as major players in large projects.

Still, it turned out that there are quite a few examples of SME involvement among the cases selected for this study, both in the European and US cases studied.

The supplier in the Swedish HF Ballast case was the Finnish (then) SME Helvar, which has subsequently grown rapidly. The supplier in the UK Digital Transport Enforcement System project was an SME, as was one of the two suppliers in the Variable Message Sign project. Finally, the supplier of the Danish CARE citizen care system is an SME[47].

In the Public Safety Network project, involving SMEs was not a priority for the procurer. The main reason for this was twofold. First of all, the project was considered too large and complex for SMEs to handle. Secondly, the supplier had to operate the new safety network, and the project had very high safety and technology demands which combined made it very difficult for SMEs to bid, as they would not possess all the expertise needed in this project. SMEs did, however, participate as "junior partners" in bidding consortia and as subcontractors for smaller parts of the project.

The same goes for the HyFLEET:CUTE project with the zero-emission fuel cell buses. SMEs are not widely used because contracts are mostly too large and too long for SMEs to handle them. Often they do not have the capacity, or they assess that the risk involved is too large for them to cope with.

The **European cases** that involved SMEs in a key role are all relatively small, most of them are not too complex and they require specialized, in-depth knowledge rather than a broad range of skills.

[47] The supplier is in fact 100% owned by a large corporation but operates as an independent company.

The **US cases** also involved SMEs in larger, high-prestige projects.

The iRobot case and the Internet case are examples of R&D procurements where small companies played the lead role in transforming great ideas into successful products. The high-end computing case is an example of a long-standing effort by the US government to spur successive waves of technological progress that has given a significant number of small emerging companies the chance to grow to world-leading companies. It is to a large extent the conscious choice of the government agencies involved to keep a strongly competitive supplier base that has given a wide range of companies the chance to grow. In the 1950 and 1960s the supercomputing procurements lead mainly to the successful growth of IBM and Cray. In the 1970s extensive efforts were undertaken to attract new small promising companies to participate in the R&D procurements in competition with the larger IBM and Cray, which lead to the fast growth of SUN, DEC/HP, Silicon Graphics and many others. Those supercomputing procurements have offered big opportunities to small companies; mainly because it was not company size but innovativeness and value proposition that were the determining selection factors. It is estimated for instance that sales to US public institutions accounted for 80 percent of SUN Microsystems revenues in its first years of business.

Such cases demonstrate that there are opportunities for SMEs in public procurement that go beyond subcontracting well-defined, small, not too complex tasks for larger firms. In the right environment, when supporting conditions for growth such as venture capital are available, SMEs can compete in R&D procurements against large firms, even to the extent that they can influence the larger firms to change their price/quality offer considerably.

Thus, these cases demonstrate that the barriers for SME participation in technology procurement projects can be overcome in several ways:

1. If the **scope and scale** of the project is right, SMEs can take on the role as single or main supplier. As regards scale this means, obviously, that the project should not be too large. Although there are exceptions, few SMEs can handle projects with a value of more than a few million euros. The scope is also important. The smaller pool of human resources available in SMEs means that they cannot usually supply a huge range of capabilities required for very complex projects; rather, most SMEs are specialists within a relatively narrow area and function best in that capacity (more complex projects can, of course, be undertaken by consortia with SME participation). A distinction should also be made between the R&D phase and the commercial development phase. Since the R&D phase is normally characterized by smaller contract values and smaller volumes (e.g. 1 prototype, 1 test series) to be delivered, SMEs do not face the same size-related difficulties to bid and participate in R&D procurements as in development projects that target the deployment of commercial end-products (e.g. large-scale integration projects). A consequence is also that bundling of demand in the R&D/PCP phase is not disadvantageous for SMEs, unlike if bundling of demand is applied immediately in a development contract involving the delivery of commercial volumes of end-products.

2. **Reducing the risks** and uncertainties related to the project will heighten the incentive for SMEs (and, obviously, larger companies as well) to participate. A simple way of reducing the risk is of course for the public partner to foot a large part, or all, of the bill for the development costs, which is how it has been done in most of the project cases which we discuss in this chapter. Should the project turn out not to live up to

commercial expectations afterwards, the risk for the participating companies is limited mainly to the alternative-use cost (opportunity cost) of not applying their resources to other, potentially more profitable, activities. However, there are alternatives to the public procurer simply covering all of the development costs; the risk for the participating enterprises can also be reduced through the development of a well-researched and realistic business case for the products or services to be developed, which also opens up the opportunity to apply risk-benefit sharing between procurers and suppliers, thus reducing the uncertainties inherent in any development project.

3. Finally, even **larger projects** can include SMEs in more than simple subcontractor roles, if the project is organized in such a way that there is a defined role/task of a suitable size and complexity to allow it to be handled by a smaller company, either as part of a larger consortium of suppliers, or holding a single contract directly with the procurer.

   In this context the pre-commercial procurement approach can be particularly interesting for SMEs to participate in;

   (1) One of the reasons why SMEs experience difficulties today in obtaining access to the public procurement market in Europe is the fact that there is almost no R&D procured in Europe. More than 99% of European procurement tenders are commercial procurements which require large volumes of products to be delivered – i.e. contracts for large amounts of money, requiring large financial commitment and proof of financial stability from suppliers.

   If there were more R&D procurements *separate from/before launching big contracts* for final service deployment, procurers would be able to leave out the heavy selection criteria related to financial stability of bidding firms as in commercial procurements. Such R&D procurements could enable SMEs to become "ready" to compete for follow-up large deployment contracts.

   (2) By *gradually increasing the size of the tasks* (R&D procurement in phases) and the corresponding contract value of each phase, PCP can help SMEs to grow alongside the PCP procurement: from the stage of first idea generation (phase 1 PCP), over all the steps of the R&D process, up to first series of tested products ready to hit the market (phase 3 PCP).

   (3) PCP is particularly interesting for SMEs because it allows them to *grow beyond their traditional role in public procurement of the subcontractor to a bigger firm*, and work with their own ideas in competition with big firms.

4.10 Bundling of demand

Bundling of demand in the development phase of new innovative solutions can be an advantage for the *procurer* in many ways. By joining forces with other procurers, the costs and risks of procurement for each procurer can be lower compared to buying design, prototype and field tests on their own[48]. In particular, bundling of demand may allow a multiple supplier approach, i.e. buying competing developments from a number of suppliers, due to the larger buying power of a group of procurers. Moreover, bundling of demand can contribute to making local and regional authorities more efficient by adopting best practices, common operating modes and common solutions.

From the *supplier* perspective, bundling of procurer demand increases the incentive for suppliers to develop products that can address a bigger coherent market, resulting in lower R&D cost and commercialisation prices, even if they have to develop in competition with other suppliers. Bundling of demand may thus stimulate industry to invest more in sectors of public interest and to raise its overall R&D investment effort[49].

However, there can also be downsides to bundling of demand. Some of these include increased resources needed for coordination among the different procurers, and the risk of creating a monopoly situation in the supplier's industry because the major buyers are all part of the procurement. The latter, however, is counteracted by combining the bundling of demand with contracting the R&D from more than one supplier.

A few case studies have made use of bundling of demand. The projects that did *not* use it were both small and large projects. Large development projects such as the French supercomputer TERA 10, the London Oyster card and the Variable Message Signs all have only one procurer. The cases where suppliers had pooled their demand were all large projects, which also was to be expected. There is no single type of innovation (radical, incremental) associated with the projects which use bundling of demand. For instance, one of the projects with a fairly high degree of innovation, the Smoke Detection System project, only has one procurer, while another project close to being radically innovative, the Fuel Cell Buses project, had multiple procurers in its first phase.

What can be seen from the cases that have used bundling of demand is that the reasons for this are rather mixed, but reducing risks, being large enough to afford the procurement, and developing a standard system are among the most prominent factors.

In the case of HF Ballast, the Swedish Government spent many resources to form a buyers group, which created a bundling of demand from the private sector. In early 1991 NUTEK and a group of private and companies formed a *buyers group* and the Government contributed with funding for experts and administration of the buyers group. This group drafted the performance specifications for the High Frequency ballast.

The reason for choosing this procurement model is threefold. First of all, forming a buyers group ensured that knowledge was gathered and spread from and to as many important buyers as possible, which also gave the buyers the confidence to buy. Hence, the knowledge sharing and adoption of best practise models has been a main driver in bundling of demand in this case.

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[48] Pre-Commercial Procurement – Building together innovative solutions that meet public needs, June 2006 (Draft staff working paper, not published)

[49] ibid.

Secondly, by forming a buyers group the government could transfer some of the risks to the private sector. There was a large risk as the market for the HF Ballast was very limited at the time. The buyers group ordered 26,000 HF-ballasts, which was 5 times more than the previous yearly sales of HF-Ballasts in Sweden.

Thirdly, the uncertainty of the future market was also one of the key drivers for making a joint procurement with the private sector and also a reason for using broad performance-based specifications in the tender, so the product could be used outside the buyers group as well. In effect, the volume of the demand which was thus secured, coupled with an intensive campaign from the Government, led to the creation of a lead market for this type of product.

The EIA also applied the buyers group strategy, but with mixed success. In the energy-efficient tumble drier case, the organisations behind the competition were not very successful in establishing a buyers group. Thus, there were no guaranteed first buyers, and the winning product turned out not to become commercially successful and was finally pulled off the market. The concept behind the buyers group appeared at first glance to be very interesting, but the practical success was, thus, very limited.

The US DOE Sub-Compact Fluorescent Lamp project adopted a modified version of the buyer's group approach, teaming up with the utilities, who were not actually procurers but who had the responsibility for carrying out incentive and information programmes to the public about energy-efficient products. Although the utilities made a major effort to promote the product it appears, however, in this case that the push from the supply side (cheaper and better consumer products) was the decisive factor in changing the market, rather than the public-sector effort to influence demand.

Bundling of demand was vital to the Public Safety Radio project. The three Departments of Emergencies in Norway joined forces in order to procure the public safety network, as it would not have been possible to buy the safety network for one of the departments alone. Also, the procurers ended up with a common solution to renew the existing three different networks and create a new joint network. The new network means increased safety for the Norwegian citizens, as the three Departments of Emergencies through the new common network can now communicate directly together. However, the cooperation has been complicated by the fact that the three departments for emergencies each had a long list of functionality requirements to the network, but few of them knew what was economically feasible. Moreover, it was difficult to get three autonomous departments to work together. Hence, many resources ended up being spent on ensuring that as many needs as possible were being met and separating out the functionalities that were economically unfeasible. Thus, the positive synergies that could have emerged from a project like this such as knowledge sharing and adoption of best practise models ended up becoming more a discussion of getting the functional specifications for each procurer's own department.

Textbox 4.7 Public Safety Radio

Procurer: Nødnett Norway, which is a co-operation between the three Departments for Emergencies: The National Police Directorate, the Directorate for Civil Protection and Emergency Planning, and the Directorate for Health and Social affairs, Norway

Supplier: Siemens, Norway

The Public Safety Radio Project is a shared digital safety system in Norway in order for the authorities to be better able to assist the citizens in emergency situations. Traditionally, the different emergency response authorities in Norway have maintained their

own analogue radio system, whereas this project will introduce a shared digital safety system. This is expected to improve the quality of the service for the general public.

Learning points:

- Bundling of demand has been essential in order to carry out the large project as it would not have been possible to buy the safety network for one of the departments alone. There has however been difficulties in the cooperation, among other things due to the fact that the three departments for emergencies each had a long list of functionalities that they wanted the public safety network to fulfil, but few of them knew what was economically feasible.
- The procurer knew as much as the supplier about the financial and technical possibilities for a public safety network and thus fully matched the supplier technologically, which meant that the procurer could determine the most economically feasible solution combined with the best technical solution and the project could be carried out within the budget limit.

The eHealth portal Sundhed.dk had seven project owners bundling resources, but also requirements and expectations, leading to many of the same type of co-ordination problems as in the Norwegian case, as all procuring partners wanted their individual fingerprints on the structure and setup of the eHealth portal. What is more, bundling of demand even in a project that supposedly should be a national project, gathering all the actors in one place, does not automatically guarantee a uniform strategy. Late in the project, some partners realised that the eHealth portal would only indirectly brand the individual procuring partners. This has led them to start parallel eHealth projects of their own to gain more brand awareness among citizens and patients.

Bundling of demand is also an important aspect of the Fuel Cell Buses project, where nine cities have joined forces to participate in the development of the fuel cell buses. As the supplier has had the main role in developing the project and the nine cities mainly have functioned as test beds, the demands from the procurers' side have not been very specific. Some of the cities, among others Hamburg, have decided to take the project one step further and hySOLUTIONS (the procurer from Hamburg) has been in direct contact with the supplier afterwards without involving the other cities. At first glance it seems that the benefits of bundling demand (reducing risk for the procurers and being able to procure the product through the consortium's size) is here achieved without the downside of having to manage different demands from different procurers. However, this model requires a strong supplier and there is also of course the risk in such cases that vague procurer demands may result in a project outcome that ends up not being in line with procurers' expectations.

Summing up, bundling of demand can be beneficial to the procurement process, especially in terms of reducing risk for the procurer, of knowledge-sharing (e.g. in the case of HF Ballast), and in terms of the procurers being able to actually procure the product or service in question (in the case of Public Safety Radio). Bundling of demand can also be an advantage for the suppliers. Larger demand enables suppliers to develop cheaper because of the economies of scale. Larger market prospects also facilitate companies' access to finance (e.g. venture capital etc) from financial investors. As can be seen from the case of Fuel Cell Buses, multiple procurers can also function as multiple test beds for the product or service, thus ensuring a more widespread test of the innovative product or service before further commercialising it. However, it should be noted that the Fuel Cell Buses example is not very representative for a demand-side driven innovation partnership between the procurer and the supplier.

It can be seen from the cases that bundling of demand is also useful in incrementally innovative projects. Bundling of demand is typically used with respect to radical innovation in order for the procurers to reduce risk, share knowledge

and adopt best practise models. However, knowledge-sharing and reduction of risk can also be beneficial in cases with incremental innovation, especially when the projects are large and complex, as was the case with the Public Safety Radio, where one department could not have handled the procurement alone.

Finally, a large volume of demand created by the bundling may in itself have significant effects; if the volume of demand and the number and/or power of the procurers involved is large enough, there is a possibility that a lead market or de facto standard can be created on the basis of the development project. In certain cases, the bundling of demand may create a volume of demand that is large enough to attract suppliers from outside Europe and interest those suppliers to locate (parts of) their R&D and possibly production activities near the procurer, that is, somewhere in the EU.

Bundling of demand is, however, not without drawbacks. As mentioned above, coordination among the different suppliers may be very resource-demanding, in particular as regards reconciling possible differences in requirements to the product or service to be developed, selection of suppliers etc. (possibly with the added issue of "nationalistic" interests if bundling occurs cross borders). An example illustrating some of the problems associated with large, multinational bundled demand projects, although not included as a case here, is the Galileo project. The reasons for the much-publicized difficulties of the project are many, but include problems of co-ordination and the clash of vested interests between national players. Finally, the failed attempt to establish strong buyers' groups in the IEA project competition also illustrates the difficulties in getting potential buyers to commit to buying a product which has not yet been developed.

4.11 Contract set-up and dialogue

Although the role of the procurement contract as a management tool is often neglected, the contract defines the framework conditions and sets the "tone" for the development process; not just the timeframe, the resources and the objectives/expected outcome etc., but also the rules for interaction between the partners.

From this follows, that the negotiation of the contract is a vital element of the process. The new procurement Directives allow for some dialogue between the procurer and prospective tenderer in the form of a technical[50] or competitive[51] dialogue.

Before launching a procedure for the award of a contract, contracting authorities may, using a technical dialogue, seek or accept advice which may be used in the preparation of the specifications provided, however, that such advice does not have the effect of precluding competition.

Competitive dialogue is "a procedure in which any economic operator may request to participate and whereby the contracting authority conducts a dialogue with the candidates admitted to that procedure, with the aim of developing one or more suitable alternatives capable of meeting its requirements, and on the basis of which the candidates chosen are invited to tender."

In the case of a competitive dialogue the decision to purchase final end-products is already taken and tender specifications for those are already published before

[50] Refer to preamble 8 of the public procurement Directive 2004/18/EC

[51] The procedure of the competitive dialogue is defined in Article 1 (11) of the public procurement Directive 2004/18/EC

launching the dialogue. In the competitive dialogue, those who tender are asked to propose solutions against those tender specifications for deployment. A technical dialogue, on the other hand, can take place at an earlier stage, for example before the start of the R&D phase, even when there is no clarity yet on what the best solution may be for solving a particular problem (i.e. before there is any decision on deployment and before there are tender specifications for the required end-products).

Thus, the new public procurement rules provide for more opportunities for dialogue than before, but there are still restrictions. For example flexible contracts, where renegotiation can take place during the project, are not allowed. Such renegotiations would normally be regarded as State aid as they exclude companies that were not selected, but could make better offers under the renegotiated conditions, to bid.

The case study on the Smoke Detection System represents a more informal and pragmatic use of the contract. The contract was formulated "loosely" in order to make room for "learning by doing". In practice this meant that several contract amendments were added to the original R&D contract to take into account learning arising from the project as it progressed. Especially additional cost put on the supplier from changes in procurer requirements were discussed openly and agreements for additional payment were made. This approach was selected to secure the interest of the supplier and to minimise the financial uncertainty of the supplier. The contract setup described above was associated with informal communication between procurer and supplier and in practice this meant that the contract was rarely used as a guideline for the day-to-day operations of the project. Only in a limited number of incidents did the procurer and supplier have to look into the wording of the contract to solve a particular issue.

Textbox 4.8 Case abstract: Smoke Detection System

Procurer: The Danish Railways (DSB), Denmark

Supplier: Bravida Denmark A/S, Denmark

Between 2000 and 2006 The Danish Railways piloted an R&D project for the development of a train-mounted smoke detection system. A smoke detection system is a hardware and software-based system for the detection of smoke (not fire) around a train's engine and passenger cabin. The system consists of electronic smoke detection sensors linked to the primary train computer. If smoke is detected in either of the two areas the train conductor is informed and if no response from the conductor is observed the system will automatically bring the train to a halt. The system is designed to limit damage on passengers, cargo and train by identifying smoke formation before actual fire has started. This way the train can be evacuated earlier and any possible fire can be dealt with as early as possible.

Learning Points:

- Limited number of potential suppliers forces procurer to disregard risk sharing, as the procurer in this case had difficulties in identifying potential suppliers in related and non-related industries (none were identified in the train industry).
- When the contract is primarily based on performance specifications it may be of limited use for solving technical or economic disputes between project partners. In this case study the informal communication between supplier and procurer meant that the contract rarely had to be invoked. The level of "flexibility" in the contract and the project partners' willingness to discuss contract content and possible contract amendments during the project was of utmost importance for the successful outcome
- The procurer experienced an unforeseen change in the security requirements for passenger transport during the contract period. In this instance, again the informal working relationship between procurer and supplier and the flexible

approach to the contract made it possible to quickly draw up contract amendments without significantly halting the ongoing development work.

Another example of contractual setups based upon pragmatic use of contracts is the CARE project. Even though the contract was seen as a classic public service contract, the actual usage of the contract in the guidance and communication of the project has some interesting aspects to it. The contract stipulated a list of functional requirements that were to be found in the technical solution. It turned out, however, that the technical issue was not the main challenge. The system interfaces and the training of staff in the ICT system proved a greater challenge than the technical specifications upon which the contract was based. The procurer and supplier therefore decided to focus time and resources on these non-contractually stipulated challenges. This type of flexibility from both the procurer and supplier was essential to the successful implementation of the project. Had the contract been used as a rigorous steering tool, the cooperation might have been terminated before any real success could have been made.

In the US eVA case, the contract was based on detailed performance specifications. However, the approach was flexible in the sense that the contract was modified along the way in accordance with the learning taking place during the development phase.

The restrictions on dialogue in the pre-contract phase and a lack of flexibility during the contract phase may constitute a significant barrier to promoting innovation through public procurement. Successful innovation requires interaction throughout the process, but this poses a dilemma seen from a legal perspective. Some of these dilemmas may, however, be addressed by dividing the project in separate phases and by separating the R&D phase from the procurement for deployment of end-products as is intended for the pre-commercial procurement approach.

4.12 Phasing of Projects

One of the basic features of the pre-commercial procurement process is the phasing of activities, allowing for gradually sharper focusing of the R&D (and also for gradual reduction of the number of suppliers involved).

The European case examples studied did not apply such phasing to a large extent. If divided in phases at all, these are usually just defined as the "development phase" and the "supply phase", respectively (the latter thus extending beyond the pre-commercial procurement phase).

In the TERA-10 project, most of the R&D actually took place in the pre-contract phase, where a prototype server was developed which was the basis for selecting the supplier. The actual contract then covered production of a large number (500+) of servers and connecting these into one supercomputer.

The whole DTES project was split into three phases, where only the second and third phase includes suppliers. The second phase was the development phase, and the third phase – the supply contract - will be out to tender later in 2007. It is therefore not automatically the same supplier who will be involved in the last two phases. It is possible to select a new supplier because the IPR is owned by the procurer.

The **US cases** studied applied phasing more often.

The DARPA procurement in which iRobot proposed its revolutionary robot movement algorithm for the first time was a procurement covering only the design and prototyping phase. Afterwards, other follow-up procurements for testing etc. followed.

The US Internet procurement case was also conducted in phases. In the 1960s a tender was issued for the basic design of the Internet protocol architecture. More than 140 bids were evaluated. One decade later, DARPA issued the procurement contract for the first implementation/prototyping of the TCP/IP protocol suite on the ARPANET. The procurements for the operation and testing of the networks were also tendered separately. A few years later followed the procurements for deploying the system across the whole defence agency and later across other agencies and universities.

The US high performance computing case is an example of a long series of procurements reflecting different consecutive development stages of high-end computing technology.

4.13 The motivation of procurers and suppliers

One final issue will be addressed here, namely the motivation of procurers and suppliers to enter into technology procurement projects.

From a political perspective, technology procurement should, in addition to fulfilling public sector needs, contribute to fostering innovation and help develop companies and markets. This is the double rationale behind the pre-commercial procurement concept.

However, based on the cases examined in this study – the ones from Europe at least – the primary concern of the procurers is to address their specific needs; the innovation and market development concerns seem to play a very small role in the motivation of the public procurers. The only European case example where the business development aspect had any real significance is that of the fuel cell buses, where the Hamburg procurer also included activities aimed at regional cluster development in the project.

The key issue here is that there is little, if any, incentive for (European) public procurers to engage in radical innovation which, by definition, is associated with a high level of risk. Indeed, the incentive to *not* run the risk is considerably larger. Financial resources are often under pressure, and public authorities are accountable to their taxpayers. While success often receives little attention, failures rarely go unnoticed, and the financial, operational and political risks are not seen as being outweighed by the benefits – in particular for authorities at sub-national level. Often, the needs defined by the procurers can be fulfilled by adapting existing technology and applying it to the new context; radical innovations are usually not strictly necessary and the procurers thus tend to stick with projects where the risk is manageable.

Radical innovation does not seem to be at the forefront of the *suppliers*' ambitions in the European cases, either. Their unwillingness to take risks in the projects could indicate that their own primary motivation to participate in these projects is to do "paid work", with the possible added bonus that they may be able to develop their core business in small steps, rather than radical ones.

The risk profile of the US cases is generally much higher, and so is the degree of innovation. US procurers spend considerably more on high risk (R&D) procurements than their European counterparts: 15% of the US federal procurement budget is spent on R&D procurement, compared to less than 1% of the European-wide tendered procurements. Where it is often quoted that it is the unlimited resources of the federal defence agencies that are behind those R&D procurements, it is worth noting that R&D procurement is not only used in military cases related to national security. 5 Billion dollars of R&D per year is also procured in non-defence related public agencies such as health, transport, energy etc. US procurers are also accountable to taxpayers just like their European counterparts. So how can they engage such large amounts of their budget in high-risk (R&D) procurements? One important underlying reason is that they have found a means to reduce those risks to the level of calculated risks worth taking...

The rationale of radical innovative procurements thus becomes one of consciously taking larger calculated reduced risks with potentially larger benefits than incrementally innovative procurements. The investment is paid back directly in the form of better value for money products for public procurers[52] and indirectly in the form of the creation of new lead markets and new employment and taxes stemming from growth of many of the companies that successfully brought radically innovative products to the market thanks to those procurements.

There is no universal single remedy for the relatively low degree of risk-taking in many European technology procurement projects. A combination of measures seems to be required to bring about a change of mind: e.g. risk-reduction techniques in procurement, career development incentives for procurers to undertake radically innovative procurements, political coverage etc. Increasing the motivation for procurers to include innovation in procurement planning is an important aspect that must be taken into consideration when designing strategies and models for improving the efficiency and effectiveness of public services and increasing innovation through public procurement in Europe.

In this respect PCP may have potential to increase the motivation for both suppliers and procurers to undertake radical innovative procurement projects; the risk-benefit sharing is developed in such a way that both parties gain most from the PCP procurement by developing radically innovative solutions that are commercialised as widely as possible (maximum potential for first mover advantage in new markets/new IPRs for firms, maximum possible cost reduction for the procurer).

[52] A US defence study shows that putting companies in competition in development results in steeper innovation/learning curves for all firms involved (higher quality products) as well as cheaper prices on products developed. For more info see textbox 4.4 in section 4.7and section 6.10.1 in annex III

4.14 Impacts

There are two main types of impacts derived from the projects:

- **Societal impacts** – derived from fulfilling the public needs which the public procurers wanted to address through the introduction of new products or services (including impacts on the quality, efficiency and effectiveness of public administration and public service), as well as broader social impacts (e.g. employment)
- **Business and market impacts** – on the participating companies in terms of company growth and lead markets/market shares

It should be noted that some of the projects have not yet produced any significant impacts because they are still not finalised or in the final phases. Further, due to the limited data material available, impacts cannot be aggregated quantitatively or generalised. Thus, the impacts cited below are examples of the types of impacts that may be derived from the projects.

4.14.1 Societal impacts

Two projects were aimed at **public safety** issues and have or are expected to have significant impact on public safety: One is the Norwegian Public safety radio project, where the citizens are expected to benefit as the network will have a better coverage, which increases the safety for the citizens. The Smoke detection system has caused a decrease in the number of fires in trains because dangerous situations are dealt with earlier (already when smoke develops), thus contributing significantly to the safety of the users of the trains. The project has also contributed to greater work safety and greater satisfaction among employees.

Another issue is **traffic safety and efficiency**, to which both the DTES (Digital Transport Enforcement System) and the VMS (Variable Message Signs) contribute; the DTES through monitoring and enforcing traffic violations (directed at cars in bus lanes obstructing bus traffic), and the VMS through contributing to a more efficient and thus safer highway traffic.

There is little information on the employment effects of projects, but a couple of examples can be mentioned. Interestingly, they relate mainly to efficiency gains which, in the medium to long run, are expected to decrease employment with the public authorities involved. **Efficiency gains combined with improved public service** seem to be a significant social effect in many projects. The Public Safety Radio project has produced a number of new jobs, not least in the Nødnett Norway organisation, but in the long run a reduction of jobs on a national level is expected, since productivity and efficiency within the three departments for emergencies is expected to improve with the closer contact between the departments and better data communication, enabling restructuring of workplaces. The smoke detection system has also lead to efficiency gains for the public sector: the insurance premium on both equipment and personnel has decreased because both material and personnel is increasingly protected by the smoke detection system.

With the CARE system, the general public service level for senior citizens and disabled people has, partly as a consequence of the service management system, increased over the last years due to a more effective use of resources. The information level for politicians and administration has increased significantly after the introduction of the service management system – the information output from the system is used as the basis for political and administrative decisions on resource allocation etc. Finally, the introduction of the service man-

agement system has improved efficiency and decreased the need for top and middle managers leading to decreasing salary costs. These impacts are now spreading, as new versions of the system have been implemented in other municipalities.

Improved public service and efficiency gains were also the motivation behind the eHealth portal Sundhed.dk, and the impacts achieved so far are significant; the development and launch of the eHealth platform has greatly enhanced citizens, patients and health professionals' access to relevant eHealth related information in an easily accessible format. It is argued by the procurer that the main benefits of the portal are to be found among the general practitioners acting as primary gate keepers in the national eHealth system. Via the portal, they have been given IT-enabled tools to more efficiently and effectively counsel and screen patients. In addition Sundhed.dk, through the use of national e-health standards provided by MedCom, is increasingly able to support more efficient flow of information, electronic prescriptions, electronic medical appointments etc. The savings for the Danish public health system from this have been estimated at several hundred million euros.

Substantial efficiency gains as well as direct savings on purchase prices have been realised in the US eVA e-procurement project. The total reduction in costs (prices) of goods and services procured by the Commonwealth and its agencies during the lifetime of the project amount to a total of approximately USD 188 million. Administrative savings and higher efficiency in the procurement processes of the hundreds of institutions and agencies using the system have not been measured but are thought to be of a considerable size. Finally, a number of local communities within the state did not have ERP or electronic procurement systems in place before the introduction of eVA and have thus been spared having to invest in such systems.

The iRobot systems have been delivered to a broad range of military and civilian customers around the world. These robots have saved scores of soldiers' lives in military operations in Iraq and Afghanistan. Subsequent successful commercialisation of the new robotics algorithm in the civilian market also made robotic in-house tasks such as vacuum cleaning more affordable for the mass market.

Substantial efficiency gains and price savings have also been realised as a result the high-end computing case. The public sector represents the largest market for the supercomputing industry. For a public procurer, achieving better value for money means getting more computing power for a lower cost. Sustained public demand for ever more computing power has reduced the cost per unit of computing power a trillion times over 60 years of R&D computing procurements. This has brought enormous cost savings to computing-intensive government departments, as well as large spill-over effects to the affordability of personal computers for the private consumer segment.

The Internet procurement project has also realised significant cost savings on network management and communications costs for the procurers. The "internet work protocol" that was developed can hide the differences between computer network implementations of different government departments. The benefits of unified network management and cheaper communication costs have already reached wider societal impacts for businesses and private consumers everywhere as the TCP/IP protocol stack developed in the procurement project later became the underlying protocol for the Internet worldwide.

4.14.2 Business and market impacts

Almost all of the case studies have led to attempts at commercialising the products and services developed, some with more success than others.

The main example of real commercial success for the supplier in a European project is the High Frequency Ballast case, where the project had a significant impact on the Finnish supplier Helvar. Prior to the project, the total sales of HF ballasts were about 30,000 units per year, and Helvar was not a leading company within this field. Thus, the order of additional 26,000 ballasts had an immediate impact. Two years later, Helvar produced more than 400,000 ballasts for the Swedish market alone, which was 80% of the total market in Sweden. 5-6 years after the completion of the project, Helvar started to export the product to several European countries. The reason for the time delay was that the Swedish market was the lead market and it took time for the product to become known in other European countries. It was the combined effort of the Swedish Government campaign and Helvar's own marketing that resulted in export to new markets and an overall increased production of HF ballasts in Helvar. Today, Helvar is Europe's second largest producer of magnetic ballasts and a significant supplier of lighting control systems. Although the development project was not the only reason for the company's growth, it played a significant role in both establishing a market leader position in the Swedish market and in subsequent expansion to other markets.

The CARE system was, at the time of its first implementation in the procurer municipality, considered a lead product and the interest from other municipalities was high. The attractiveness of the product to other municipalities should be seen in the light that the procurer in this project had financed most of the R&D needed to develop the product (but let the supplier keep the IPR). A subsequent sale to other municipalities would not entail the same level of R&D costs. Thus, the service management system developed for the municipality of Aalborg has been sold to other Danish municipalities. In addition, the procurer has during the last five years several times supported the supplier in sales oriented activities such as system demonstration and presentation at conferences and support at sales meetings. The procurer has also acted as external consultants (for a fee) during the implementation of the service management system in other municipalities.

In the VMS project, one of the two suppliers has made use of the IPR for projects including the Athens Olympics, New Zealand and Australia. The other supplier has also bought the license and used it to bid for other projects. The supplier and procurer in the other traffic project, the DTES, are currently promoting the Smartcard developed separately, but are also talking about a joint effort in order to promote the product in a better way.

Thus, some degree of commercial success has already been achieved in several projects. There are, however, also less successful examples. This goes in particular for the Smoke Detection System where the supplier, despite support from the procurer at sales meetings etc., has not yet managed to sell the system to other clients. However, the effort continues, so there may yet be commercialisation effects to be had.

The fuel cell bus project is not yet finalised, so concrete commercial successes cannot yet be reported. However, although there are other fuel cell buses developed worldwide, it is expected that the project will create a lead market at least within Europe due to the broad co-operation network of potential clients who have acted as test beds for the buses. In terms of business development, the project has also had great strategic value for one of the suppliers, Vattenfall

(the Swedish energy company), as they have been able to create synergies between their traditional housing competencies and the transport competencies, which in many ways resemble the core competencies of Vattenfall. Vattenfall's participation in the fuel cell project has implied a shift in technologies and has reinforced Vattenfall's work with sustainable energy.

The US procurement cases also achieved large commercial successes.

A US case with substantial business impact is **iRobot**. As described in the previous section, the company did not focus only on military robots and successfully commercialised this new robotics algorithm in the civilian market. In September 2002, the company introduced one such civilian product – the iRobot Roomba Vacuuming Robot. It became a big commercial success, leading to a boost of the company's financial situation. Since 2003, the company's revenue has grown by 248%, from 54.3 million USD in 2003 to 189 million USD in 2006.

Finally, the impacts of the **US high-performance computer procurements** were obviously large; it spurred the development of a world-leading computer industry through a series of procurements taking place over a time span of half a century. Thus, there is a significant difference in scale which sets this case apart from the single and much more modestly-sized projects otherwise studied here. This US experience shows that a consistent and large-scale effort over a long period of time can result in impacts on a global scale, significantly impacting the economy. It is, however, important to keep the perspective in mind; the US strategy dwarfs even large-scale European initiatives such as the Galileo project in terms of both resources and time-frame. Thus, it is not easily replicable in a multi-national context such as that of the EU and requires a sustained, concerted, and long-term effort.

4.15 Key success factors

In conclusion to this chapter and the analysis based on the case studies, we will outline some of the key success factors in public technology procurement as they appear from the cases studied:

- **A clear risk handling strategy**

Risk is a major issue that requires proper handling by the parties involved; the "default" position in Europe seems to be that the procurer covers the full cost of development and thus takes on the major part of the risk associated with this phase. In many cases, the procurer considered sharing the risk with the supplier but decided against it, usually because it was considered necessary to have an "attractive" risk scenario to attract qualified suppliers, and because the business case was weak (not developed – cf. below). Thus, the potential post-project benefits to suppliers were unclear, providing them with little incentive to share the risk.

A proper risk assessment combined with a clear business case (including an IPR strategy) would enable risk-sharing and thus make the project more attractive to both procurers and suppliers. Real risk *sharing* has not been observed in any of the European cases. We shall discuss this in the following chapter in relation to the pre-commercial procurement concept.

- **Long term planning of procurement needs reflected in a well-prepared business case**

It is evident from a number of cases that (the lack of) a clear business case has had significant importance for several projects. It is closely related to the concept of risk (cf. above), since a well-prepared business case for subsequent

commercialisation reduces uncertainties for the supplier who will have a greater incentive to invest in the project - not only financially, but also in terms of staff resources, knowledge transfer, and not least subsequent commercialisation. Thus, the supplier may be encouraged to take a greater risk, by lowering the development price below exclusive development cost for the producer, with a well-prepared business case.

- **Considered strategy for handling IPR (or more generally, project outcomes/benefits)**

The IPR strategy is vital to the "benefits" part of the shared risk-shared benefits approach. The terms should be attractive enough for suppliers to want to invest in the project (and subsequent commercialisation), while at the same time provide "value for money" for the procurer. The IPRs may be owned by the procurer, the supplier, or both; license agreements may be free, with a modest fee or a larger fee, depending on the market value of the IPRs. What should be chosen must depend on the project in question, and on the capabilities and ambitions of the procurer and the supplier. Many factors point to the advantages of IPRs being owned by the supplier. However, the important thing is that (1) IPR rights are not awarded "by default", but as the result of deliberate considerations of the business plan and other relevant aspects, and (2) the procurer always retains a minimum of IPR-related rights in order to ensure continuity of its internal operations and a competitive supply chain (i.e. procurer retains license free usage rights and the right to require suppliers to award licenses to third party suppliers under fair and reasonable market conditions).

The following points are not necessarily "key success factors" for technology procurement in general, but they represent aspects of projects which may be desirable for different reasons (cf. also the next chapter on the role of pre-commercial procurement). Thus, what we have included here are some pointers on barriers and success factors if these aspects are included in the project.

- **Close dialogue between the parties involved**

The more complex the project in terms of technology (including degree of innovation) and organisation, the more pronounced the need for dialogue between procurer and supplier. Projects of very low complexity may perhaps be fairly successful (in terms of delivering what the contract requires), but in general, successful innovation requires dialogue between the user/procurer and the developer. The eVA and high performance computing case are good examples of this. Added value which may be achieved through close dialogue includes increased creativity through "sparring", increased knowledge transfer and efficiently dealing with problems which might otherwise be exacerbated through lack of communication.

- **A performance (not just lowest-cost based) contract, possibly with performance requirements that become more specific over time**

The contract is a tool which defines the overall framework and the basic rules for the co-operation. Being primarily a legal instrument, the contract is not the best tool for day-to-day management of a development project, as it usually either has too few details – or too many. There are several examples where frank and direct communication between procurer and supplier in difficult situations combined with a willingness to amend the contract prevented actual contract disputes, which might otherwise have ended up in court. Thus, a flexible approach, being willing to learn from the experiences gathered and the developments taking place, even if they require amendment of the contract, may be

essential to ensure smooth co-operation and thus the best possible results of the development project.

- **A capable and involved procurer**

The cases show clearly that the best results and the most efficient process are achieved when the procurer has sufficient knowledge of the subject field of the development project, and a (project) organisation well-equipped to steer and participate in the project. This is a precondition for both the preparation of a good tender process, for assessing tenders and tenders, for maintaining a constructive dialogue between the parties to the contract, and – in particular if the supplier is an SME – to be able to support and guide the supplier during the project.

This is not to say that the procurer needs to have expert, in-depth knowledge of the technical aspects of the project (if necessary for matching the supplier, independent experts may be hired to assist the procurer). But, as a minimum, the procurer needs to have very good insight into his own needs and the possibilities for addressing these needs.

Proper preparation is the key to any good project. The procurer may already be very knowledgeable about the R&D field in question, but even if this is the case, he needs to define his own needs before he can ask a supplier to fulfil them (cf. above). As a minimum, the procurer needs to ask himself whether he has sufficient knowledge to answer the key questions: What is the size and scope of the project? Who are the potential suppliers? What are their strengths and weaknesses? What are the key technologies and key issues in this area?

Pre-studies and a technical dialogue with industry before starting the project may be necessary if the project is expected to be very complex, or if the procurer is not very familiar with the field. Independent experts (if such exist) may be called in to advise the procurer during the tendering process, and possibly also during the execution of the project.

Organisational and project management issues are also of key importance. Procurement expertise is not enough, since innovation projects go way beyond the skills needed for procurement of off-the-shelf products. The eVA case from the US in particular illustrates the importance of having a dedicated team with the right competences (including project management) in place.

- **Incentives and enabling structures**

Public procurers in Europe at present have little incentive to procure radically innovative projects, since their main concern is to address their immediate needs and not take too big risks with their budgets. If public procurers, especially at sub-national levels, are to undertake more radical innovation projects, other incentive structures are needed, in particular larger rewards for innovative approaches and entrepreneurial behaviour. How such rewards may be put in place will differ between Member States, according to e.g. the degree of self-management of local authorities versus national government control of budgets etc.

In terms of enabling factors, a key issue is financing. Few public entities will be inclined to run large risks with their operational budgets (i.e. budgets intended for fulfilling basic tasks such as social services). Thus, funding of innovation projects may require some redirecting of funding from other "non-essential" (operational) purposes, e.g. business promotion activities or research funding (at local, regional, or national level). One approach could be to invest some part of such funds in procurement of innovative solutions. An example is research funding for e.g. sustainable energy, which could be redirected to procurement of,

say, an innovative solar energy system for supplying heating and energy to public institutions.

A key prerequisite for public authorities behaving in a more entrepreneurial and innovative manner is, furthermore, support from the top political level of the organisation in question. Again, the US eVA project benefited from very strong support from the Governor, who pushed hard to have the project implemented quickly and provided the procurement team with the organisational clout necessary to carry out the project successfully.

- **Multiple competing suppliers**

Multiple suppliers, developing in parallel alternative solutions to the same problem, are a key aspect of the pre-commercial procurement concept. There are two main issues in relation to multiple suppliers: firstly, the availability of qualified (and interested) suppliers may in some cases be limited, in particular for much specialised or very large projects. Secondly, if several suppliers are to work in parallel, the benefits need to be made very clear to the potential suppliers; otherwise, they may be reluctant to participate. In particular, the issue of IPR and of disclosure of company knowledge to competitors needs to be dealt with, in addition to the commercialisation aspect. Benefits ("what's in it for the companies") need to be clarified – in particular for those who do not make it all the way to a supply contract and/or subsequent broader commercialisation of the products or services developed. Also in this respect, the IPR strategy is important, since the main benefit for the "losing" suppliers (who do not end up winning a supply contract) will consist in exploiting commercially the knowledge they have gained from the development project. This also speaks in favour of letting the suppliers keep the ownership of the IPRs against a price for the development work which is lower than if the procurer wants exclusive rights to the knowledge developed.

- **Bundling of demand**

Bundling of demand is generally seen as desirable, because it creates a volume of development resources and of demand which few procurers can manage by themselves. If the project is of a large enough scale and the procurers involved are sufficiently central/powerful, the volume and quality of demand may help establish a lead market, and perhaps even de facto standards in the field. However, bundling of demand has its drawbacks; it should be combined with the competing suppliers approach in order not to contribute to a monopoly situation for the supplier (bundling of demand should provide enough volume for several suppliers to be involved); most importantly however, the resources required for the co-ordination of demands may in some cases outweigh the advantages. Thus, it is important to not underestimate the need for co-ordination, and perhaps even for establishing an independent organisation to handle the co-ordination and the communication with the supplier(s).

- **Successful involvement of SMEs**

The involvement of SMEs in development projects is not in itself a key to success; but if the procurer wants to make it possible and attractive for SMEs to participate in a project, there are a number of ways in which the main barriers to SME participation can be overcome;

    - Setting the scope and scale right; ideally the project should not be too large, or require a very broad range of different capabilities (although this can be addressed through participation in consortia). Keeping the scope and scale manageable for SMEs may be achieved by dividing the project in phases starting from small budgets/resources that increase incrementally. Separating the R&D phase from the procurement of a large scale deployment also helps

as this does not require SMEs to put large financial guarantees on the table in the R&D phase and allows them to grow their company simultaneously until they can compete for a large supply-contract.

- Reducing the risks, e.g. through the preparation of a solid business plan, applying risk-benefit sharing, and/or providing access to venture capital or other types of financing for the commercialisation phase.

- If the project is large, it can be organised in such a way that there are defined tasks/roles of suitable size and complexity which can be undertaken by smaller enterprises, either alone or as part of a consortium

The following two tables contain an overview of the case projects and the impact which their approach to the key success factors has had on their project. The more successful projects have had positive impacts from a number of key success factors in combination; some have mixed impacts since they have performed well on some key success factors and less well on others. Finally, a number of projects may be called "medium" (or perhaps even mediocre) performers; few of the "key success factors" have had either particularly positive or negative impacts on project implementation or results. This does not in any way mean that the projects have failed – none of the case projects have – but simply that they might have been even more successful if more of these factors had been present to influence the project in a positive way.

The US cases were all highly successful, and it is clear from the table that there has been a positive impact on the projects from a broad range of key success factors, in particular those relating to the commercialisation aspects (IPRs with the supplier, clear business case, risk sharing strategy), and also very capable procurers, both in terms of organisational and technical capabilities and in terms of enabling structures and incentives within the procurer organisation (as evidenced for instance in the eVA case). One of the most clear-cut – although relatively small-scale – European success projects was the HF Ballast case which also experienced positive effects from several key success factors both related to commercialisation and to the competences of the procurer and buyers' group.

Interestingly, close dialogue and a flexible approach to the contract does not seem to be a key factor in most of these cases, whereas in at least one of the European cases (CARE), the presence of flexibility and dialogue appear to have ensured a reasonable success of the project, even though some of the factors favouring commercial success (business case and a proper risk strategy) were not really present from the outset. Perhaps those two factors – flexible contract approach and close dialogue – should be seen exactly in this light, namely as something that can help "save" a project which is headed for trouble because of the absence of other key success factors. However, it should be kept in mind that open lines of communication and a common understanding of the targets to be met are of course essential to any relationship between procurer and supplier.

Following this discussion of the key success factors, the next chapter will be devoted to an analysis of the PCP concept in the light of the experiences from the cases.

Figure 4.1 Overview of cases and key success factors[53]

Legend/colour code:

***POSITIVE IMPACT** on project:*	
***NEGATIVE IMPACT** on project:*	
***NO IMPACT** in particular:*	

Key Success Factor / CASE	EU/US	Proper risk handling strategy	Long term planning / Well-prepared business case	Close dialogue	Performance based / flexible contract	Technically capable procurer	Organisationally capable procurer	Incentive/ enabling structures in place	Considered IPR/project outcome handling Strategy	Multiple suppliers developing in competition	Bundling of demand
Care	EU	No; not very considered	No. Missed opportunities	Yes.	Partly flexibility through dialogue	No		-	Supplier keeps IPR, but sharing was discussed	No	No
CUTE Fuel Cell Buses	EU	Yes, Supplier	-			Partly	Yes. Buyer's group	-	Supplier, but knowledge transfer to procurer	No	Yes, buyer's group
DTES	EU	Yes, risk workshops	Yes	-	-	Yes	Yes	-	Procurer	No	No
HF Ballast	EU	Yes. Through buyer's groups.	Yes	-	-	Yes	Yes.	Yes. Gvt. support	Supplier	No	Yes, buyer's group
Oyster Card	EU	Yes. PFI contract	Yes	-	-	No, lack of procurer prep.	No, lack of procurer preparation	Yes	Shared	No	No

[53] The US high-performance computer case is not included here as it involved a long series of separate projects and thus does not allow for meaningful assessment of the individual elements of the "project", although many of the key success factors were, obviously, in place.

Key Success Factor / CASE	EU/US	Proper risk handling strategy	Long term planning / Well-prepared business case	Close dialogue	Performance based / flexible contract	Technically capable procurer	Organisationally capable procurer	Incentive/ enabling structures in place	Considered IPR/project outcome handling Strategy	Multiple suppliers developing in competition	Bundling of demand
Public Safety Radio	Europe	No, but benefit sharing	Yes	Yes	-	Yes	Yes, procurer had org. set-up to match supplier	Yes	Procurer	No	Yes
Smoke Detection System	EU	Partly. Procurer helps in commercial.	No. Commercialisation difficult	Yes	Flexible contract	Partly	Partly	-	Procurer	No	No
Sundhed.dk	EU	-	No	No	Flexible contract	-	-	-	Supplier, but high royalties to proc.	Partly/ consortium (not competing suppliers)	Yes
Tera10	EU	-	-	Yes	No. Extreme number of requirements.	No	Partly	Yes	Procurer	No	No
VMS	EU	Two suppliers to minimise proc. risk	-	Yes	-	Yes, with support from experts	Yes	-	Procurer (shared with other gov. agencies)	Yes, two suppliers	No
iRobot	US	Yes. Multiple suppliers to minimise proc risk.	Yes	-	Performance based	Yes	Yes	Yes	Supplier	Yes	No
High performance computing	US	Yes. Multiple suppliers, procurement in multiple	Yes (long-term government strategic	Yes	Performance based	Yes	Yes	Yes	Supplier	Yes (IBM, Cray, DEC/HP, SUN, Silicon	No

Key Success Factor CASE	EU/US	Proper risk handling strategy	Long term planning / Well-prepared business case	Close dialogue	Performance based / flexible contract	Technically capable procurer	Organisationally capable procurer	Incentive/ enabling structures in place	Considered IPR/project outcome handling Strategy	Multiple suppliers developing in competition	Bundling of demand
		rounds, etc.	procurement plans)							Graphics)	
Internet	US	Yes.	Yes (procurement was planned and prepared long time ahead)	Yes	Performance based	Yes	Yes	Yes	Supplier	Yes, 3 suppliers	No
eVA	US	Yes	Yes	Yes,	Flexible. Amendments	Yes, matching supplier	Yes, matching supplier	Yes, political backing	Supplier	No	No
Sub-Compact Fluorescent lamp	US	Yes	Yes	Yes	-	Yes	Yes	Yes	-	Yes	Yes
IEA Tumble Dryer	US	Partly. Buyers group not efficient	No. Limited commercialisation potential	No (competition)	-	Yes	Partly, through buyer's group	Yes	Supplier	No, but award system	Yes, buyer's group

5. Pre-commercial procurement in the light of the case study experience

In this chapter, we take a closer look at the pre-commercial procurement (PCP) concept, which was introduced in section 2.3. The aim is to discuss the key aspects of the PCP concept in the light of the case studies which were analysed in the previous chapter – i.e. a kind of "reality check" of the concept against real-world experiences with technology procurement – the barriers, the best practices etc.

We begin with a brief review of what makes PCP different from more traditional technology procurement and then discuss the concept more in-depth against the background of the conclusions made in the previous chapter. Finally, we discuss a number of other measures which may complement or support PCP.

5.1 What is new in PCP?

To determine the difference between PCP and traditional technology procurement, it is useful to recap a few main points of PCP. First of all, PCP sets out to address a "missing link" in the European Innovation Cycle, which Europe may be starting to lose: A technologically demanding first buyer who is prepared to share the risk and effort to move R&D up to the point where the first products and services developed are tested to fulfil commercial deployment requirements[54].

As previously mentioned PCP is an approach to procuring R&D services which applies risk-benefit sharing at market conditions and that does not constitute State aid. It is exempt from the public procurement directives and the WTO Government Procurement Agreement (GPA). It should be noted, however, that the single market rules and the fundamental principles of the EU Treaty are still applicable. In order not to distort competition, while sharing R&D benefits, the contracting authority would have to respect the fundamental principles of the Treaty i.e. treating suppliers equally in a non-discriminatory and transparent manner.

The three main characteristics of PCP are:

- risk-benefit sharing at market conditions
- competing development in phases
- separation between the R&D phase and the procurement for large-scale deployment of final end-products

5.2 Preconditions for success in the light of the case study experience

5.2.1 Shared risk – shared benefit

The shared risk – shared benefit approach of the PCP concept is central to innovation and to creating a lead market.

[54]Independent Expert Group report for an ad-hoc working group of the National ICT Research Directors Forum: "Pre-commercial procurement of innovation: A missing link in the European innovation cycle", March 2006

Traditionally, in Europe, procurement is the instrument of procurers taking no R&D risks unless all benefits can be collected, whereas pre-commercial procurement is specifically tailored to R&D risk and benefit sharing. In order to reduce the risk concerned with developing a radically innovative project the procurers who have a concrete need for a technology yet to be developed reach out to the supply side to share the benefits of the R&D, for instance by not assigning the IPRs exclusively to the procurers and allowing suppliers to commercialise new products/services resulting from the R&D[55]. In return, the procurer does not carry all the risks of the R&D, for instance by obtaining a price reduction on the development cost and requiring suppliers to carry the costs related to IPR ownership (filing, litigation costs etc).

A procurer with a need for a technology that needs to be developed has an opportunity of having his problem solved at the cost of reaching out to the supply side and sharing the R&D risks and benefits of a pre-commercial R&D project[56]. Procurers share benefits with other procurers (through publication and standardisation, sharing of information when bundling of demand etc), with suppliers and with external stakeholders outside of the project[57].

Benefits accruing to suppliers include early feedback from potential customers about the technological and commercial feasibility of the product or service being developed and the possibility of adjusting the project accordingly. Suppliers can also benefit from post-project co-operation with procurers, either in the form of shared commercialisation of the final product or service or in the form of additional sales to the procurer. Procurers can fuel this development by for instance handing the IPRs over to the supplier (either partially or entirely) and/or allowing suppliers to commercialise the new product/service independent of the procurer. Other measures could provide for procurers and suppliers to contribute to European standards bodies wherever R&D results are of European interest[58].

Hence, the shared risk – shared benefit approach is expected to fuel innovation and creating a lead market in the PCP context. The European case studies, however, revealed no examples of **risk sharing between procurer and supplier**, although the possibility has been discussed in several of the cases. There are currently more on-going experiments with risk-benefit sharing approaches in the UK and the Netherlands (for more info see Annex II).

Several cases point to the fact that the financial risk of the procurement is difficult to share because of a tendency for both suppliers and procurers to be risk-averse[59]. This can be due to the fact that the business case has been too weak in some projects, thus making the post-project business plan possibilities opaque for the procurer and supplier. The latter was the obstacle to risk sharing in the CARE system project where it was discussed that the supplier could directly fund some possible additional R&D costs themselves. However, the procurer abandoned this idea because the R&D costs in question were to be used

[55] Ibid.

[56] Independent expert report for an ad-hoc working group of the National ICT Research Directors Forum: "Pre-commercial procurement of innovation: A missing link in the European innovation cycle", March 2006

[57] In addition to the direct market effects (introduction of new products of services), other stakeholders may benefit e.g. from contributions to standardisation or publishing of R&D results from the project.

[58] National IST Research Directors Forum Working Group: Pre-commercial procurement of innovation: A missing link in the European innovation cycle, March 2006

[59] This tendency may be linked to the fact that the case projects are almost exclusively concerned with incremental innovation which may reduce the risk but also reduce the potential benefit of introducing something radically new to the market.

for a development that the procurer could not see the post-project market value of. It did, however, later turn out that it could have been a highly profitable investment, which a clear business case probably could have shed light on much earlier in the process. Hence, the project could have been more innovative had the business case been clearer. Instead, the development ended up being rejected.

Different set-ups with respect to who takes the risk are seen in the cases. In Europe procurers tend to cover the full costs of development and thus take on the major part of the risk associated with this phase[60]. Supplier risk bearing can in for instance the Oyster Card case be seen to hamper innovation and to some extent dialogue, since the main interest of the supplier was to finish off the development of the product as quickly and efficiently as possible. In a few cases, such as for instance the TERA-10 project, where the procurer had difficulties attracting qualified suppliers, the procurer assuming the risk was considered necessary to attract qualified suppliers.

When it comes to **risk sharing between procurers**, it can be seen that the procurers who bundle demand also share risk amongst themselves. This is often due to the fact that the projects are large and complex (technologically and organisationally) and that the procurers are aware of the fact that neither of them could have carried out the project alone. For instance, in the HF Ballasts case, the Government shared the risks with the private sector by forming a buyers group. The financial risks would then be shared between the group of buyers (and not only the Government), and in return, the private buyers would receive a grant from the Government, meaning that if the project turned out to be successful the private buyers would have a financial benefit.

In conclusion, it has not been possible to detect **European cases** where procurer and supplier share risks, which probably has to do with the fact that the cases are not radically innovative and the incentives for risk sharing are therefore limited. Most procurers state that the projects are incrementally innovative because they have limited financial means and therefore prefer to build on existing knowledge, although it can imply that the final project is not as sophisticated as it could have been.

If the procurer is not interested in a truly radically innovative project, a solution could be to develop radically innovative parts of the project and thereby consider risk sharing in connection with these parts of the project, as it was discussed in the CARE project. However, a strong business case is needed here in order for the procurer and the supplier to see the advantages of 1) taking the risk and 2) sharing the risk. A proper risk assessment combined with a clear business case (including an IPR strategy) would enable handling risks and thus make the project more attractive to both procurers and suppliers.

A strong business case would also be likely to fuel more radically innovative projects, as a clear post-project business plan could attract qualified suppliers and additional potential future buyers/procurers. Furthermore, a strong business case could help industry seeing the development potential in the project (as was one of the lessons learned from the Fuel Cell Buses project) and it is thereby more likely to have industry participate in the project as a strong partner – be it as a supplier, financially or in the form of a strong network or sparring partner.

[60] Again, the risks taken by the procurers are *relatively* low since most projects deal with incremental innovations; if the innovations were radical, the propensity to accept the risk would probably be lower, thus reflecting the general perception that public procurers in general have a low propensity towards risk-taking.

On the other hand, examples from the US show that risk-benefit sharing is possible. In most **US cases** studied, suppliers obtained IPR rights to exploit their products in other markets (e.g. the supercomputing case). For example, Intel offered a cost reduction for the procurer in return for commercialisation rights for Intel chips into commercial markets such as the PC market. In the iRobot case the procurer (DARPA) did not pay the full development cost, and thus iRobot was allowed to commercialise their robot algorithm in other products, including vacuum cleaners for the commercial market.

5.2.2 Competitive development (multiple suppliers) in phases

One of the central issues of the PCP concept is the phased approach, where the number of suppliers is reduced in each phase, thus funnelling down until ending up with at least two suppliers to prevent a monopoly situation (cf. fig. 2.1 in chapter 2).

The PCP approach is based on a phased process, each stage with multiple suppliers in competition. A phased approach has been introduced in order to tackle possible technological uncertainties stemming from procuring radically innovative technology:

1. Solution Exploration
2. R&D up to prototype
3. R&D up to original development of a limited batch of first products/services validated through a field test.

Through these phases, an evaluation filters out the best projects at the end of phases 1 and 2 based on their performance in the previous phase(s) as well as the project's degree of innovation, commercialisation potential and ability to address the problem of public interest posed in the tender. If the project proceeds to a follow-up public procurement phase for procuring commercial end-products resulting from the R&D (what would be phase 4 in the model), an external supplier as well as one of the suppliers involved in the pre-commercial phase could be selected as the final supplier. In practice, suppliers making it to Phase 3 are well prepared to bid for the supply contract, as these suppliers have acquired expert knowledge in the field through the R&D phase.

Only one of the European cases studied, namely the VMS project, has made use of multiple (two) suppliers doing development work in parallel. The specifications for this project were highly functional and both parties fulfilled the requirements, albeit with very different solutions. Both suppliers ended up being awarded a supply contract. The advantage for the procurer in using this set-up was to spread the risk by not being locked into one supplier and ensuring security of supply for example if one of the suppliers could not carry out the contract. This set-up obviously required a few coordination meetings between the suppliers as it was a requirement from the procurer that the two solutions were compatible. In the development phase, the suppliers bore a very limited risk as the procurer financed the development phase fully. Hence, the main obstacle for the suppliers was that much of the companies' technical knowledge was made available to the other supplier.

The "funnel" model (filtering out the best projects) has however not been seen in any of the European case studies, and the majority of the case studies carried out the procurement with only one supplier. The reasons for this are numerous. First of all, as previously mentioned the identified cases mainly deal with incremental innovation, and the technological uncertainties stemming from radical innovation have therefore to a large extent not been present. However, an even

more weighty argument in the European context of a fragmented public procurement market with differences across borders in national standards and specifications is that in some cases, the availability of qualified and interested suppliers is limited. In addition, it can be seen from the case studies that suppliers tend to be rather risk-averse and are not willing to invest time and money in an R&D project where they cannot be sure if there is a commercial benefit for them. As previously discussed, the benefits needs to be made very clear for the participants. Lastly, as pointed out in the VMS project, suppliers may be reluctant to participate due to fear (real or not) that some of their company knowledge may be revealed to other suppliers working in parallel towards the same goal. Thus, it seems that when there is lack of qualified suppliers, a special effort should be made to ensure that the benefits for suppliers (especially the ones who end up not being awarded a supply contract) as well as potential disclosure of company knowledge to competitors are clarified. However, with these issues in place the funnel model can prove to be a catalyst in fuelling innovative projects. As discussed in section 4,12 some of the US cases (e.g. iRobot, Internet protocol development, and high-end performance computing procurements) successfully applied phased R&D with multiple suppliers developing in competition.

Finally, it is important to discuss the issue of cost of procurement projects with multiple suppliers. If more than one supplier is to be involved in a project, the procurer may either face a significantly higher cost than if only one supplier was involved, or the available resources must be divided between the multiple suppliers, resulting in fewer resources for each of them. However, four elements of the PCP model mitigate the cost problem of multiple suppliers. First, examples from the US (defense procurement and high-performance computers) show that significant cost savings can be gained from a *competitive (multi-supplier) approach*, both in the R&D phase and in the production phase. The savings on the first unit cost are possible even for small-volume products but the additional savings on the final unit costs are mainly effective for large-volume production projects. Secondly, *risk-benefit sharing* reduces the cost of the R&D phase for the procurer, in exchange for expected future benefits for suppliers. Again, the main barrier here is that a good business case is needed because of the reluctance of suppliers to reduce the development costs without clear market prospects, as evidenced by the cases. Thirdly, *bundling of demand* may further increase the resources available for the R&D stage. Finally, the *phased funneling model* (reduction of number of suppliers after each phase) also helps to keep the R&D cost of the multi-supplier model under control.

Typically, each R&D phase is more expensive than the previous one. Reducing the number of competing suppliers at the end of each phase prevents the R&D costs from multiplying linearly with the number of suppliers. Under certain assumptions[61] for example the cost of a pre-commercial procurement with 5-3-2 suppliers is cheaper than procuring phases 1, 2 and 3 from one supplier from the moment there are minimum three procurers bundling demand (i.e. sharing the R&D costs). In case no bundling of demand is applied the cost reductions thanks to competition and risk-benefit sharing can recuperate the pre-commercial procurement R&D cost of a 5-3-2 supplier funneling model from the moment there is a first commercial procurement contract of minimum 10 million EURO. Thus pre-commercial procurement can be an interesting approach also for relatively small size procurement projects which can be applied in a variable geometry of a relatively small number of procurers.

[61] Assumptions: Cost phase 1 (5 suppliers): 100000 EURO/supplier, phase 2 (3 suppliers): 300000 EURO/supplier, phase 3 (2 suppliers): 750000 EURO/supplier. 20% cost reduction on R&D cost due to risk-benefit sharing. 20% cost reduction on first unit cost due to competition in R&D phase.

5.2.3 *Best value for money through competition*

An important issue (and one of the main goals of PCP) is to foster innovation through competition amongst bidders. The reason behind this is to trigger a wave of innovativeness amongst suppliers, to tackle market fragmentation and lack of interoperability and coherence of solutions across borders[62].

As previously noted, PCP is excluded from the WTO Government Procurement Agreement and restriction of the tender to bidders from the EU is therefore in principle allowed. The Commission Communication on pre-commercial procurement recommends carefully assessment of the situation on a case by case basis.

One of the basic assumptions behind the PCP concept is no geographic discrimination across the EU. The rules of the internal market apply to all PCP-based procurements. The free exchange and flow of goods and services across the EU borders is the cornerstone in the Internal Market. Basically, the hypothesis is that non-discriminatory actions, in the long run, secure the best suppliers for the best projects.

In interviews conducted for the case studies, some procurers indicate indirectly that national protectionism plays a smaller or larger role in their selection of suppliers.

Generally a desire not to discriminate could be observed among procurers but often issues of national security of supply, national employment or national capacity building were mentioned as reasons to use geographical discrimination. Often it is brought forward that cultural factors play a role in the selection of suppliers and not always only objective performance-based criteria.

If geographical discrimination of suppliers can be attributed to culture and tradition any initiative to change this must be carried out with great attention to national issues of interest like SME development, employment, brain-drain etc.

For EU Member States to fully benefit from PCP it is important to address the issue of geographical discrimination of suppliers. One of the key lessons learned from the US is its ability not to discriminate geographically within their internal market. This way, it is argued, the "right" suppliers are more often selected and the macro-economic/social gains in terms of long-term employment of highly-skilled workers, diminishing brain drain and increased competitiveness and innovative capabilities among SMEs can be obtained.

[62] Ibid.

5.2.4 *Bundling of demand*

The PCP hypothesis with respect to bundling of demand is that bundling of demand from the R&D stage can contribute to creating a lead market.

In order to create pay-offs for the PCP first buyer strategy in terms of creating truly sizable lead markets for new technologies, two fundamental principles must be respected: the willingness of public procurers to share risks and benefits of high-tech R&D procurements with future suppliers, and bundling of demand to reduce market fragmentation and narrow the R&D public procurement investment gap between the EU and the US. Furthermore, according to the independent expert report[63], incentives are needed to overcome risk aversion of public procurers. While risk sharing will be discussed below, bundling of demand should rather be seen as a prerequisite for achieving the highest possible pay-offs and also for reducing risk.

In two of the European cases making use of bundling of demand (HF Ballasts and Fuel Cell Buses) a lead market or at least good prospects for future lead markets have been created. This is very clear in the case of HF Ballasts, where the supplier ended up producing ballasts for 80% of the Swedish market and later exported the product to several other European markets, where the product until then had been completely unknown. In the Fuel Cell Buses case, it is still very early in the process, but the fact that the project reached a wide range of European cities, cooperated with similar projects in Iceland and Australia (and still does through the Fuel Cell Bus Club network) and the fact that at least one of the cities (the city of Hamburg) chose to procure the buses afterwards is a good indication that the supplier in this case could succeed in creating a lead market (at least at European level). The Public Safety Radio project did not create a lead market, but this can largely be explained by the fact that the innovation was incremental and many other actors across Europe were working with similar but technically very different networks. Hence, the preconditions for creating a lead market were not present as different, not compatible solutions were and are at play all over Europe.

Bundling of demand at the R&D stage was also used in some of the US cases. For example in the high performance computing case long term procurement plans are made in cooperation with all computing intensive federal government agencies. It is recognised that one of the main reasons for the success of the first IBM supercomputers was that the machine had to balance performance requirements of both DOE and NSA. The Internet case did start at Darpa, but the objective was from the beginning to develop a solution for inter-governmental network connection, so it was clear to all companies bidding that the requirements for the solution (as well as the market potential) were related to multiple government customers interested in buying the same solution.

Although other issues can and do play a role in creating a lead market, it is safe to say that the case studies indicate that bundling of demand can help in creating lead markets. This finding is not very surprising, though, as in creating lead markets, volume of demand[64] is needed in order to create and maintain industry standards and to be large enough to attract foreign director investments or to

[63] Ibid.

[64] It should be noted that at the pre-commercial (R&D) stage, bundling of demand only means bundling of requirements and cost sharing – however, the bundling of requirements in the development phase obviously implies that the volume of demand in the commercialisation phase will also be larger, as procurers of the R&D services may be expected to be in the market for the product or service developed.

convince suppliers to relocate their activities, thus creating a fertile soil for attracting R&D and production to be carried out in Europe.

However, when discussing bundling of demand there are certain pitfalls that one should be aware of, which include the aforementioned resources being spent on coordinating the wishes of the different suppliers, ensuring that as many needs as possible are being met and separate out the functionalities that were economically unfeasible. This has been an essential drawback to bundling of demand both in the Public Safety Radio case and, especially, in the Galileo project.

5.3 PCP in the light of other initiatives

Several other countries are currently working with public programmes and initiatives focused on industry development, innovation, SME development and the like. For this project especially the US Small Business Innovation Research (SBIR) programme, and the UK and Netherlands versions of this type of programme, have been analysed. The purpose of the analysis has been to identify key learning points for the PCP concept. A description of the US, UK and Netherlands SBIR programmes can be found in appendix II.

The US SBIR programme is often taken as a model for promotion of innovation and commercial application of new technologies, and a large number of very successful US companies owe some or all of their initial success to SBIR contracts (e.g. Qualcomm, Symantic, SnapFit, Amgen, Genentech etc). In this respect it should be mentioned that aiming specifically at SMEs is not an objective of the PCP concept. However, it was thought that the SBIR programme could potentially teach us something about successfully bringing R&D concepts to the market (including the public segment), and not just for SMEs.

The US SBIR initiative was created in 1982 against the background of a setback in the US economy that was attributed to too sluggish growth of new small companies that could give a new impulse to the US economy, at that time comprised mainly by large old firms. In response to this, the SBIR programme was setup with the overall purpose to stimulate technological innovation in small private-sector businesses while providing the government with cost-effective new technological solutions to challenging mission-critical problems, and to market innovative technologies further in the private sector[65].

SBIR established a programme structure agreed across US government agencies tailored for SMEs to develop in competition with others their own conceptual ideas (not as subcontractors developing under the constraint of bigger firms) into marketable products. It was agreed that a whole range of government agencies would dedicate a predefined percentage of their annual budget to SBIR projects.

Some government agencies that are not responsible for direct operation of public services (e.g. NSF, Environment Protection Agency, etc), and therefore have no needs for specific new products to be developed for their own use, run SBIR projects as grants. Other government agencies with considerable operational responsibilities/budgets (e.g. Department of Defence, Department of Energy, Department of Transport etc) concluded that the best way to get new products developed that would match their internal needs would be to implement their SBIR projects as procurements. The first category of "Granting agencies" let companies make the specifications for concrete project proposals in broadly defined interest areas. The second category of "Contracting agencies" defines

[65] An assessment of the SBIR programme, 2007, Charles Wessner

concrete problems to be addressed as well as the performance targets to be achieved.

The competitive funnelling model, the phased approach, and the risk-benefit sharing model of pre-commercial procurement are similar to that of SBIR agencies that run SBIR projects as procurements, but not to those agencies that award SBIR projects as grants. Nevertheless, although the SBIR programme has been incredibly successful, due to differences between the legal framework in the US and Europe, one has to be careful to transfer the key success parameters to a European context.

Similarly, **the UK version of the SBIR, called the Small Business Research Initiative or SBRI**[66], has been analysed. The programme is fairly new (launched in 2001) and has so far not been as successful as hoped for. According to analyst comments from 2004 the lack of success stemmed mainly from a lack of long term planning of government procurement needs for new product development, an unbalanced risk-benefit sharing approach (companies were not given IPRs but asked to bring in themselves external financing) and no concrete strategy for phase 3. Consequently, the SBRI underwent a national review and the October 2007 review recommendations were adopted to modify the operation of the programme. These recommendations provide interesting lessons learned for the PCP concept:

- Since the review, SBRI awards must take the form of procurement contracts, not equity loans or grants in order to ensure that department requirements are met more effectively, and in order to enable the award of an SBIR contract to act as a "seal of approval", reassuring future investors (such as venture capitalists) and customers of the firm's value.

- With regards to the risk management strategy it was decided after the review that SMEs will retain the IPRs associated with any new technology to boost incentives to bid for contracts. The report recommended in particular UK governments agencies to follow the standard IPR risk-benefit sharing approach in procurements under the UK ministry of defence, where it is standard practice to leave IPRs with suppliers in return for a financial compensation for the procurer.

- To further minimise risk, the SBRI contracts will also follow a phased structure and will continue to work with multiple suppliers developing in competition.

- The report also revealed that investment in R&D by UK utilities (such as water, electricity and gas companies) is disproportionately low compared to turnover and encouraged UK utilities to also start applying SBRI,

These recommendations confirm the importance of some of the key characteristics underlying the PCP concept:

- the recommendation to use procurement of R&D to get innovative solutions developed for specific government needs and attract venture capital for SMEs.

- the potential to reduce R&D procurement risks through competitive development in phases and leaving IPRs with suppliers in return for financial compensation for the procurer.

[66] http://www.sbri.org.uk/

- the importance of increased long term planning of procurement needs and the significant opportunity for more R&D and innovation in non-defence sector in Europe

During the SBRI review exercise the PCP concept has not gone unnoticed in the UK. Around the same time as the SBRI review the UK Office of Government commerce has published a document identifying PCP as one of four evidence-based practical approaches for finding and procuring innovative solutions[67].

The Dutch SBIR initiative[68] (launched in 2004), much like in US, is implemented by some public authorities as grants and by others as procurements. The programme holds interesting practical experiences with approaches similar to PCP that has been taken into account in the recommendations in the sections below. For example, in terms of complementary measures the Dutch have already established a link between the SBIR scheme and VC funds; they have experimented with financial incentives (innovation premiums) for procurers and are currently investigating new financial mechanisms to be developed together with banks and insurance companies to further reduce the risk for procurers to undertake high-tech high-risk procurements.

For more information on the US SBIR, the UK SBRI and the Dutch SBIR programmes cf. appendix II.

5.4 Other possible measures to support and promote the PCP concept

Increasing the innovative outcome of public technology procurement is a complex matter and several measures can be implemented simultaneously to achieve this goal. Some initiatives may be supporting each other and others can be seen as mutually exclusive.

The purpose of this section is to present and discuss several of these initiatives. The following initiatives are selected not only based on their feasibility in a PCP context but also to support the overall discussion on public technology procurement. Purpose is not to give judgment on the "right" way to foster innovation in public technology procurement but more to discuss the consequences of individual initiatives as a stand alone initiative and as part of a greater initiative, notably the PCP.

[67] "Finding and procuring innovative solutions: evidence-based practical approaches", UK Office of Government Commerce, 2007

[68] http://trendchart.cordis.lu/tc_datasheet.cfm?id=8840 and http://www.senternovem.nl/sbir/index.asp

5.4.1 *PCP and support to develop the R&D project business case*

One element of the PCP concept that has proven of particular interest to both procurer and suppliers has been the need to develop up front (before taking the step of procuring R&D) a solid post-development (commercialisation) business case for the development project. As discussed before, the opportunities for technical dialogue with industry enable the procurer to gather the required information from the market to develop such a business case.

A source of uncertainty for several suppliers in the case studies has been the lack of a clear and meticulous procurer-prepared business case for the R&D project. Although uncertainty as regards market potential etc is obviously an inherent characteristic of any innovation project, much can be done to assess the risks and the opportunities for the service or product to be developed. This applies both to large and small suppliers, but especially for SMEs a clear business case facilitated by the procurer has been seen as a means to limit uncertainty both financially and technically.

From a procurer's point of view the lack of a solid business case is not only a matter of lacking financial resources for pre-project feasibility studies. A lack of technical and project capabilities can make it difficult for procurers to develop a solid business case. Often the procurer is not a technical expert within the field where they are planning to procure innovation.

The procurer needs to pay close attention to the needs of suppliers when it comes to minimising uncertainty. Support to the procurer in developing a solid business case could be an add-on to the PCP concept that would secure the interest of more suppliers through a carefully prepared business case and in addition make better R&D projects because the basic, but all important, needs definition etc. was conducted more professionally.

5.4.2 *PCP and the financing model*

It has been argued by suppliers in the EU cases that the business model for post-project commercialisation has been so unclear that anything but a 100% procurer financed model would have made the development project unattractive (cf. also above regarding business plans).

Based on this it is important to draw the attention to the "shared risk – shared benefits" setup of the PCP approach. Clearly, companies' willingness to share development risks requires good business cases to be developed. Even then the procurement set-up may work spontaneously for larger and financially stronger companies. However, if there is an intention to enable also SMEs to participate, additional financing opportunities may be necessary, in particular for the commercialisation phase where the required investment may exceed the financial capacities of SMEs. One of the major success points of the US is that the government supported the setup of a Venture Capital funds accessible to SMEs participating in R&D procurements for the commercialisation phase. Establishing a dedicated "PCP Venture Capital Fund" or close links to existing Venture Capital could improve the prospects for successful commercialisation and thus the attractiveness for all types of companies to participate in PCP projects.

5.4.3 PCP and the value of support for commercialisation

Commercialisation of R&D is a challenge, especially for SMEs. Limited resources for business and market intelligence along with limited contacts and global market insight may make commercialisation of the developed product or service difficult. For PCP to be a success it is therefore important to look at the non-financial commercialisation support tools given to procurers and suppliers.

As discussed above unclear business cases were found in many of the European projects. The attractiveness of the PCP concept from a supplier point of view may be strengthened if PCP could be coupled to a commercialisation strategy for the R&D achievements resulting from PCP-based development projects. The knowledge base and contact network of the procurer is often attractive for suppliers when commercialising and suppliers may be willing to take greater financial and commercial risks if the procurer would actively support their attempts to commercialise the results of the development project. The impartiality of the procurer must however always be kept in mind when setting up these commercialisation support initiatives. US experiences provide interesting perspectives on the procurer organisation's ability to support the supplier in the post-project commercialisation. By providing the contact network to a large public procurement market to the supplier and by concrete commercialisation support tools procurers can actively support the commercialisation of R&D. Availability of such commercialisation support may also help the procurer to attract better value for money offers for the pre-commercial procurement.

This can be taken even further by taking steps towards creating buyers' groups which we have seen, in different versions, in several cases. The approach is not without difficulties, and varying degrees of success have been identified. However, if it is possible to ensure a strong commitment from potential buyers, this could be a powerful tool for ensuring the commercialisation success of the developed product or service.

It could be argued that the attractiveness of the PCP concept from a procurer's point of view may also increase the branding value of the procurer by being associated with innovation and R&D.

6. Conclusions and Recommendations

6.1 Conclusions

The overall conclusion from this study is that there are certainly opportunities for public authorities in Europe in public technology procurement; opportunities that could bring both significant improvements to the quality and efficiency of public services, as well as facilitate the emergence of new lead markets for businesses.

The cases show that technology procurement can be successfully applied in different areas of public service, including non-defence (e.g. public transport, energy provisioning etc) as well as across different technology domains (in ICT and non-ICT related sectors). There is however indications that ICT procurements will continue to play a catalysing role for innovation in European public services in the future. Today, ICT procurements already constitute roughly 20% of the EU procurement budget. The opportunities for procuring the development of new ICT solutions in the coming decades are estimated to have considerable growth potential: both because an ever growing portion of public services in Europe are based on ICT, and because quite a few of those public services are facing major transformations in the coming decade in the light of socioeconomic challenges such as the ageing population, climate change, reduction of energy consumption etc.

The case studies have shown that although European public authorities can successfully undertake technology procurement, there are a number of barriers in Europe, in particular when it comes to radical innovation. Whereas several of the US cases were radically innovative, none of the European cases which could be identified for this study were. Instead, the European procurers opted for relatively low-risk, adaptive projects which fulfilled their immediate needs. No European examples of PCP-like procurements could be identified, except very recent cases in UK and NL SBIR which were too recent to make a detailed analysis. Thus, there is clearly a basis for finding ways to promote more truly innovative European technology procurement. In this connection, **risk** – the willingness to take it, and how to handle it – is key.

The **degree of innovation** that procurers are willing to embrace has a direct impact on the process and outcome of technology procurement. The lack of radically innovative procurement projects in Europe seems to be related to a lack of coordinated mid-to-long term planning of public sector transformations. Although awareness of long term challenges facing public services and possible technology evolutions able to address them can be found at public sector level, it is often available in separate organisational entities that do not cooperate enough (R&D&I[69] funding agencies, policy makers, public procurers). An open dialogue with industry before and during the project is an additional way of developing a better understanding of how radically innovative approaches could bring significant improvements in public services. Continuous dialogue on project progress and intermediate milestones is one way of limiting the potential "risks" related to developing radical innovations and dealing with technologically and/or organisationally complex projects.

Different **risk sharing** schemes have been applied to different procurement setups. Dimensions like SME involvement, technical complexity, degree of innovation and knowledge held by the procurer etc. are factors that influence the

[69] Research & Development & Innovation

risk sharing scheme. The European cases show that the financial risk of the R&D activities is difficult to share without **benefit sharing**. The business case for post-project commercialisation is often insufficiently explored by procurers in Europe which supports risk-averse behaviour among suppliers. In particular in relation to attracting SMEs as suppliers the procurer must be aware of the often more vulnerable economic situation of many SMEs which does not allow them to take large risks, in particular in the commercialisation phase. Linking a venture capital programme to R&D procurements may be a solution to consider. Support from R&D&I agencies to procurers could also help reduce the perceived risk of radical innovation projects for procurers. Such support could encompass both legal and practical guidance on how to set-up a PCP scheme, information about upcoming promising technologies, support to link PCP with other innovation support measures, financial incentives to procurers to undertake PCP projects, co-funding of projects, etc. It can also be envisaged that in cooperation with banks and/or insurance companies financial schemes can be set up to reduce the risk of producers of procuring radical innovation. Finally, political recognition that failure is not a drama since PCP procurements are carried out in the knowledge that they are high risk because of the potential high impact/value they may generate; a PCP project that fails to deliver only corresponds to a loss of a small R&D budget, but it can prevent crucial technology risks in procurements for large-scale deployments where failures are much more costly.

The benefit sharing aspect is closely related to the **IPR** strategy. This varies considerably in the European cases. In some cases studied, the IPR is owned by the supplier, in others by the procurer – and in only one case studied, IPR ownership is formally shared between the supplier and the procurer. The size and capabilities of the procuring institutions seem to be decisive for how the IPR issue is handled most effectively. Many European procurers keep the IPR ownership rights, entering into license agreements with the suppliers and/or sharing the IPR with other public authorities/organisations. It is difficult to generalise about the type of procurer able to do this; but the IPR-owning procurers in the cases analysed here are large, professional public institutions and public-owned companies with a certain specialisation; whereas a relatively small municipality seemed to find the ownership and management of IPR rights incompatible with their core activities. In the US cases, IPR rights were shared between procurers and suppliers (suppliers keeping non-exclusive ownership rights of their inventions, and procurers getting free usage rights on supplier-owned IPRs). The case experiences seem to indicate that most benefits (including, not least, the incentive to take risks, to innovate and commercialise) may be obtained from letting the supplier keep the IPR ownership rights to its own inventions.

Multiple competing suppliers in development projects do not seem to be a very common phenomenon in Europe. Among the EU cases studied, only one had multiple (two) suppliers. In the US, the strategy of competing supplier development has, however, been used more frequently and successfully. Because many EU cases studied were large integration projects the number of suppliers available for a project was often limited, and due to the operational scope of the assignments the creative innovation potential was often restricted. Suppliers were also found to be rather risk-averse due to the fact that procurers were often not interested in seriously addressing the potential business case of the project. Thus, suppliers were not inclined to invest time and money in developing groundbreaking value-for-money innovations in a development project where they could be sure that there would be a real commercial benefit for them afterwards. Suppliers are also reluctant to risk revealing their company knowledge to other suppliers working in parallel on the same project. Thus, special effort needs to be put into ensuring that the benefits for suppliers, including issues regarding IPRs are clarified before the tendering process. The PCP "funnel model" can prove to be a catalyst in fuelling innovative projects. It is, however,

assessed that the multiple supplier element is probably the most challenging part of the PCP concept. The post-project business plan should be updated after each phase, gradually making the potential benefits more and more complete as the project develops.

Bundling of demand can be beneficial to the procurement process, especially in terms of reducing risk for the procurer, of knowledge-sharing, and in terms of the procurers being able to raise enough money to actually procure the product or service in question. If the critical mass of the procurers involved is large enough in their sector, there is a possibility that a lead market or de facto standard can be created on the basis of the development project. In certain cases, the bundling of demand may also create a volume of demand that is large enough to attract suppliers from outside Europe who may be willing to locate (parts of) their R&D and possibly production activities in the EU. Often, however, procurers are concerned with issues relating to national security of supply, national employment or national capacity building. For EU Member States to fully benefit from PCP it is important to address the issue of the geographical scope of the PCP project.

Bundling of demand is also not always without drawbacks. In particular, the requirements for coordination among the different suppliers, reconciling possible differences in requirements to the product or service to be developed, selection of suppliers etc. may require much co-ordination, time and resources.

The more **capable** and knowledgeable the procurer, the better equipped he is to choose the right supplier for the project, to foresee and rectify any shortcomings or pitfalls in the process, and to be a professional and equal sparring partner with the supplier. This is also related to the issue of benefit, since tapping into the knowledge and capacity of the procurer (e.g. knowledge of user needs, test capacity etc.) may also be counted among the benefits that the supplier can get from participating in public innovation projects.

Barriers to **SME involvement** in major development projects can be high, in particular due to the requirements to financial capacity and human resources. However, there are a number of ways in which the main barriers to SME participation can be overcome:

1. Setting the scope and scale right; ideally the project should not be too large, or require a very broad range of different capabilities,

2. Reducing the risks of commercialisation, e.g. through the preparation of a solid business plan and linkage of a venture capital programme to R&D procurements,

3. If the project is large, organising it in such a way that there are defined tasks/roles of suitable size and complexity which can be undertaken by smaller enterprises, either alone or as part of a consortium, and

4. Separating R&D procurements from procurement of final end-products for large-scale deployment. In this way, company selection criteria related to financial turnover/stability and customer references, which procurers often use as a tool to filter out companies with a high risk profile in procurements for commercial deployment, do not hinder SMEs in bidding for R&D procurements which cover exactly the growth phases an SME has to go through in order to become a firm with customer-tested product references.

The **contract** is an important, but not exclusive, tool for steering the project. A close **dialogue** between procurer and supplier is, however, even more important, in particular when the project faces difficulties. Lack of flexibility during the contract phase may constitute a significant barrier to promoting innovation through public procurement. Some of the more successful projects amended the contract several times during the development phase in order to incorporate experiences gained during the project, although this cannot be said to be a success factor in and of it. Successful innovation requires interaction throughout the process which may be facilitated by dividing the project in phases.

The **motivation** of EU procurers to undertake technology procurement is overwhelmingly to address their short term specific operational needs, whereas concerns regarding innovation, business and market development seem to play a very small role in the motivation of the public procurers. Procurers in Europe tend to focus on immediate tactical purchasing needs rather than strategic, longer term quality/efficiency constraints on public services. Again, this is linked to the lack of an incentive structure which rewards entrepreneurial behaviour and innovation. Often, the short-term needs defined by the procurers can be fulfilled by adapting existing technology and applying it to the new context; radical innovations are usually not strictly necessary to address these short-term needs and EU procurers thus tend to stick with projects where the risk is manageable. Radical innovation does not seem to be the primary concern of *suppliers* in EU procurements, either. Their observed unwillingness to take risks in projects where all benefits stay with the procurer could indicate that their own primary motivation to participate in these projects is primarily to do "paid work", with the possible added bonus that they may be able to develop their core business in small steps, rather than radical ones. This situation is different in a number of the US procurements where due to the procurers' willingness to share R&D benefits and risks, more radical innovation projects can be initiated.

As for impacts, there are two main types of impacts that can be observed from the projects studied: **Social impacts** are derived from fulfilling the public needs which the public procurers wanted to address through the introduction of new products or services. These include both wider social impacts such as increased public safety and traffic safety, as well as efficiency gains in the public sector and/or improved public service. **Business and market impacts** are experienced by participating companies in terms of market growth, company growth and, in rarer cases, the emergence of lead markets.

Based on the analysis of the case studies, a number of key success factors for public technology procurement were identified:

- Long term planning of procurement needs, resulting in a well-prepared business case for the procurement project
- A clear risk handling strategy
- A considered strategy for handling IPR (or more generally, project outcomes/benefits)
- Close dialogue between the parties involved
- A performance (not just lowest cost) based contract, possibly with performance requirements that become more specific over time
- A (technically and organisationally) capable and involved procurer
- Incentives/enabling structures in place

Summing up, there are many advantages to the PCP model compared to the traditional approach to technology procurement. PCP-like strategies have been applied successfully in the US, not only in the defence sector but also, as described in this report, in the energy sector, which led to the development of the US computer industry. The difference in scale and long-term commitment be-

tween these US examples and what is feasible in a European context must be considered, but it is clear that public authorities *can* significantly improve the quality and efficiency of public services and simultaneously foster innovation by acting as a demanding first buyer, in particular when resources are pulled together (bundled) and applied within the framework of a long-term strategy. There are, however, also a number of issues that need to be addressed, in particular that of a well considered strategy for risk-benefit sharing and ensuring a competitive supply chain.

6.2 Recommendations

In this section, a number of recommendations based on the findings of this study are presented. The recommendations are linked to the key success factors. As was seen in the discussion and overview of key success factors in chapter 4, many of the European cases studied were not performing particularly well in these areas, whereas the US cases to a much larger extent were positively influenced by strong performances on several key success factors. Thus, there is a need to reconsider the way technology procurement is done in Europe so that these key success factors are more likely to be present.

Before presenting the recommendations in detail, an overview of the recommendations and their relationship to (i.e. potential positive influence on) the key success factors are shown in table 6.1.

In the table have also been included some additional elements, such as the involvement of SMEs, which - as previously mentioned - are not in themselves necessarily key success factors, but which are key to European industry and innovation policy.

The coloured fields in the table indicate which of the key success factors the implementation of the recommendations is expected to have an effect on. Some effects are direct – such as the direct effect of training of staff on organisational capability – while others will be more indirect, such as initiatives to promote bundling of demand, which may reasonably be expected to have a positive effect in terms of more projects with multiple suppliers.

Figure 6.1 Overview of recommendations and their relation to the key success factors and other key aspects of PCP

Key Success Factor / Recommendation	Clear risk handling strategy	Long term planning, good business case	Close dialogue	Performance based contract	Technically capable procurer	Organisationally capable procurer	Incentive/enabling structures in place	IPR / project result handling Strategy	*Multiple suppliers*	*Bundling of demand*	*SME involvement*
1. Identify public sector priority challenges which could be addressed through pre-commercial procurement of innovative solutions (linking to Lead Market Initiative)		■	■		■		■				■
2. Establish specialised networks of public procurers within specific areas for exchange of information and best practices	■	■				■	■		■	■	
3. Promote bundling of PCP demand at European level									■	■	
4. Establish special support measures for public procurers (e.g. for networking, development of business plans)	■	■						■			■
5. Establish training courses/ "continuing professional development" for PCP	■	■	■	■		■		■	■	■	■
6. Rethink incentives and enabling structures to encourage radically innovative procurements (e.g. funding)							■				
7. Develop "PCP in practice" handbook for procurers	■	■	■	■	■	■	■	■	■	■	■
8. Link PCP to external funding (venture capital) schemes		■									■

In the following, the recommendations have been grouped under two headings:

- Promoting knowledge and uptake of the PCP concept among public procurers

- Improving the PCP concept in practice

6.2.1 *Promoting knowledge and uptake of the PCP concept among public procurers*

1. Identify public sector priority challenges which could be addressed through pre-commercial procurement of innovative solutions
To ensure long-term planning and strategic co-ordination at European and national levels, it is recommended that activities are initiated with respect to identifying specific and high-priority public sector challenges that offer significant potential for innovation through pre-commercial procurement projects.

It is **strongly recommended** that such activities are co-ordinated with the **Lead Market Initiative for Europe** which has already identified six innovative markets among which, in particular, the eHealth and renewable energy markets seem to offer a host of possibilities for addressing public sector challenges through pre-commercial procurement. Co-ordination is needed to combine resources and avoid duplication of effort. The Lead Market Initiative includes public procurement as one of its instruments, and including pre-commercial procurement in the "toolbox" could help achieve rapid "lift-off" for high-profile pre-commercial procurement projects, building on the work that has already been done under the Lead Market Initiative.

Other markets offering pre-commercial procurement opportunities (supplementing those selected for the Lead Market Initiative) could be identified by expert group(s). Such groups may be appointed by the Commission, for trans-European initiatives, or by governments at the national level.

Once the areas in which there are clear public needs/challenges and opportunities have been identified, activities can be taken further as detailed in the following recommendations.

Responsibility/initiative:	**Commission (and national governments for national initiatives)**
Time horizon:	Immediate start of activities. 1-2 years for projects to begin implementation.

2. Establish specialised networks of public procurers within specific areas for exchange of information and best practices
Following the identification of areas that offer particular opportunities for initiating the first real pre-commercial procurements, it is recommended to set up networks of public and semi-public procurers (authorities, institutions, utilities, etc). The initial purpose of such networks will be exchanging information, learning from best practice examples and further detailing specific needs and pre-commercial procurement opportunities within the relatively narrow field to which each network should be dedicated. The issues covered by the networks should include practical aspects of pre-commercial procurement, including how to initiate and carry out dialogue with potential suppliers, the definition of technical specifications and award criteria, the use of standards, the handling of risk, IPR issues, contract implementation etc.

Some of these networks may keep their focus on mutual learning and exchange of experiences, with individual procurers improving their own procurement activities on the basis of the information and knowledge gained from the network activities. However, the formation of groups of procurers that initiate common

procurement projects – i.e. bundling of demand – should be prioritised, as detailed further in the next recommendation.

Procurer networks can be set up at both European and national level. As with the Lead Market Initiative at European level, the set-up of networks at national level should draw on networks and relevant initiatives already existing at national or regional level.[70]

Responsibility/initiative:	**Commission (and national governments for national initiatives)**
Time horizon:	1 year after definition of areas in which to set up networks.

3. Promote bundling of demand for PCP projects at European level
Bundling of demand at the stage of procuring R&D is key is to establishing technology procurement projects with more radical innovation and commercialisation potential, attracting multiple suppliers, sharing of knowledge between public authorities, and contributing to setting new standards.

It is therefore recommended that the Commission, in co-operation with Member States, promote the formation of buyer's groups of public authorities and institutions with similar needs with a view to initiating common PCP projects (bundling demand). The groups may, for instance, initiate common "calls for solutions", inviting potential suppliers to propose innovative solutions for the identified challenges.

As a second step the Commission could also provide financial incentives to co-fund cross-border PCP projects addressing topics of common European interest. This should be linked to both Recommendation 1 and Recommendation 2, focusing on specific public sector challenges in order to avoid redundant networking activities with too little focus on and commitment to solving specific problems.

Possible initiatives could include:

- Establishing new procurer networks in specific fields of priority (cf. also Recommendation 2, above)
- Establishing a "procurers' portal" with a database of procurers with similar interests by subject/field of interest. This could be an add-on to e.g. the SIMAP website, or a new portal/website dedicated exclusively to innovation and technology procurement. Such an initiative will probably need to be promoted in connection with more concrete network-building initiatives, such as:
- Working with existing European networks of potential technology procurers (public authorities etc.) to promote the concept of PCP and to "match" procurers in specific areas
- Establishing a Community programme to give financial incentives to cross-border PCP projects on topics of common European interest proposed bottom-up by groups of procurers or top-down from top political priorities

Responsibility/initiative:	**Commission**

[70] Examples of existing national/regional initiatives include The UK Office for Government Procurement, which brings together actors from procurement authorities, and initiatives in Germany at Länder level.

Time horizon:	1-2 years for establishment of groups.

4. Establish special support measures (networks of expertise) for public procurers for development of PCP post-project business plans at European and/or national level

Solid business plans/analyses of post-project commercialisation potential are key is to attracting potential suppliers to PCP projects. At the same time, public organisations, especially at the local level, often have little expertise in preparing such business plans. It is therefore recommended to establish (links with) networks of experts who can assist public organisation in this. The simplest way to do this would be to link up with existing public/private organisations to utilise existing expertise (e.g. business case analysis provided by organisations like German IHK, KfW, regional development organisations, etc.). It could also be considered founding a European special PCP group to support the public entities.

The services could be co-funded by the Commission or national technology development programmes, but should incorporate at least some degree of user fee in order to ensure commitment on the part of the users. Establishment of or linking with such networks of experts should be accompanied by an information effort, preferably in connection with publication of PCP guidelines or a similar effort to promote the knowledge of the PCP concept among potential procurers.

Responsibility/initiative:	**Commission and/or national authorities**
Time horizon:	2-3 years

5. Establish training courses/ "continuing professional development" for PCP

In order to improve the knowledge of the PCP concept and the professional implementation of technology procurement projects, it is recommended to prepare PCP training curricula and promote the establishment of national training courses/continuing professional development schemes (e.g. "Master in public technology procurement") for public procurement staff and other public servants in relevant positions. In order to maintain high standards of training and linking with related issues such as project management, the training should preferably be carried out by existing institutions (e.g. business schools) and professional bodies.

Responsibility/initiative:	**Information/awareness activities or incentives by Commission in co-operation with national level, possible development of common curricula**
Time horizon:	3-4 years

6. Rethink incentives and enabling factors for public procurers to engage in truly innovative technology procurement

Encouraging public authorities to engage in radically innovative technology procurement requires a higher degree of incentives – financial, political, etc. How this can be done will depend on the different governance structures in Member States and will thus require more attention than can be provided within the remits of this study. Examples of issues that need to be addressed include the separation of procurement activities and economic (e.g. regional) development teams in different offices or even at different levels of government. This does

not encourage the combination of addressing public needs and promoting innovation through pro-active technology procurement.

As regards enabling factors, a key issue is funding, and it may be considered promoting alternative ways of spending funds earmarked for business development and/or research, by redirecting some R&D funds to PCP procurement, or by awarding financial incentives from R&D&I agencies to procurers to undertake PCP projects. It can also be envisaged that in cooperation with banks and/or insurance companies financial schemes can be setup to reduce the risk of producers to procure radical innovation. Finally, political recognition of the importance of procurers to carry out PCP in areas of political priority is also needed. It is therefore recommended to initiate a debate with the Commission, Member States, research institutions and others on how such incentive structures could work in practice.

Responsibility/initiative:	**All levels**
Time horizon:	4-5 years

6.2.2 Improving the PCP concept in practice

7. Develop "PCP in practice" handbook for procurers
This recommendation is closely linked – possibly a prerequisite - to the previous recommendations regarding the promotion of the knowledge and uptake of PCP.

It is recommended that showcase projects are set up and funded at European (cross-border) level to demonstrate the potential contribution of PCP to the improvement of public service effectiveness and the innovation capacity of Europe in a few key areas of political priority for the public sector. Based on these experiences and experiences of individual Member States it is recommended that a handbook on "PCP in practice" is developed to further elaborate on concrete implementation lessons learnt and demonstrate how success factors can be optimised, e.g. bundling of demand, IPR and financing issues, etc. The handbook should be based on real case examples and be sufficiently operational to assist individual public authorities in initiating public technology procurement projects.

Responsibility/initiative:	**Commission**
Time horizon:	2 years

8. Link PCP to external funding (venture capital) schemes, primarily for the commercialisation phase
With a view of attracting innovative companies, and in particular provide SMEs with the opportunity to compete on equal footing with larger firms in PCP projects, it is recommended that some SME specific measures are considered to be combined with PCP.

Innovation, especially radical innovation, usually requires high company investment in the commercialisation phase. Therefore it is recommended that PCP is "linked" to a venture capital-type scheme to help SMEs finance the commercialisation of new products or services developed in PCP projects. The "link" could be realised by having a venture capitalist in the expert evaluation team for the PCP procurement, and by recommending SMEs in PCP projects to submit an application to existing VC funds in their field, or possibly even setting up new 50% government – 50% private financed VC funds in areas addressed by strategic

PCP projects where there is a lack of VC resources. A new "PCP Venture Capital Fund" could be set up at European level, or close links developed with existing public and/or private funds.

Large companies may not only possess larger resources than SMEs for the commercialisation phase but also during the R&D phase, e.g. for protecting intellectual property. Therefore it is recommended that member states that have implemented the new R&D&I state aid measures for intellectual property rights support to SMEs, inform SMEs that participate in PCP projects of the opportunities to apply for such funding.

Responsibility/initiative:	**Commission**
Time horizon:	2-3 years

Annex I: Methodology

6.3 Overall approach

The overall approach to methodology in the present report has been a qualitative approach based on case studies. The approach corresponds with the Terms of Reference (ToR) and has moreover been chosen, as the PCP concept in a European context is highly tangible and therefore a qualitative approach was needed in order to thoroughly understand how the mechanisms in PCP contribute to make the procurement process more innovative.

A database of innovative public technology procurement cases was originally required in ToR. However, as the focus and scope of the present project has changed since ToR was written, and it was agreed with the Commission that focus should be on PCP cases, a database became superfluous as no clear-cut PCP cases could be identified.

The focus has since shifted back to increase the focus on innovative public technology procurement cases along with cases with PCP elements in them in order to expose how innovation is promoted in public procurement in Europe as thoroughly as possible.

6.4 Data collection

Data collection has mainly been through case studies. However, prior to identifying and carrying out the case studies, data has been collected through scientific literature, internet research, and the TED database. As previously noted, the PCP concept is a fairly unexploited term in the general scientific literature, and it has therefore been necessary to put great value in the case studies.

6.5 Identification and selection of cases

The case studies have been identified and selected by taking departure point in identifying best practise examples of PCP in Europe and the US. The process however revealed that no full-fledged PCP cases could be identified. Hence, the case studies presented in this report are not necessarily best practice examples of PCP (as these could not be identified). Rather, the cases were selected for their potential to illustrate elements of relevance for PCP, such as multiple suppliers or risk sharing (the case selection criteria are further discussed in section 6.5.3).

The identification and selection of cases has been undertaken with departure point in steps three and four of the ToR, being:

Step three, which involves desk, research of available cases through scientific literature, internet research, and the TED database.

Step four, which involves identification of best practice cases via a survey among 25 Member States[71].

While not exactly narrowing or changing the scope of the study, the focus on the pre-commercial procurement aspect meant that a large part of the search for relevant case studies focused very specifically on finding examples of pre-commercial procurement. However, as the concept is new and legally based on

[71] Ramboll Management, 2005: Opportunities for Public Procurement in the ICT sector in Europe, Part B: Technical proposal, page 10

a little known – and somewhat obscure – paragraph in the new procurement Directive from 2004, finding cases matching the characteristics proved to be challenging. Moreover, PCP is registered centrally, neither in Member States nor at EU level. The identification of relevant PCP cases has hence been based on different publicly available sources of information. Moreover, as previously mentioned, finding clear-cut PCP cases has not been possible and instead, the research has evolved around identifying cases where elements of PCP could be found and thus discussed in a European context.

6.5.1 Sources of information

The following sources of information have been used to identify relevant cases[72]:

a) Scientific literature
b) Online references
c) Tenders registered in the TED database
d) Survey among the 25 Member States

In the following, the experienced challenges in identifying relevant cases through the above mentioned sources of information are briefly discussed.

Ad a) and b)
As mentioned, research has shown that PCP is a fairly unexploited term in literature. Existing literature analysing procurement of products and services often focuses on public technology procurement, which is associated with procurement of commercial products under the public procurement rules outlined in the procurement directives of the European Union. Research and explorative telephone interviews revealed that procurers and suppliers in Europe are largely unfamiliar with the PCP concept and thus the exemptions from the WTO GPA and the procurement directive. Procurement is conducted under the procurement directives and R&D, feasibility studies and the like are typically carried out in the procurer's network without assistance of potential suppliers.

The research has been extended to include military cases from the US, but with a civilian application. However, as the analysis shall later show, the framework conditions differ greatly in the US compared to Europe. Inspiration can be found in the US but due to the framework conditions lessons from the US cannot be transferred directly to the European context.

Ad c)
The report on pre-commercial procurement of innovation estimates, based on CPV code 73 of the TED, that the EU wide tendered R&D procurement market has a value of €2,5Bn[73]. A review of a sample of 50 tender notices and publications from 2006 within CPV code 73 (Research and development services) has been conducted by Ramboll Management in May 2006. The review shows that a number of the tenders registered under CPV code 73 are commercial consultancy services. It is not clear from the notices and publications if any of the 50 tenders qualify as pre-commercial procurement of innovation as defined previously in this report.

Ad d)

[72] Ramboll Management, 2005: Opportunities for Public Procurement in the ICT sector in Europe, Part B: Technical proposal, section 4.4, 4.5 and 4.6, page 28f

[73] National IST Research Directors Forum Working Group on Public Procurement in Support of ICT Research and Innovation, 2006: Pre-commercial Procurement of Innovation – the missing link in the European Innovation Cycle. March 2006, page 10

The Institute for Prospective Technological Studies (IPTS) has carried out interviews with procurement experts from eight Member States with regards to public procurement practices in support of ICT Research and Innovation[74]. Through these interviews, five examples of innovative procurement was identified, all of them in the field of e-government[75]. We have extended this survey to include all 25 Member States. We have identified and contacted at least one expert from each member state by e-mail and telephone. The response from the member states has mainly been negative in terms of identification of potential PCP case studies. This confirms the difficulty and unawareness of the concept PCP among EU Member States. However, EU Member States like the United Kingdom and the Netherlands have initiated specific programmes like the Forward Commitment Procurement Programme (FCPP)[76], SBRI and SBIR to facilitate and promote innovative products and services. The results of these programmes, especially the FCPP, is yet to be exploited, but seems promising in terms of identification of potential case studies (For a list of contacts see Annex 3).

Throughout the project it has been a challenge to identify persons with a good knowledge of PCP cases. In addition, it has been a challenge to identify experts with knowledge on the applied processes of the investigated case studies and the macro economic impact of the case studies. Moreover, respondents involved in procurement are generally not familiar with the term PCP which further complicates the identification of relevant PCP case studies.

6.5.2 Methodology for the identification of case studies

Given the challenges with identifying case studies, the following provides some comments to the agreed methodology for the identification of case studies.

The following points outline the case study identification and validation process:

[74] National IST Research Directors Forum Working Group on Public Procurement in Support of ICT Research and Innovation, 2006: Pre-commercial Procurement of Innovation – the missing link in the European Innovation Cycle. March 2006. Page 11

[75] National IST Research Directors Forum Working Group on Public Procurement in Support of ICT Research and Innovation, 2006: Pre-commercial Procurement of Innovation – the missing link in the European Innovation Cycle. March 2006. Page 11

[76] Forward Commitment procurement has been identified by the Environmental Innovations Advisory Group (EIAG is an industry led advisory group to the UK Government) as having the potential to drive environmental innovation, help innovations reach the market and deliver much needed solutions to pressing environmental problems.

Figure 0.1: Methodology for case study identification, validation and selection

No.	Activities	Approach
1.	Identification of potential case studies	Desk research
2.	Analysis of size of procurement contract	Desk research/ Selected exploratory telephone-based interviews
3.	Analysis of PCP content and type of product/process innovation	Desk research/ Selected exploratory telephone-based interviews
4.	Comparison of identified case studies with desired geographical-/ sector scope	Desk research

Approach to the identification
Focus was on identification of large government projects in the relevant field (e.g. e-government, transportation, healthcare, education, energy or media), and then at the same time or afterwards looking into the specific process under which the product/service was developed and procured.

Looking for cases outside the ICT sectors
The scope of the study, and thereby also the identification of cases, was expanded to include not only the ICT sector, but also the IS sectors, consisting of both the ICT producing sectors and the ICT intensive sectors, in order to identify the best pre-commercial procurement of innovation cases.

Cases in the US, South Korea and the private sector
Good cases on pre-commercial procurement of innovation will be identified in the US and South Korea. If necessary, we will expand the scope to include more cases in these two countries and less in the European Union.

Following the initial screening of potential cases, the actual selection of cases was based on a number of case selection criteria which are presented in the following section. They represent the key aspects of the PCP concept.

6.5.3 Case selection criteria

In the search for and screening of potential cases, a check-list of case selection criteria was used. Firstly, a few overall "killer criteria" which were required to be present were applied:

- Procurement (i.e. the acquisition of goods or services at the best possible total cost of ownership) took place (i.e. not research grants, seed capital etc.)
- That the case was not too old (not more than 15-20 years, preferably younger)
- The case should be far enough in the innovation process to yield learning point of the innovation process

Secondly, for a case to be interesting for this study it needed to include at least 2 or 3 – and preferably more - of the following elements:

- Project based on **public need**; post-project market potential for the innovation/product regarded as limited
- **Functional or performance-based specifications** applied instead of technical specifications in the tender material

- "**Technical dialogue**" or similar interaction between procurer and potential supplier(s) has been applied
- **Flexible contracts** (a.k.a. imperfect contracts) have been used. This would imply that negotiation on ToR (or alike) has been carried out during the execution of the project
- **Process and/or service innovation** where the public procurer needs assistance in optimising public service etc.
- **Geographically split R&D** between European and non-European R&D facilities (e.g. Europe/US). Co-location of R&D is an issue of interest when setting up PCP projects
- **Pre-commercial volume production** with field testing
- **Risk sharing** between supplier and procurer
- **Transfer of IPR** between supplier and procurer
- **Bundling of demand** - several procurers bundle their orders to establish "critical mass" to justify development costs
- R&D from SMEs; involvement of SMEs is not in itself a characteristic of PCP but is an essential part of EU innovation and industrial policy
- The creation of **lead markets** for the products/services developed

6.5.4 In-depth case screening

The initial case database based primarily on desk research turned out not to provide sufficient data to determine whether a project was relevant for the study or not, since the type of information required (the selection criteria) is rarely publicly available on the internet, in published reports etc. Thus, it was necessary to go beyond the desk research-based screening and establish a direct contact to each potential case study project in order to establish the project's eligibility.

As a rule, the procurer was approached first and the procurer's permission was solicited to contact the supplier. Only in exceptional cases was the supplier approached first. Since the subject is rather complex and the PCP concept not commonly known, first contacts were made by e-mail, explaining what the study team was looking for. Depending on the answer (if any), the contact would then be developed via e-mail and telephone, with one or more explorative telephone interview(s) as the first milestone. Only then could it be determined whether the project could become a case study.

This screening process has taken several months, with a large number of projects and contacts involved. Close to 60 projects were included in the screening process.

Most of the potential cases of interest were discarded on the basis of the screening; either because the project was assessed as having little or no PCP relevance - usually because no procurement has taken place - or because the person(s) responsible for the project in question could or would not participate.

As already mentioned, no fully-fledged PCP cases were identified; procurement takes place within the procurement directives. Thus, cases were selected for their potential to illustrate elements of relevance for PCP, such as multiple suppliers or risk sharing (cf. the case selection criteria above).

6.5.5 Clustering of cases

At the first review meeting, the possibility to cluster cases with similar characteristics (e.g. smartcard projects) was discussed, and this possibility has been pursued in the screening process. However, with the limited number of relevant cases emerging from the exercise, clustering possibilities were limited and have thus not been pursued.

Annex II: Programme approaches: US SBIR and others

Increased competitiveness among small and medium-sized enterprises (SMEs) is a key focus point for many countries currently. One of the main sources for increased competitiveness is increased innovative capabilities and especially SMEs may struggle with the increased pressure to be innovative. Research and development is often costly in terms of capital and highly skilled labour and public support programs for SMEs have increasingly been used by nations to work with this.

The American Small Business Innovation Research (SBIR) program and its European counterparts are one way for the public to support innovation among SMEs through R&D grants and public procurement. Another approach to public support for increased SME innovation capabilities is the (more specialised) agency approach represented in this report by the EUROCONTROL case.

This chapter serves to present the status and lessons learned by some of the dominate SME support programmes. In addition this chapter aims at projecting these lessons learned into a discussion on possible pan-European support programmes for SMEs.

6.6 US Small Business Innovation Research programme

The United States Small Business Innovation Research programme (SBIR) was established in 1982. Each year it makes about 4.000 awards to SMEs, totalling over USD 2 Billion in value. SBIR awards take the form of procurement contracts or grants for the development of technologies that US federal government agencies see future perspective in both in the public and private sector. It is anticipated that this R&D support the aim is that this will lead on to mainstream development contracts, procurement by the agency of developed products or some other form of commercialisation. Of the 12.000 companies that have received SBIR grants since 1983, about 10.000 are still in business[77].

SBIR awards are designed to provide 100% of the funding needed for a project, plus a small profit element for the business undertaking it. Whilst the 'norm' is USD 850.000 for each project, the size of awards can be substantially larger. Small businesses can win and run multiple projects in parallel. The majority of award winners are businesses with less than 25 employees.

Small businesses must meet certain eligibility criteria to participate in the SBIR program.

- American-owned and independently operated
- For-profit
- Principal researcher employed by business
- Company size limited to 500 employees

The US legislation underpinning the SBIR programme requires that agencies involved in the SBIR program distribute 2.5% of external R&D budgets through this means. Eleven US federal departments and agencies are required by SBIR to reserve a portion of their R&D funds for awards to small businesses. These agencies are part of the US SBIR programme:

[77] Interview with Mrs. Jo Ann Goodnight, NIH SBIR/STTR Program Coordinator, National Institute of Health

- Department of Agriculture
- Department of Commerce
- Department of Defence
- Department of Education
- Department of Energy
- Department of Health and Human Services
- Department of Homeland Security
- Department of Transportation
- Environmental Protection Agency
- National Aeronautics and Space Administration
- National Science Foundation

Each participating department or agency publishes a list of topics under which business can apply for SBIR grants. Following submission of proposals, the departments or agencies make SBIR grant awards based on small business qualification, degree of innovation, technical merit, and future market potential.

Each agency or department has a list of international third-party experts that can be called upon to assess incoming proposals on the publicised topics of interest. These experts give written recommendations to the agencies on which proposals the agency should support with an SBIR grant.

Small businesses that receive and SBIR grant automatically enrol in a three phase development process:

- Phase I is the start-up phase. Awards of up to USD 100.000 for approximately 6 months supported exploration of the technical merit or feasibility of an idea or technology.
- Phase II awards of up to USD 750,000, up to 2 years, expanding Phase I results. During this time, the R&D work is performed and the developer evaluates commercialization potential. Only Phase I award winners is considered for Phase II.
- Phase III is the period during which Phase II innovation moves from the laboratory into the marketplace. No SBIR funds support this phase. The small business must find funding in the private sector or other non-SBIR federal agency funding. Procurement by a public institution is also a possibility.

Key features of the US SBIR process:

- Regular solicitations at fixed dates during the year
- Awards directed at the best submissions from across the US; no state or regional quotas
- Transparency in terms of topics, awards winners and amounts
- Standard contracts; companies own the intellectual property developed
- Clear linkage to agency R&D interests and priorities; strong focus on commercialisation
- Prime contractors are encouraged to take up SBIR developed products.

The US Small Business Administration (SBA) acts as the coordinating agency for the SBIR program. It directs the 11 agencies' implementation of SBIR, reviews their progress, and reports annually to the US Congress on its operation. SBA is

also the information link to SBIR. SBA collects solicitation information from all participating agencies and publishes it quarterly[78] [79] [80].

The SBIR programme promotes a phase structure where individual contracts are assigned to each phase. Procurement may take place in phase 3 which may in a few instances make projects comparable to PCP (if the procuring institution is the same one that financed the research phases) - but in most instances this must be considered procurement of an already existing product (developed in phase 1 and 2).

In addition the SBIR program only funds the R&D stages meaning that funds for commercialization must be obtained in the private sector or other non-SBIR federal agency funding.

In conclusion, the SBIR programme incorporates interesting elements of which the PCP frame work may draw some lessons learned. The SBIR programme however is put in place for a different purpose than PCP.

One of the main pillars in the US SBIR concept is to secure a low-risk environment for SMEs to develop and verify ideas and technologies. Two cases were analysed where the project was implemented as a grant, not procurement: the Symantec and Snap-fit case. These US SBIR cases exhibit substantial impacts on the involved companies and their markets. However, these impacts cannot be generalised, since these project cases were chosen exactly because they were successful. Thus, they serve to illustrate the kind of impacts that *can* be achieved from a targeted SME research programme; they are not necessarily representative of the entire programme.

Symantec case

Radical innovation
The Symantec case is an example of radical innovation. Symantec, now a major international software company, is a spin-off from the NSF SBIR programme. Funded by SBIR, Symantec developed the very first natural language understanding (English) for microcomputers in 1979. The project initially involved a group of Stanford University Researchers led by Dr. Gary Hendrix. The outcome of this project was the Q&A software, which was regarded as a true breakthrough in software.

The Symantec case benefited greatly from the risk tolerance which is part of the framework conditions in SBIR. The SBIR grant was not linked to public procurement; the commercialization breakthrough came after the company published an article about Q&A in a trade journal, which resulted in thousands of orders. It was of significant importance that SBIR provided extremely high-risk start-up capital for the complex idea of Q&A to be developed. SBIR provided the early financing, and profits from the commercialization of Q&A enabled Symantec to pursue rapid growth and recruiting, growing from a small, four-person start-up to a large, diversified software firm.

The growth of Symantec – the company

[78] Secrets of the worlds largest seed capital fund, Cambridge Centre for Business Research
[79] Description of the Small Business Innovation Research Program (SBIR), United States Small Business Administration, www.sba.gov
[80] Interview with National coordinator Dr. G. Cleland, United States Department of Agriculture

In 1982, the company Symantec was founded by Dr. Gary Hendrix, the leader of the Stanford University Researcher which developed the natural language understanding programme under the NSF SBIR. The establishment of Symantec was based on the commercialisation of the Q&A software. Q&A's significant sales and earnings allowed Symantec to rapidly expand and diversify through acquisitions.

According to the founder of Symantec the NSF SBIR project was vital for the development and commercialisation of the Q&A technology by providing intellectual and commercial interest that worked as a catalyst. Furthermore, it was of significant importance that SBIR provided extremely high risk start-up capital for the complex idea of Q&A to be developed.

Symantec quickly went after top quality technical and marketing staff and venture capital, and ultimately 19 acquisitions. "SBIR provided the extremely high risk, startup financing for a very complex idea that had many exciting, potential applications and great economic leverage, if successful." It provided the early financing and profits from Q&A for Symantec to pursue rapid growth and recruiting, as Symantec later managed to attract 12 scientists and engineers from academia s well as skilled marketing people and $3.5 million of venture capital from Kleiner, Perkins.

The profits from Q&A sales supported the company's early development and Symantec grew from a small, four-person start-up to a large, diversified software firm. Symantec's initial success with Q&A led to an initial public offering of $10.5 million that was followed by 19 acquisitions.

Snap-fit case

The "Snap-Fit" composite connections, developed and patented by Ebert Composites Corporation is an example of commercialisation of a technology developed for the U.S. armed forces under the SBIR programme. The Snap-Fit technology allows for rapid assembly and improved mechanical integrity of large, load-bearing composite structures. These connections do not rely on secondary bonding or fasteners; instead, fibre architecture, combined with low-cost machining, produces joint connections with mechanical strength.

In the US Snap-Fit case, the development of the Snap-Fit technology rested on the three-phase model of the US SBIR Program. The first phase focussing on proof of concept and the second more R&D-oriented phase makes for interim project reviews and the ability to halt the project after phase one if the technology does not show clear signs of viability (Go/no-go decisions). The outcome of the Snap-Fit R&D project is not seen by the supplier as being directly related to the phase structure of the SBIR program but the ability to finance proof of concept work (phase 1) is highlighted as one of the strengths of the program. This way companies may test more or less hypothetical ideas without putting it through costly R&D development.

In the Snap-Fit case, procurement was not directly part of the SBIR funding, but the SBIR project was instrumental in securing the US Navy as the first customer. The technology has later been integrated in commercially successful 'civilian' products based on licensing of the technology. The company argued that they would not have been able to get acceptance from shareholders etc. for a technology validation project, and without the SBIR bringing forward a risk-minimum platform for R&D development the Snap-Fit tech-

nology would not have been as developed as is the case today. Risk sharing takes place in the SBIR programme through the IPR agreement with the companies. Companies are given non-exclusive IPR ownership rights on their developments in return for license free use and the right to license to third party suppliers for the government.

The development of the **Snap-Fit** technology is viewed by the developing company, Ebert Composites Corporation, as a great civilian commercial success even though the financing came from the armed forces. The civilian market proved more ready for the Snap-Fit technology than the defence market and Ebert sees the SBIR grant as essential for the civilian success of the technology. The development of the Snap-Fit technology has impacted both the US Navy as SBIR granting organisation as well as the commercial market. Through the SBIR program, the US Navy received highly relevant information on new composite materials with better properties than existing materials currently used in ships and ground installations. Different defence-related products are now being developed based on the Snap-Fit technology and these products are expected to improve performance and durability of many different defence applications from ship hatches to infantry river-crossing materiel. The civil commercial market has gained from the development of the Snap-Fit technology as well; especially the transmission/communications towers market has been impacted by Snap-Fit. Several new transmission/communications towers have been brought to the market with better performance, less weight and less negative production impact in terms of emissions. Ebert does not manufacture the products themselves, but have generated revenue from license fees of 5.25 million USD since the technology was developed in the 1990s.

Learning Points:

- As argued by Ebert Composites Corporation the company would not have been able to develop the Snap-Fit technology without external financing. Hence, 100% public funding is a necessity due to SME cost of capital
- The commercial success of the technology rests upon the fact that Ebert Composites Corporation owns all proprietary rights to product, services and documentations developed under the SBIR grant. This puts Ebert Composites Corporation in a position to commercially exploit the technology with a joint venture partner fast and efficiently.

6.7 The European attempts

6.7.1 Dutch Small Business Innovation Research programme

In November 2004, the Dutch Ministry of Economic Affairs launched a pilot for contracting out innovative R&D to SMEs, following the approach of the US Small Business Innovation Research Programme (SBIR). On a governmental level the main motivation for starting an SBIR initiative in the Netherlands was the identified innovation gap between the US and Europe. It was anticipated that the SBIR initiative could help close this gap, as SMEs often can bring unique innovative solutions to improve the quality and efficiency of public services, and in addition support the innovative capabilities of Dutch SMEs through innovative procurement. On a department level the main drivers for developing an SBIR initiative was the wish to directly stimulate innovation among SMEs[81]. Much like in the US, some departments implement SBIR as procurements (specific prob-

[81] Interview with Mrs. Nelleke E. Corbett, Directorate-General for Enterprise and Innovation, Dutch Ministry of Economic Affairs, 27 April 2007

lem critical to the mission of the department to be addressed), others as grants (general area of interest published in which companies can make project proposals themselves).

The objective of the Dutch SBIR pilot was to assess how the American SBIR programme could be implemented in the Netherlands in an effective way. The technology field of electro magnetic power technology was selected as a testing ground for the first SBIR pilot. In this field the government had already funded strategic basic research at universities via the Innovation-Oriented Research Programme (IOP) instrument. After the first tender 17 proposals were received from which four were selected to do feasibility studies in December 2004. Subsequently, after half a year, two of the four SMEs received a contract for the second phase (development/prototyping).

One of the main differences between the Dutch and American SBIR initiative is to be found in the number of topics addressed by SBIR projects along with the way these topics are generated. In contrast to the US SBIR initiative the Dutch SBIR initiative addresses a fairly limited number of topics (only a limited number of Dutch government departments are participating so far). In addition the topics of the Dutch SBIR are developed based on specific public /societal needs of the government departments involved.

Currently 4 departments are involved of which 2 are defence related. Other departments have also been invited to participate in the SBIR initiatives but have so far been reluctant to participate due to the perceived increased risk of procuring from SMEs. As of summer 2007, 20 bids have been received of which 4 phase 1 projects and 2 phase 2 projects have been granted. The number of bids received was higher that originally expected.

Legally, the same R&D exemption from the public procurement Directives as for PCP is used. The Dutch SBIR programme is open to all types of companies, not only SMEs, but the programme is heavily promoted to SMEs and their branch organisations. The project scope and contract values are also kept at levels that are well manageable for SMEs. The Dutch SBIR programme is also linked to a Venture Capital programme for phase 3 like in the US.

As in PCP, all IPR ownership rights are located at the SBIR grantee but royalty free use as well as the right to require licensing to third party suppliers is requested by the granting organisation.

The SBIR initiative is expected to become a nation-wide initiative with an increased number of participating departments and companies.

The main learning points form the initiative so far has been:

- The SBIR setup in general is a success and the value of the initiative is steadily increasing
- The initiative brings positive publicity for the companies involved
- In order to make the process learner terms must be kept short and flexible.

The experiences of the Dutch SBIR programme brings with it relevant insights with regards to the practical application of PCP-like characteristics. For example, there has been no issue with companies experiencing the effects of the risk-benefit sharing arrangements as unbalanced because the IPR conditions were very clearly outlined from the beginning in tender documents. As the initiative is still so recent no definitive conclusions can be drawn from it yet, but the (partial) outcomes of the first SBIR pilot projects are promising.

With respect to the combined use of public procurement and innovation subsidy instruments, the Dutch Ministry of Economics[82] also started a test to award an innovation premium to government departments starting public procurements of innovative high-tech products. Another route under investigation is newly designed financial schemes in cooperation with banks or insurance companies to reduce the risk for procurers to procure high risk R&D.

6.7.2 British Small Business Research Initiative

The Small Business Research Initiative, launched in 2001, is a UK government programme designed to stimulate Government procurement of radically innovative R&D from small companies and to give small companies the opportunity to demonstrate that they are able to develop high quality innovative solutions in response to strategic Government needs. The SBRI launched in 2001 attempted to make R&D programmes of Government Departments and the Research Councils more accessible to smaller businesses. In 2005 a target was set for the Government Departments involved to contract at least 2.5% of their R&D requirements from smaller businesses[83].

The research councils, although not government departments, are supporting a specific Small Business Research (SBR) scheme that recognises the specific nature of Research Council funding. The Research Councils will move to meet the same 2.5% R&D targets over time giving the total target of GBP 50 million worth of government research to be bought from smaller companies. The Small Business Service is coordinating the Small Business Research Initiative on behalf of the Government Departments.

The SBRI aims to provide opportunities both to existing small companies whose businesses are based upon providing R&D - by increasing the size of the market, as well as to other smaller businesses to increase their R&D capabilities and capacity - to exploit the new market opportunities, and to create opportunities for starting new technology-based or knowledge-based businesses. The aim is to increase the number of high-tech companies and especially SMEs.

The initiative is open to all businesses. However it is particularly beneficial to SMEs. An SME is classed as a business that:

- Has fewer than 250 employees; and
- Either an annual turnover not exceeding about GBR 34 Million (about EUR 50 Million) or a balance sheet total not exceeding about GBR 29 Million (EUR 43 Million); and
- When determining whether thresholds are reached, it is necessary to take into account the same data i.e. number of employees, annual turnover, (balance sheet total) of 'partner' and 'linked' enterprises.

Charities, university spin-offs, individuals and groups are eligible to participate if they fulfil the above criteria.

SBRI are currently also discussing the concept of 'imaginative procurement' (modern procurement methods like e-procurement). The next phase of SBRI will be SBRI+, with the aim of achieving the idea mentioned above[84].

[82] http://www.technopartner.nl

[83] Interview with Senior research associate Mr. David Cornell, Cambridge Centre for Business Research

[84] Interview with Mr Andrew Miller, U.K. Small Business Service, October 20, 2006

The 2006/2007 baseline SBRI R&D budget for the 12 participating departments totalled GBR 429 Million (about EUR 500 Million).

A few years after the start of the UK SBRI it became clear that the programme was not as successful as hoped for. A number of reasons for this were brought forward by analysts[85]:

- The programme was run on a voluntary basis unlike in the US, UK government departments were not obliged to participate nor to devote a predefined set of their budget to SBIR procurements
- The risk-management strategy could be challenged. Unlike in US SBIR, the UK SBRI programme required the SME to have other sources of risk funding available beforehand without setting clear rules on IPR sharing etc.
- The UK SBRI did not finance SBIR phase 3 (R&D phase between prototyping and commercial development, involving further R&D up to first non-commercial volume batch of pre-products validated in real-life field tests).

The UK SBRI initiative subsequently underwent a national review[86]. The October 2007 report confirmed that the UK SBRI had not been so successful and proposed a number of changes, which were accepted for implementation by the Treasury[87].

- Because of the voluntary character of the scheme, before the review most of the contracts advertised had been concerned with the development of policy, rather than the technological development which, work the scheme was intended to promote. Since the review a Technology Strategy Board is created in charge of collecting twice a year project topics from government departments. The board will publish the calls on fixed dates and assess the proposals jointly with the departments. Topics for SBIR projects will now exclude the humanities, social sciences and consultancy, for which the scheme was never intended.

- From now on SBRI awards must take the form of procurement contracts, not equity loans or grants; this will ensure that departmental objectives are identified more clearly and met more effectively, and will enable the award of an SBIR contract to act as a "seal of approval", reassuring future investors (such as venture capitalists) and customers of the firm's value.

- With regards to the risk-management strategy it was decided after the review that SMEs will retain the IPRs associated with any new technology to boost incentives to bid for contracts. To minimise risk, the contracts will also follow a phased structure, still only limited to Phase I and II (no provisions for Phase III).

- The report also revealed that investment in R&D by UK utilities (such as water, electricity and gas companies) is disproportionately low compared to turnover and encouraged UK utilities to also start applying SBRI,

[85] Exploiting the UK science and technology base: how to fill the gaping hole in UK government policy', Dec 2004, David
Connell, CEO TTP Venture Managers.

[86] "The race to the top: A review of government's science and innovation policies", Lord Sainsbury of Turville, October 2007

[87] http://www.hm-treasury.gov.uk/independent_reviews/sainsbury_review/sainsbury_index.cfm

Targets for the new scheme will start again from 1.5 per cent, rising over three years to 2.5 per cent.

It is still too early to analyse the success and impact of new SBRI projects initiated after the review of the programme.

6.8 The Agency Approach: EUROCONTROL

The objective of including this programme in the present report is that it has been used as a way of fostering innovation in the public sector. Compared with the other programmes that has been reviewed this programme is atypical as no market is readily present and no real procurement has taken place – only procurements of ideas. However, the programme sets up a highly innovative environment and attracts numerous innovative ideas. Hence, the programme has been included in order to assess if any learning points derived from the CARE INO programme could be beneficial to the PCP concept.

The CARE INO Programme is founded in the Air Traffic Control Project in EUROCONTROL.

EUROCONTROL (The European Organisation for the Safety of Air Navigation) is a civil and military organisation which currently numbers 37 Member States, and has as its primary objective the development of a seamless, pan-European Air Traffic Management (ATM) system. EUROCONTROL is an international public body. EUROCONTROL hosts at its Experimental Centre ("EEC"), a research programme which focuses on innovative research applied to Air Traffic Management: the innovative research area ("EEC INO RA"). The EEC INO RA working plan is among others concerned with Co-ordinated Air Traffic Management research supporting the CARE INO programme. The CARE INO Programme is the centre of the present programme case.

The Air Traffic Control Project, which is an ongoing project carried out by EUROCONTROL. At present, there are around 75 Air Traffic Control Centres in Europe. EUROCONTROL operates one of them in Northern Europe (Maastricht) and is developing another one in Central Europe. The Air Traffic Control Centre in the Netherlands (Maastricht) has been in operation since 1972.

The CARE INO Programme concentrates on co-operative work aimed at Innovation in ATM Research. **CARE** stands for **C**o-operative **A**ctions of **R**&D in **E**UROCONTROL.

CARE has been set-up by the EUROCONTROL Agency to define co-operative actions which address R&D issues of high priority making use of the fact that co-operation has value in fostering motivation and exchange of ideas, bringing together different approaches, cultures, competencies, forging common views and solutions.

The procurement and development process is governed by the main principle of competition aimed at achieving the best value for money for the EUROCONTROL Organisation and for its Member States. It should here be noted that EUROCONTROL is an international organisation, which is not part of the European Commission and thus has its own procurement rules.

The main learning points from this programme with respect to the PCP concept are:

- The CARE INO programme has the ability to attract highly innovative ideas by using the combination of functional specifications and a highly skilled procurer with knowledge of the 'market', so that the procurer can function as a sparring partner throughout the procurement process. In order to ensure the relevance of the project, the specialist knowledge is crucial when the specifications are as highly functional as is the case here.
- The functional specifications and the lack of recommendations (other than the project has to be radically innovative) has created a need for reviews along the process in order to ensure that the projects stay useful for the procurer. In a PCP perspective, if the project should be highly innovative it could be useful to include reviews in order to ensure the right direction of the project. However, if the project is discarded after the review it either requires that two or more suppliers are working simultaneously on the project, or that the procurer is risk-minded enough to accept that the project can be cancelled without the possibility of continuing it.
- All projects under the CARE INO programme are financed by the procurer, which gives the supplier an incentive to participate in a highly innovative project with limited risk if the project turns out not to be marketable. The risk-mindedness of the procurer seems to be decisive for the companies' willingness to participate in the study and thereby to be part of such an innovative project.

Procuring institution

EUROCONTROL is the European Organisation for the Safety of Air Navigation. This civil and military organisation which currently numbers 37 Member States has as its primary objective the development of a seamless, pan-European Air Traffic Management (ATM) system. The achievement of this objective is a key element to the present and future challenges facing the aviation community, which are to cope with the forecast growth in air traffic, while maintaining a high level of safety, reducing costs, and respecting the environment.

EUROCONTROL develops, coordinates and plans for implementation of short-, medium- and long-term pan-European air traffic management strategies and their associated action plans in a collective effort involving national authorities, air navigation service providers, civil and military airspace users, airports, industry, professional organisations and relevant European institutions.

EUROCONTROL's core activities span the entire range of gate-to-gate air navigation service operations - from strategic and tactical flow management to controller training; from regional control of airspace to development of leading-edge, safety-proofed technologies and procedures, and the collection of air navigation charges. EUROCONTROL employs some 2,500 people from its 37 Member States of which 2,100 are permanent staff and 400 are consultants on a fixed contract.

Description of the CARE INO Programme

As previously mentioned, the CARE INO Programme concentrates on co-operative work aimed at Innovation in ATM Research. The CARE INO programme concentrates on co-operative work aimed at Innovation in Air Transport Management Research. The idea behind this is to open the floor for external bodies such as Universities, R&D centres, small, medium and large industries to

propose projects aimed at developing any innovative idea, be it new or emerging technologies applied to the Air Transport System or new Air Transport System concepts or a combination of both. The objective is also to re-enforce cooperation within Europe, attempting to avoid duplication of work and more efficient use of the existing resources within each of the organisations/companies participating in the CARE INO Programme. The projects run by the organisations are inter-related. Calls for proposal are issued to find organisations interested in this type of work and CARE INO is providing whole or part of the funding to develop the new ideas.

The objective of the CARE INO Programme is to identify any innovative ideas which could be of use to the Air Traffic Control project. Hence, new players are continuously being introduced to the programme and the projects are rarely prolonged. Also, the ideas that the project participants come up with are ideas that have not been previously tested in the ATM project. The aim is to reach as broadly as possible.

CARE Actions are defined individually with a limited time duration, clear objectives and well defined deliverables fitting in the EATM Research and Development structure supported by the relevant EATM domains or work areas. This explicit support is a pre-requisite for any action to be accepted in CARE.

The R&D actions will be carried out as projects on their own, including identified funding. The origin of the funding is to be defined on a case by case basis. It is suggested that the various partners define for themselves, as a target, that a certain proportion of their R&D activity be devoted to such European cooperative actions. The R&D actions will be defined so as to ensure the participation of the appropriate stakeholders.

Before the publication of a tender

Projects are identified via calls for proposal. There are no detailed specifications for this type of call for proposal. The specifications are highly functional and free of technical issues and as a result, the procurer does not conduct pre-studies, feasibility studies or the like. However, the procurer is a specialist in Air Traffic Management and thus has extensive knowledge of the field and of which solutions are feasible, and can through this knowledge function as a valuable sparring partner towards the possible suppliers.

The purpose of the call for proposals is obviously closely linked to the objective of the CARE INO Programme, namely to open the door to any partner willing to develop and assess any innovative idea applicable to the Air Transport System. The Air Transport System shall be understood as a combination of airport, Air Traffic Management (ATM) and any kind of flying object. An innovative idea may be the application of new or emerging technologies to the Air Transport System or the development of innovative Air Transport System concepts, or a combination of both.

Tenders have the total freedom to propose anything which seems to be innovative. Lateral thinking is strongly favoured to come up with brand new ideas. The main outputs expected from any CARE INO selected project are a description of the idea proposed, conclusion of the assessment of this idea, prototype(s) if any (hardware and software platform) that could be re-used later for presentation and/or demonstration of the idea and a final document summarising the recommendations from the project.

The tenders can only apply once with the same project idea. The projects for further development are selected by a board consisting of people from EUROCONTROL, DG TREN and varying academic people.

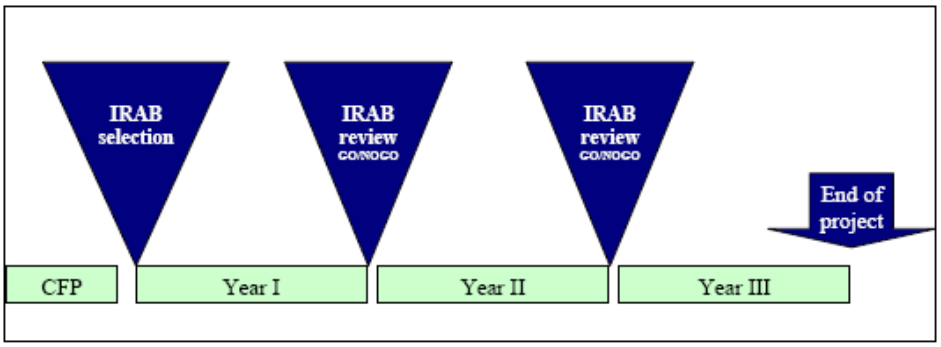
Development phase

The phase being executed after the publication of a tender is the first development phase of the new product or service. As the specifications are highly functional, the tenders have the freedom to propose anything that seems innovative, and that the main outputs are a description of the idea proposed, conclusion of the assessment etc., it is hardly possible to talk about a procurement phase in this programme.

The contract will be firm for the first year only and optional for the remaining years. The contract for the remaining years will depend on a yearly review by the Innovative Research Advisory Board (IRAB) and the subsequent decision as to whether the project can continue.

As can be seen from Figure 0.1 below, each project is subject to a yearly review performed by the IRAB, who may decide to continue or to stop the work according to the results presented and the perspectives proposed for the future. This review is performed during the yearly EUROCONTROL Innovative workshop and exhibition.

Figure 0.1: Phases of the CARE INO Projects



Source: Eurocontrol

With respect to IPR, normally the projects which EUROCONTROL is partly funding shall be fully owned by EUROCONTROL. Therefore, where necessary, the proposal shall include specific IPR requirements. It can in principle happen that the supplier is granted the IPR and the procurer is given compensation, but as EUROCONTROL is the only ATM provider in Europe it is in practise rather difficult to sell the products or services developed through the CARE INO programme to competitors, as there are no competitors in Europe.

Examples of projects

In 2004, a second CARE INO round was opened ("CARE INO II"). Amongst 50 proposals, 5 projects were initially selected by IRAB and performed in 2004. Examples of these projects are presented below:

Adapted observation for activities of an airport
Supplier: ARMINES (École des Mines Paris – France) and Readymade.

The project aimed at exploring the provision and the sharing of the vision of its working environment to any professional branch of the airports actors. This project was based on augmented reality and wireless applications. This project terminated at the end of 2004.

Neural network-based recognition and diagnosis of safety critical events
Supplier: National Aerospace Laboratory (NLR) and SNN University of Nijmegen (Netherlands)
The project aimed at investigating the feasibility of a neural network-based system for automatic recognition and diagnosis of non nominal events in ATM. Such system was intended to further enhance safety in ATM. This project terminated at the end of 2004.

Safety of Controller Pilot Dialogue
Supplier: Thales Research & Technology France, IntuiLab and IRIT
The project explored the use of voice recognition systems as a third part in the communication, capturing parts of the communication, and using the resulting information to improve the efficiency and safety. This project terminated at the end of 2005.

ANIMS
Supplier: IntuiLab and Intactile design (Toulouse – France)
The project aimed at improving efficiency and safety of ATM users interfaces through visual animation and sound. This project explores the potential for ATM software of the design-centred methods used in industries from different horizons. The study focused on the benefits and conditions of use of two related design-intensive interface technologies: animation and sound. This project is still running.

Airport of the future or **central link of inter-modal transports (MODAIR)**
Supplier: M3 SYSTEMS, ENAC, LEEA and ANA (Portugal)
The project explored the possibility that the transport modes could be collaborative instead of only competitive, and exploring the transport inter-modality as a way to tackle what could be the ATM/ATC. This is an attempt to envision the airport of the future. This project is still running.

Learning Points

The following chapter sets out to describe the issues from the CARE INO Programme that could be useful in order to increase innovation in public technology procurement in Europe through focus on pre-commercial procurement. First of all, as previously mentioned the objective of including this programme in the present report is that it has been used as a way of fostering innovation in the public sector. As no market is readily present and no real procurement has taken place – only procurements of ideas, the programme will mainly serve as inspiration of possible learning points that could be beneficial to the PCP concept.

Functional or performance-based specifications

EUROCONTROL has used extremely functional specifications as the Air Traffic Control project has very intangible demands and radical innovation is favoured. Also, some of the contracts signed have been delivery-based in the sense that if the project was not feasible, the procurer was not obliged to pay.

The idea of publishing a call for tender that does not identify any specifications, but only sets out to fulfil the public need of improving and ensuring smoother and safer traffic in the sky very much resembles the thinking behind PCP. Moreover, the requirement that the proposed projects shall be innovative is also very much in line with the overall aim of PCP, namely to fuel innovation in the EU. What is however not present in this case study is the funnel model, where several suppliers are working on the same project in order to ensure the best possible project through increased competition? However, as the projects are as highly innovative and the 'tender' is mostly steered by the supplier's ideas and with the procurer mainly functioning as a sparring partner and not the one setting the scene for the content of the tender, the funnel model might not work very well in this particular case. Moreover, in this case, the funding provided by the procurer has been decisive for the willingness of the suppliers to come up with a tender and participate in the programme, which also has to do with the fact that the suppliers are often consortia of SMEs and universities which do not have the same amount of money to conduct research and development for as larger companies.

In a PCP perspective, it is interesting to note that the programme has the ability to attract highly innovative ideas by using the combination of functional specifications and a highly skilled procurer with knowledge of the 'market', so that the procurer can function as a sparring partner throughout the procurement process. Obviously, not all procurers can be as knowledgeable of the market, but the specialist knowledge seems to be required when the specifications are as highly functional as is the case here.

Review of the phases

With such a highly innovative set-up as the CARE INO Programme, there exists a need for reviews along the process in order to ensure that the projects stay useful for the procurer. In a PCP perspective, it could be useful to include reviews in order to ensure that the project stays on track. However, this either requires that two or more suppliers are working simultaneously on the project (which from the case study evidence is rarely an option) or that the procurer can accept that the project may fail, if the innovative set-up is not strong enough after all.

Incentive schemes

All projects under the CARE INO programme are financed by the procurer, which gives the supplier an incentive to participate in a highly innovative project with limited risk if the project turns out not to be marketable. The main incentive for industry to participate in these projects is to be able to conduct innovative products and have them financed at the same time in order to avoid risk. At the same time, the procurer is extremely risk-minded.

This venture-like capital seems to be decisive for the companies' willingness to participate in the study and thereby to be part of such an innovative project, a tendency which can also be seen in for instance the American study of Symantec, where venture capital was decisive for the development of the project.

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Annex III: Case studies

6.9 European cases

6.9.1 CARE Social Management System

Procuring institution
The Municipality of Aalborg, Denmark

Supplier
Ramboll Informatics A/S, Denmark

Abstract
The development of a service management system for a Danish municipality illustrates how a public service innovation process can be structured. The case highlights the benefits of thorough pre-tender process analysis for the success of an R&D project, the issues of the usability of functional requirement specifications and the issue of post-project cooperation.

Presentation of the project
During the 1990s politicians in the municipality of Aalborg, Denmark identified a need for better control with public spending within the area of senior citizens and disabled people. In 1995 the municipality decided to engage in an R&D project for the development of a new ICT-based service management system. This development project is an example of a service innovation based on a public need carried out by a medium-sized Danish municipality.

The service management system developed in this project is a software and hardware-based dependent care system that enables the Administration for Senior Citizens and Disabled People monitor the use of resources in the in-home help and medical care, housing control, payment administration and management information. In addition the system incorporates an analytical tool to analyse resource and equipment utility etc. The system can be integrated with existing systems like on-duty scheduling, medical reference books, pension data etc.

A precursor for the decision to initiate the project for a new ICT-based service management system was the successful cross-municipality project aimed at developing a national terminology within the area of public service for health care etc. In connection with this the municipality of Aalborg had initiated talks with 7 other Danish municipalities on the co-funding of a new ICT-based service management system. This initiative failed, due to issues of funding and demand specifications, and the municipality of Aalborg decided to start an R&D project single-handed.

Procuring institution
The municipality of Aalborg has 192.500 inhabitants and is the regions biggest employer with over 18.000 employees covering all areas of public services. Total annual budget is about EUR 1.4 billion of which expenses for social and health-related expenditures was about EUR 733 million (2006).

Supplier

Ramboll Informatics A/S is a Danish-based IT supplier and IT systems developer with app. 175 employees. The company offers application management, customised application development, facility management, outsourcing, infrastructure, and health care systems.
Within these fields of ICT and systems development the company handles systems development, maintenance and support, systems integration, facility management, offshore solutions, and project management.

Ramboll Informatics is part of the Nordic consulting company Ramboll Group, with about 5.000 employees in 97 offices, covering the Nordic region intensively.

The technology procurement process

Before the publication of a tender
For the purpose of a thorough needs definition the municipality of Aalborg created a number of user panels. These user panels where created based on different areas of expertise with the areas of public services for senior citizens and disabled people, including:

- Supplementary materials
- Senior citizen care
- Medical care
- Administration
- IT-system

These working groups were to discuss and analyse current work flow processes with the aim to map the appropriate processes for which the service management system was to be designed. By mapping out current processes the staff was able to both develop cost saving changes in work routines and develop a needs definition for the new system.

The working groups were co-ordinated by a steering committee consisting of key personnel from different areas of the administration. The head of the IT department within the administration was placed in all working groups to secure the cross-group consistency in the proposed needs definitions.

Based on the work conducted in the decentralised working group the overall requirements to the IT system were specified as follows:

- The system should have an interactive user interface
- It should consist of a series of modules that could be individually changed and/ or modified
- The system should be based on a Microsoft DOS 3.1 platform

Publication of tender
The public tender based on the findings of the user groups was published in the summer of 1995. The pre-qualification phase 2 tenders where selected. Neither of the two pre-qualified suppliers where not able to propose a finished product in their pre-qualification materials hence the municipality of Aalborg was already here prepared to interact with both pre-qualified suppliers. In the phase before final delivery of tender the two pre-qualified suppliers often posed questions to the procurer on technical and functional topics. The technical proposal included more than 250 specific technical demands to suppliers concerning technical viability of the system etc.

The total contract sum was about DKK 20 million (about EUR 2.7 million) plus additional costs for training of employees and new IT hardware whereof the service management systems constituted DKK 5.5 million (about EUR 730.000).

Contract conclusion
One single suppliers was selected among the two pre-qualified and the municipality of Aalborg applied a standard contract K-18[88]. The selection criteria were among others:

- Overall price
- Integrity of the technical proposal
- Sophistication of the technical solution proposed
- ICT integration possibilities with existing systems
- Upgrading possibilities
- Confidence in the suppliers project management skills

All patent rights are held by the supplier. Traditionally the municipality of Aalborg has limited experience with IPR sharing and licence agreements and based on conversations with the supplier the procurer did not find it feasible to require any IPR rights in this project.

Research phase/ solution proposal phase
The research phase was rather limited because most of the research needed for the development of the new service management system was already conducted in the pre-qualification and tender phase.
During the solution proposal phase the contract was often used a guidance tool for both the procurer and the supplier. The contract described in detail the mechanism surrounding monetary penalty etc.

The supplier argues that the funnel model of the PCP concept could have been valuable in the research phase because more small SMEs would be able to engage in smaller R&D contracts with less economic requirements and less commercial risk. The extra competition between suppliers arising from the funnel model is not seen as a barrier for SMEs.

Commercialisation
The service management system is currently used by 4.500 employees in administration for senior citizens and disabled people. Additional 1.500 are about to be trained in the use of the system bringing the total number of users up to 6.000. The system has been continuously developed both on the software and hardware side since the completion of the pilot R&D contract. This development has been conducted by the same suppliers and any shift to another supplier is found inconvenient and costly due to the amount of tacit knowledge embedded in the current procurer/supplier relationship.

According to the supplier the type of commercialisation process taking place in this project is fruitful from a supplier point of view because the procurers acts as an ambassador for both the platform from with the software is developed and the specific software solution. The procurer thus supports both the commercialisation of the IT standard and the product.

Impacts from the project
The procurer evaluates that most impacts are to be observed in the medium to long term. In the short term any positive financial impacts from the introduction of the system were compensated by increased cost in education and ICT hardware. In addition the procurer assesses that it takes more than 5 years to embed the new routines developed in the system into management and employees.

[88] K-18 is a public standard contract for the development and/or procurement of ICT related products and services.

The general public service level for senior citizens and disabled people has also, partly as a consequence of the service management system, increased over the last years due to a more effective use of resources.

The information level for politicians and administration has increased significantly after the introduction of the service management system. The information output for the system is used as the underlying basis for political and administrative decision on resource allocation etc.

From a human resources perspective the introduction of the service management system has decreased the need for top and middle managers leading to decreasing salary costs.

Learning points

Thorough process analysis and identification of needs are essential for the success of an R&D project
The subsequent fit of the service management system is attributed to the process identification and analysis conducted before the issue of a tender. The development of working groups based on function rather than profession contributed to both a clearer specification of requirements but also to additional process optimisation as a parallel success story to the R&D project.

Most of the R&D conducted by the supplier was actually put into writing the tender because the supplier had to develop and then describe the proposed technical solution already in their tender. This meant that the suppliers spent many resources in developing a theoretical prototype that they could then describe in their tender. Subsequently the supplier could then use their own tender as a "script" to create a real prototype.

Functional requirements can be applied in a tender with success
The specification of requirements brought forward by the procurer was in the form of performance and functionality requirements. These where then translated into a needs definition that acted as the technical appendix to the public tender. The procurer did not put any requirements to design, layout, support-system design, and use of specific hardware or the like. Based on this the potential suppliers provided quite different technical proposals. The procurer was aware of this and therefore incorporated a selection criteria of "Integrity of the technical proposal" and "Sophistication of the technical solution proposed".

Post-project cooperation may have an effect on post-project commercial success
The product developed was, at the time, considered a lead product and the interest from other municipalities was subsequently high. The attractiveness of the product to other municipalities should be seen in the light that the procurer in this project had financed most to the R&D need to develop the product. A subsequent sale to other municipalities would not entail the same level of R&D costs.

The service management system developed for the municipality of Aalborg has been sold to other Danish municipality (on international clients). The procurer has during the last five years several times supported the supplier in such sales oriented activities. These activities have been system demonstration, system presentation at conferences and support to sales meetings. In addition the procurer has acted as external paid consultants during the implementation of the service management system in other municipalities.

Procurer-owned intellectual property rights may require additional investment in legal, economic and administrative bodies
In retrospect the municipality of Aalborg may have found a licence agreement or the like interesting. Currently the initial R&D contract paid for most of the R&D needed to commercialise the product. The municipality has however not gained significantly from the subsequent commercial success of the product. Among other things the procurer expresses concern with the administrative and resource requirements to host/hold intellectual property right and/or handle royalty/license agreements. The municipality is in no position to build up the economic and legal competences to handle the ownership of such rights. Public support for such public investment in administration may be difficult to obtain.

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6.9.2 HyFLEET: CUTE - Fuel Cell Busses

Procuring institution
hySOLUTIONS, a company primarily founded by Hamburger Hochbahn AG

Supplier
Evobus, subsidiary of DaimlerChrysler, and Vattenfall

Presentation of the project

The CUTE Project

CUTE stands for Clean Urban Transport of Europe and was initially an European Union project initiative to introduce zero-emission fuel cell buss in nine cities in Europe (Amsterdam, Barcelona, Hamburg, London, Luxembourg, Madrid, Porto, Stockholm and Stuttgart). The CUTE project tested three fuel cell buses each in the aforementioned nine cities in Europe. The aim of the project was to demonstrate the feasibility of an innovative, high energy efficient, clean urban public transport system which should ultimately contribute to the reduction of overall CO2 emissions. In addition, the elimination of local NOx, SO2 and particulate emissions will improve health and living conditions in urban areas. The outcome of the project was also expected to be an improved public acceptance of the H2 fuel cell transport system, a more secure energy supply for the EU and the realistic application of renewable energy sources. Its vision was moreover to strengthen the competitiveness of EU's industry, create new jobs and greatly contribute to the Kyoto commitments of the Member States.

The project was initially a project founded under the European Commission's Fifth Framework Programme. The European Union co-financed the trial with the support of the European Commission Directorate-General for Energy and Transport. The CUTE-project was initiated in 2001, and the demonstration phase began in 2003 and ended in 2005.

After the testing of the fuel cell buses in Hamburg, the Municipality of Hamburg was so pleased with the results that they decided to do a follow-up project. The demonstration phase of the HyFLEET: CUTE project ended in February 2007.

The HyFLEET: CUTE Project

The main reason for the city of Hamburg to participate in the project, although the fuel cell buses are 5 times more expensive than ordinary buses, is twofold:

- The city is dedicated to reducing CO2 emissions. The dedication is part of an overall green profile and helps branding the city as a green city
- Certain industry clusters has been appointed in Hamburg, these being an energy cluster (many energy producers, like Vattenfall and Siemens are situated here) and a transport cluster (comprising of among others airbus). The fuel cell bus project is thus a way of targeting these two clusters and to create synergy effects between them.

Hence, the goal for the city of Hamburg is to support the general technology development in the area through the cluster strategy, and not only to get a cleaner environment.

The project was carried out as a public-private partnership with hySOLUTIONS as the procurer and EvoBus (main supplier) and Vattenfall as suppliers.

The HyFLEET: CUTE Project allows a direct comparison between hydrogen fuelled ICE (Internal Combustion Engine) and FC (Fuel Cell) buses. The project will examine the ecological and economical advantages and disadvantages of both technologies.

The fuel cell buses used in the previous CUTE project has been used in HyFLEET: CUTE as well. Operating conditions for the buses was however made more severe by extending average daily operations to twelve hours per day. The goal was to reach 4000 hours of operations of the individual fuel cell buses.

Testing will also be carried out to reduce the energy consumption of the buses, and to continue to analyse the parameters which influence the lifetime of the fuel cells under practical, rather than laboratory, conditions.
A prototype pre-commercial Fuel Cell Hybrid-bus will be developed and produced. This bus will have a range of changes from the current generation fuel cell buses to reduce fuel consumption, weight, costs and noise, while increasing reliability, availability and range.

As of now, according to Senator Dr. Michael Freytag, Hamburg is a pioneer in the field of hydrogen and fuel cells, and need strong networks to speed up the development of this environmentally sound and innovative technology. The aim is to improve the quality of life in Europe's major cities.

Hamburger Hochbahn AG has the world's largest fleet of zero-emission fuel cell buses currently operating day-to-day services on scheduled routes. In a survey more than 93 percent of passengers said they would welcome increased use of the hydrogen buses. Jost Knebel, director responsible for bus and ship transport at Hamburger Hochbahn AG states that the reason passengers like these buses so much is that as well as using green technology, they also offer great comfort. It goes without saying that even this technology offers scope for improvement, for example by combining the benefits of hybrid technology with the fuel cell. HOCHBAHN will probably start using this optimised generation of hybrid-drive fuel cell buses in 2009.

Presentation of the buying institution and the supplier

Procuring institution

In July 2005, the Hamburger Hochbahn AG initiated the establishment of a company intended to promote the use of fuel cells and hydrogen in Hamburg. The company was hySOLUTIONS, the procuring institution of the CUTE fuel cell busses.

The goals of hySOLUTIONS are:

- to increase the number and scale of hydrogen and fuel cell applications in Hamburg
- to make hydrogen and fuel cell technology affordable and economic, and hence competitive
- to establish Hamburg at an early stage as an economic location for hydrogen and fuel cell applications

HOCHBAHN, as a pioneer in the field of promoting fuel cell technology, founded hySOLUTIONS and is the company's principal partner (61%). Since October 2006, Vattenfall Europa AG has held a 25% interest and the Hamburg Company Germanischer Lloyd 6%. In addition, the Hamburg Chamber of Craft Trades and the Hamburg Chamber of Commerce each hold 4% of the shares.

By involving other companies, hySOLUTIONS extends its know-how. At the same time, hySOLUTIONS GmbH assists its project partners with the use and commercialization of fuel cell and hydrogen technology.

Suppliers

EvoBus is one of the leading full-line suppliers on the European bus and coach market and is also present on the global market.

EvoBus is integrated into the DaimlerChrysler Group and consists of two brands, Mercedes-Benz and Setra. The company has customers worldwide. EvoBus' bus-specific services range from insurance and consulting to concepts for financing and the procurement of original parts and accessories. In addition to a sales network for new and used vehicles covering all of Europe, we also offer a comprehensive service network of more than 500 bus stations to help you with all your bus and coach needs. Our dedication in research and development sets international standards for new technologies and ideas in the production of buses.

Vattenfall is a Swedish energy company and one of the leading energy producers in Northern Europe. The name *Vattenfall* is Swedish for waterfall, and is an abbreviation of its original name, Royal Waterfall Board (*Kungliga Vattenfallstyrelsen*).

Production resources for hydroelectric power is mainly located in Northern Sweden, nuclear power north of Stockholm at Forsmark and gas and coal based power in Germany and Poland. Vattenfall is wholly owned by the Swedish government.

Vattenfall AB is the parent company of the Vattenfall Group. With its registered office in Stockholm, it is a Swedish public limited liability company.

The technology procurement process

On October 5, 2006 in Brussels, representatives of the cities of Amsterdam, Barcelona, Berlin, Hamburg, London and a representative of the Canadian province of British Columbia signed a "Memorandum of Understanding" aimed at future joint procurement of hydrogen buses, and a purchasing alliance for fuel cell busses was formed.

This network guarantees the vehicle industry dependable demand for its hydrogen buses, with the aim of enabling it to offer hydrogen buses that are economically and technically ready for series production. This is one of the measures that help reducing risk for the suppliers.

The purchasing network, which is a cross-national network, functions as the procurer in this case. The CUTE network functions as a sparring partner and a forum where it has been possible to discuss technical and practical issues with suppliers and to have discussions such as how to develop possible risk sharing between procurer and supplier. Hence, the CUTE network has functioned as a forum where industry could mature enough so that the purchasing network could be a reality.

An obstacle in the present project has been that local procurers prefer local suppliers (e.g. English procurers prefer English suppliers). The CUTE network has tried to solve this issue by bringing suppliers together in order to have those establishing strategic relationships and enter into joint bids.

The HyFLEET:CUTE project in Hamburg was carried out as a public-private partnership. The participants were Hamburg, Evobus and Vattenfall.

For the present project, it has been of significant strategic value to have large companies such as Vattenfall and Evobus (through DaimlerChrysler) on the project, as it has created great awareness and lent the project credibility. Likewise, the project has had great strategic value for Vattenfall as they have been able to create synergies between their traditional housing competencies and the transport competencies, which in many ways resemble the core competencies of Vattenfall. Vattenfall's participation in the fuel cell project has implied a shift in technologies and that Vattenfall now works with sustainable energy.
Hence, in the present project it has been an advantage to step out of the conventional way of thinking with respect to which industries can be targeted in specific projects. It has here been an advantage to look for partners in industries, which was not necessarily thought of otherwise.

Learning Points

Bundling of demand
The fuel cell bus project is a good example of bundling of demand, as nine cities have joined forces in order to participate in the development of the fuel cell buses. It has not been the aim, neither has it been possible, to place research and development activities within Europe. In this case, it is at best meaningless to dictate that the production is placed in Europe as it will then be difficult to get access to the right products. At worst, Europe will risk that the Americans outperforms us.

The use of SMEs
SMEs are not widely used in the HyFLEET: CUTE project. This is due to the fact that the contracts are too large and long for the SMEs to handle them. Often they do not have the capacity, or they assess that the risk involved is too large for them to cope with. One of the ways of reducing risk for SMEs and involving them further in such projects could be through the use of a life-size test bed provided by the public partner. However, in this particular case it might not be a solution as it is not possible to simulate a bus route.

IPR
The IPR stays with the supplier. The procurer does not wish to keep them as they do not have the resources to make use of the rights afterwards. Nevertheless, the knowledge transfer has been secured through legal obligations in the contract. These obligations have ensured that the procurer now has sufficient knowledge to further develop the fuel cell buses.

Challenges
First of all, industry has so far not been sufficiently impressed with the development possibilities of the project. The answer to impress industry is in this case to develop very specific business cases. In order, to do this, it is however decisive to be very knowledgeable about industry trends, and in this connection, the CUTE network can prove to be beneficial. In line with the first challenge, it is secondly an issue for the procurer to have enough knowledge of the project to match the supplier. The CUTE network provides in this respect a good base for knowledge sharing, but industry networks could in the future advantageously be established, where open trend discussions of the industry could take place. Lastly, there is currently a strong explicit support for the project from the Municipality of Hamburg, but it is crucial for the project to remain focused in order to achieve continued support.

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6.9.3 Digital Traffic Enforcement System (DTES)

Procuring institution
Transport for London (TfL), England

Supplier
SEA, England

Abstract
The Digital Traffic Enforcement System (DTES) project started in 2002 and is still running. Commissioned by Transport for London (TfL), DTES will replace the labour-intensive analogue video cameras and CCTV system. The aim is to reduce the cost of collecting, processing and storing evidence while improving the quality and reliability of future operations.

The supplier, SEA, developed a system part of which has been fitted into a Smartcard and is now operating in London to capture evidence of illegal parking on red bus routes.

TfL talked to the Home Office and industry and carried out pilot tests before the project went out to tender at a European-wide level. However, only one non-UK Company submitted a proposal.

TfL is currently in the middle of the procurement of a contract to implement the digital traffic enforcement system across London and is looking for a single service supplier who will be responsible for implementing and supporting the whole enforcement infrastructure as well as identifying innovative uses of technology.

Due to legislation, TfL will at this point have to choose another transport organisation in the UK and jointly implement the system in London and another location. The tender is currently under preparation and will be out in early 2007.

The project

The Digital Traffic Enforcement System (DTES), commissioned by Transport for London (TfL), will replace the labour-intensive analogue video cameras and CCTV system. The aim is to reduce the cost of collecting, processing and storing evidence while improving the quality and reliability of future operations. The DTES mobile enforcement unit uses GPS to determine a car's location, and compares this with a downloaded enforcement schedule.

The key difference between the old analogue system and DTES is that the new system will only store images of offences and thereby reduce the burden on storage and the time it takes to find the right piece of evidence.

The project was split up in three phases. The first phase was the feasibility stage and the next phase was the development phase. A further phase, which will implement the whole system in London and one other location, will be put out to tender in 2007.

<u>The buyer (Procuring institution)</u>

Transport for London (TfL) is responsible for all public transport in London and was previously known as London Transport. The primary role of TfL, which is a functional body of the Greater London Authority, is to implement the Mayor of London's Transport Strategy and manage transport services across the Capital. TfL is responsible for London's buses, the Underground, the Docklands Light

Railway (DLR) and the management of Croydon Tramlink and London River Services.

TfL is directed by a Management Board whose members are chosen for their understanding of transport matters and appointed by the Mayor of London, who chairs the Board.

In July 2004, TfL agreed a groundbreaking five-year funding settlement with the Government. The agreement enables £10bn to be invested in London's transport infrastructure over the next five years.

The supplier

SEA is a UK-based systems company set up in 1988. It delivers advanced surveillance systems and products for demanding environments. The main activities of the company are focussed on the Defence, Aerospace and public sector markets.

The company is a medium sized company with approximately 180 employees.

The technology procurement process

Research phase
In the period from 2002 to 2004 TfL talked through the concept with the Home Office and industry in order to determine if the planned system would meet all the key evidential requirements.

Particularly important were early discussions with the PSDB (Police Scientific Development Branch), now the HOSDB (Home Office Scientific Development Branch), as any enforcement system depends on the quality of the evidence collected. From these discussions a 'road map' outline design of DTES emerged.

The next step was to talk to key industry players about the various components of the new system: Enhanced Global Positioning System (GPS), Automatic Number Plate Recognition (ANPR), cameras and communications.
Through this process TfL found out that all the required components were readily available as off the shelf products, but there was a need to integrate these components to provide an approved system for enforcement.

At this stage of the feasibility and technology review, external consultants WS Atkins were selected to be part of the project. They were asked to assess whether the DTES concept could be accepted by the Home Office, so TfL could choose which technologies could be used. Once this stage was complete the architecture was taken back to the Home Office for conceptual approval. WS Atkins is still involved in the project today and their role is to provide detailed technical advice for the project. A risk workshop was held in order to identify risks which could occur during the project.

After this stage TfL could outline a number of performance-based specifications, which were used in the tender.

Prior to the procurement phase, TfL spent months spreading the news about the product they needed to develop in order to get suppliers interested in the DTES project. This was done through presentations for the ITS community and at conferences. Part of this campaign highlighted the potential market for the product, which in this case were other local authorities in the UK who were using bus enforcement zones as the one in London.

Procurement phase
The DTES project was advertised in the OJ in 2003 and the pre-qualification process took place. 50 companies showed interest in the project and TfL pre-qualified seven companies.

Five companies submitted a proposal, but two were discarded because they did not live up to the criteria.

Transport for London interviewed the three remaining suppliers, SONY, Siemens and SEA, who had to make a presentation for the procurer. The suppliers also had to answer questions with regard to the specifications and they were evaluated through a marking scheme, with a pass/fail threshold. The suppliers were also assessed on the cost of the project.

SEA was selected and prior to the signing of the contract, TfL held a risk workshop with SEA, end-user representatives (e.g. enforcement operations staff) and an external risk advisor. SEA was asked to make a list of risks that could occur during the project and that list was discussed and merged with the list identified by TfL.

The risks identified were included in the contract, so if a problem occurred, the responsibility were already allocated in the contract.

As a result of this process SEA was chosen as the preferred supplier and a 3-year contract was signed.

Post contract phase
The development of the DTES system was done in close collaboration between internal TfL experts and SEA. TfL contributed with input of ideas to the development of the system and described the development as a close working partnership.

During the development phase a trial system was built and piloted in the Bristol area. Another trial was subsequently carried out in London in which a system was operated with one specially adapted vehicle operating and one static camera along a specific route.

Commercialisation
The project is still ongoing, but in order to get approval from the UK Department of Transport to carry out the DTES project, TfL have to involve another transport authority in the UK at the implementation stage. This will be the third phase and the tender for this stage will be out in 2007.

TfL are currently looking for a second procurer and will have to make a decision in early 2007. There will be further development and implementation after this contract and it will have to go out to tender again, so SEA are not automatically the preferred supplier at this stage.

The IPR are with TfL, so it can be used for the next stage. SEA can use the IP, but will have to pay royalties to TfL.

SEA and TfL are currently promoting the SmartCar developed separately, but are also talking about a joint effort in order to promote the product in a better way.

Learning points

IPR

The IPR rest with TfL and this was part of the contract and normal procedure for TfL. However, it is possible for the supplier to negotiate a price with TfL in order to use some or all of the IP in another project. It is a two stage project and TfL will need the IPR in order to engage another company in the project, if that is to be the case.

Bundling of demand
There is no bundling of demand in this project, but at the next stage there will be another procurer along with TfL. It will be a joint procurement project, which will be implemented in both London and the location of the new partner.

Handling risks
TfL held two risk workshops, one internally with a risk advisor, and one with the supplier and an external risk advisor in order to allocate responsibility for possible risks that might occur in the project. This does not minimise risks directly in financial terms, but it will ease the process if any of the identified problems should occur.

Interest of suppliers
TfL had to spend several months in order to get potential suppliers interested in the project. It is a specialised area and the supplier base is very limited. It was important for TfL to get as many possible suppliers interested in the project as possible, in order for them to be able to benchmark the suppliers against each other in terms of technological abilities and price.
TfL commented on this issue as a barrier to the PCP funnel model. The chance of getting more than one supplier to develop a prototype is very limited in this specialised field, as the commercialisation opportunities will be limited.

Two phases
The whole DTES project is split into three phases, where the second and third phase includes suppliers. The third phase will be out to tender later in 2007. It is therefore not automatically the same supplier who is involved in the last two phases. It is possible to select a new supplier because the IPR rest with the procurer in this case.

Commercialisation
SEA and TfL are currently having talks about promoting the product jointly and SEA has also had interest in the product from other public bodies. TfL have promoted the product/project at international ITS conferences after the development of the Smartcard and have received a lot of interest in the product.

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6.9.4 HF Ballast

Procuring institution
NUTEK, Sweden

Supplier
Helvar, Finland

Abstract
The project background stems from the Swedish Governments activities in the 1980's where the aims were to phase out nuclear power; reduce energy consumption; and provide safer energy.

The attempt to promote energy efficiency in this period by means of grants and information decreased and was regarded as expensive. Therefore the Government needed a new strategy to improve energy efficiency amongst Swedish companies.

The Government therefore started discussions with experts and industry to understand the technology and the market. The aim of this process was to find out if it was possible to move the current technology barriers and set higher demands for the product. No Swedish companies were involved in the process.

In early 1991 NUTEK and a group of private and companies formed a buyers group and the Swedish Government contributed with funding for experts and administration of the buyers group.

This group drafted the performance specifications for the HF Ballast and the procurement of the HF Ballast was announced in September 1991 and concluded in March 1992.

The Finnish supplier, Helvar, won the contract and developed and delivered the HF Ballasts.

The buyers group guaranteed a direct purchase of 26.000 HF electronic ballasts, which would replace the traditional ballast in fluorescent lights.

The energy saving from the HF Ballasts was up to 25% and the life-time would be increased with 20%. When combined with other lighting improvements, the energy savings amounted to 70% compared to normal ballasts.

Through tests, the Government found out that the HF Ballast was better for the eye than normal lighting and this became the main selling argument of the Government campaign to promote the HF Ballast in the commercialisation phase.

The project

Ballasts are required to start and operate fluorescent lamps. The ballasts provide the voltage to start the arc discharge and they regulate the lamp current to stabilise light output. The HF (high frequency) Ballast operates lamps at higher frequencies, eliminating flicker and increasing energy efficiency.

Part of the Swedish Government's energy saving strategy was to promote the use of energy efficient lighting, which was done through tax rebate and advertising. The HF Ballast was originally introduced in the 1980's, but the product was expensive and therefore not common on the market.

The overarching aim for this project was for the newly developed products installed in the lighting fittings to result in markedly better electricity efficiency and work environment than the lighting installations already on the Swedish market.

The aim of the HF Ballast project was reduce the energy consumption in large offices in Sweden.

Presentation of the buying institution and the supplier

The buyer (procuring institution)

The Swedish National Board for Industrial and Technical Development (NUTEK), formed in 1991, had two primary responsibilities from the offset:

- to promote the growth and regeneration of Swedish industry; and
- To promote long-term changes in the country's energy system.

NUTEK is Sweden's central public authority for industrial policy issues.

Working with businesses, institutes of technology and universities, NUTEK's aim is to develop Sweden's technical status and competitiveness.

In the HF Ballast project, NUTEK formed a buyers group, including themselves and several of the leading real estate management companies in Sweden. This group both set out the specifications and also took full part in the procurement process. It also guaranteed a certain volume if demand for the finished product.

The supplier

Helvar is a Finnish company who manufactures ballasts and lighting electronics for the luminary industry and other customers specialising in lighting. The product range includes magnetic ballasts, controllable and non-controllable electronic ballasts, and lighting control products.

Helvar is headquartered in Karkkila, Finland. The magnetic and electronic ballasts are manufactured in Finland, but they also work closely with selected partners around the world.

In addition to sales offices in Karkkila, London, Gothenburg, Stockholm, Frankfurt and Milan, Helvar has representatives in several other countries. Today, Helvar is Europe's second largest producer of magnetic ballasts and a significant supplier of lighting control systems.

The technology procurement process

Research phase
NUTEK's knowledge of energy efficient lightning was limited at the outset of the project and they were therefore forced to investigate the technical barriers and possibilities for developing a new efficient product. The procurement of the HF Ballast was not about producing a new invention, but to push the technological innovation barriers of an existing product.

The Government started discussions with experts from universities, the energy supplier Vattenfall and demand side experts from the industry in order to understand the technology and the market for energy efficient lighting. The compa-

nies consulted in this phase were all foreign, as no Swedish companies were working within energy efficient lighting at the time.

The aim of this process was to find out if it was possible to move the current technology barriers and set higher demands for high energy efficient lighting systems.

In order to fulfil the intentions of this lighting programme, NUTEK had to involve the most important (largest) purchasers on the market in Sweden at the time. Agreements were signed with several real estate management companies and owners of public, commercial and industrial buildings. In 1991 NUTEK and the real estate management companies and building owners formed a buyers group. As an incentive, the Swedish Government contributed with funding to the private companies joining the project.

Hans Westling, who used to work for NUTEK, worked on the 'buyer's group model' and his work was one of the reasons for choosing this procurement model. The model ensured knowledge was gathered and spread from and to as many important buyers as possible, which also gave the companies the confidence to buy.

Another reason for forming a buyers group was to transfer some of the risks to the private sector. There was always a large risk as the market for the HF Ballast was very limited at the time. The buyers group ordered 26,000 HF-ballasts, which was 5 times more than the previous yearly sales of HF-Ballasts in Sweden.

The uncertainly of the future market was also one of the key drivers for making a joint procurement with the private sector and also a reason for using performance based specifications in the tender, so the product could be used outside the buyers group as well.

Based on the previous talks with industry and experts, the buyers group came up with a set of performance based specifications, which were used in the tender, so it was up to the supplier then to meet these specifications.

NUTEK did some efforts in order to try and get other countries involved and they wanted this option open in the tender. However, it ended up as a national procurement project.

The invitation to tender was part of the so-called technology procurement, a method of work with the particular aim of stimulating technical development. Submitters of proposals are offered the opportunity of conducting development work in co-operation with important customers well-acquainted with administrative and user requirements.

Procurement phase

The tender was advertised in the EU Official Journal in September 1991 and concluded in March 1992. This type of procedure was also common in Swedish Governmental procurement exercises before Sweden became a member of the European Union.

Prior to the deadline for submission of proposals, the companies were allowed to ask questions to the procuring institution (buyers group). All the questions and answers relating to the specifications were reported back to all the suppliers included in the process.

All companies, including Helvar, who submitted a clearly and fully presented proposal containing interesting solutions, received a grant of SEK 100,000 (approximately 10,500 EUR) for the development of a prototype.

The suppliers had to develop a prototype based on the demand criteria and the buyers group tested these prototypes. The selection of the supplier was based on the following requirements:

- Energy efficiency
- Reliability
- Electrical and magnetic fields
- Harmonic content
- Simple and efficient light control
- Development value
- Price

The buyers group did reserve the right to free testing and to have the final decision preceded by negotiations.

The contract was awarded to Helvar AB, a medium sized Finnish company. The decision was made mainly on the selection criteria, but also because Helvar showed strong interest in developing the product further.

The contract was an umbrella agreement, stating that NUTEK would give a grant for each ballast bought by the buyers group. Under this agreement each buyer had an individual agreement with Helvar referring to the umbrella agreement.

It was known to the suppliers that NUTEK planned a campaign for the HF Ballasts after the completion of the project. Another important contractual fact was that the Intellectual Property Rights would remain with the supplier and not the procurer.

Post-contract phase

After the contract was signed, Helvar developed and produced the 26,000 HF-Ballasts. The development phase was based on joint development between the buyers group and Helvar.

There was an ongoing dialogue during the development of the HF Ballast, but the majority of changes were caused by issues outside the specifications, e.g. change of design of lamps, but the goal remained the same during the whole period. The cost of these changes was covered by Helvar and not the procurer.

When the HF-Ballasts were developed and procured, a problem occurred, as the electrical contractors did not know how to install the new HF-Ballasts. After discussion with the electrical contractors, NUTEK then had to set up a training course in order to ensure that the HF Ballasts could be installed in the buildings owned by the buyers group, as well as future buyers of the product.

A positive result of the tests carried out in the development phase was that it showed that the HF-Ballast increased the optic performance and this was to become the main selling argument in NUTEK's campaign when the product was commercialised.

Commercialisation

After the product was installed, the Government continued their campaign and the sales of the HF Ballast in Sweden increased significantly. Today, NUTEK's

contribution accounts for at least 80% of the commercial HF-ballasts sold on the Swedish market.

The project also had an indirect effect on employment, as some Swedish companies started to produce fixtures for the new HF Ballast and subsequently started to export their products.

In the specifications material it was stated that there were international declared interest in participation and that prospects of further deliveries internationally were substantial. At the outline of the project NUTEK already started co-operation with Denmark, Norway and France.

In the umbrella agreement between the buyers, supplier and NUTEK, it is stated that NUTEK would promote the ballasts. They did so by mentioning the product on international conferences, but the international co-operation which started prior to the project did not continue. This was due to the complexity of the project, which meant that NUTEK had to spend more time and resources on the project than first planned and they did not have the resources the co-operation.

The project had a significant impact on Helvar. Prior to the project Helvar the total sale of HF Ballast amounted to 30,000 and they were not a leading company within the field of HF ballasts, so the order of additional 26,000 ballasts had an immediate impact.

Two years later Helvar produced more than 400,000 ballasts for the Swedish market alone, which was 80% of the total market in Sweden.

5-6 years after the completion of the project Helvar started to export the product to several European countries. The reason for the time delay was that the Swedish market was the lead market and the product was unknown in other European countries. It was a combined effort from the Swedish Government campaign and Helvars own marketing that resulted in export to new markets and an overall increased production of HF ballasts in Helvar.

PCP learning points

Buyers group
The procurer group was a mix of building owners, real estate management companies and the NUTEK. They formed a buyers group and came up with the performance based specifications which were used to select the supplier.

The private companies and the Government took a large risk in procuring a product based on very broad performance based specifications. From the offset there was the possibility that the project would fail. However, the financial risk would then be shared between the groups of buyers.

One of the main reasons for NUTEK for choosing this model, was that they could gain and spread knowledge from and to as many important buyers as possible.

Low risk for supplier
The risk for the supplier was reduced before the contract was signed as the supplier was made aware that a Government campaign would promote the product on the Swedish market. This was a very successful campaign and the HF Ballast is today the leading product on the Swedish market for energy efficient lighting.

The buyers group also secured an order of 26,000 HF Ballasts from the offset and Helvar received SEK 100,000 (EUR 10,500).

However, the supplier had to make alterations to the product first developed and they had to cover the costs themselves. This was always a risk for the supplier and it was not included in the contract sum for the project, which was an agreed price for the ballasts developed.

Best practise procurement model
The technological procurement model used in this project was a best practise example in Sweden and after the completion of the successful project and future technological procurement was based on this model. The successful Heat Pump project was based on the same model.

The projects is a good example of how the public sector can procure an innovative product by pushing the technology barriers and at the same time reduce the risks by using bundling of demand to secure economies of scale.

NUTEK also minimised the risks by bringing together a group of experts, which helped to define a clear task for the tender.

Sweden was not a member of EU at the time of the project, so they were not obliged to apply to European tender rules.

NUTEK were not interested in the intellectual property rights, so the supplier could use all the knowledge gained in the project for commercialisation and further development of the product.

Commercialisation
The subsequent Government campaign had a large impact on Helvar who increased their supply of ballasts to the Swedish market by more than 10 times the previous amount. The news about the product was spread around Europe through conferences by NUTEK and this helped Helvar to enter new markets.

Barriers
A problem with pre-commercial procurement of innovation in relation to this project is that it is hard to attract suppliers who are willing to take a risk, so the amount of suppliers is limited. The model used did not transfer the risks to the supplier, but procurer shared the risk with the private sector.

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6.9.5 *London Oyster Card*

Procuring institution
Transport for London, England

Supplier
TranSys (consortium), England, USA and Japan.

Abstract

Increased usage, inadequate controls and unsophisticated revenue collection systems put immense pressure on the public transport ticketing system in London. In 1998 Transport for London issued a call for tender for a smart card system which was the largest ever private finance initiative deal in UK history.

The Oyster Card project was won by a consortium consisting of 4 companies from England, USA and Japan. The contract was a 4-year development and build contract and a 13-year operation contract.

Today there are more than 10 million users of the card in London.

The project

London has one of the world's best known and busiest public transport systems. In the 1990's the combination of increased usage, inadequate controls and unsophisticated revenue collection systems put immense pressure on the system transport ticketing system.

London needed new ticketing and revenue collections systems and took the opportunity to include the smartcard as a new feature. The problem was that the Government was not able to provide the necessary funding.

Thus in 1998 came about the largest ever Private Finance Initiative (PFI[89]) deal in UK history - TfL Prestige - worth £1.2 billion over 17 years, with a capital investment of £200m. The project is the largest government PFI transport deal in the UK. The Prestige project enables Transport for London (TfL) to provide customers with an advanced and user-friendly smartcard system, the Oyster Card system. The Oyster card can be used as an electronic ticket to allow access to tube, bus, DLR and National Rail services within London.

In 2005 there were 2.2m Oyster card users in London and in 2007 the number has risen to approximately 10m.

The buyer (procuring institution)

Transport for London (TfL) is responsible for all public transport in London and was previously known as London Transport.

The primary role of TfL, which is a functional body of the Greater London Authority, is to implement the Mayor of London's Transport Strategy and

[89] Private Finance Initiative contracts is where the private sector funds builds and runs project where the public will pay for the use of the product. After a certain length of time, the product will be handed over to the public sector procuring the product.

manage transport services across the Capital. TfL is responsible for London's buses, the Underground, the Docklands Light Railway (DLR) and the management of Croydon Tramlink and London River Services, as well as other functions such as cycling, walking, roads & congestion charging.

TfL is directed by a Management Board whose members are chosen for their understanding of transport matters and appointed by the Mayor of London, who chairs the Board.

In July 2004, TfL agreed a groundbreaking five-year funding settlement with the Government. The agreement enables £10bn to be invested in London's transport infrastructure over the next five years.

Suppliers

TranSys is a consortium consisting of four companies, Cubic, EDS, Fujitsu and WS Atkins. Cubic and EDS are American companies, Fujitsu is Japanese but based in the UK and WS Atkins is a British company. The Japanese company Fujitsu only became a consortium member after its purchase of ICL, a UK company. All four companies are major international corporations with offices around the world.

The consortium was formed during the procurement process for the Oyster Card and managed to raise £192m to finance the project.

The TranSys consortium is today responsible for the ticketing and fare collection system design, planning, infrastructure development, installation, operation and maintenance along with the production and marketing of the Oyster card.

The technology procurement process

Research phase

In the early 1990's London Transport (now TfL) needed to either change or upgrade the current ticketing system to a more efficient and secure system. London Transport therefore carried out two trials over a three year period from 1992 to 1995 where different kinds of travel passes were assessed. It was the Harrow Bus Trial and the Touch and Pass trials. These trials were carried out by London Transport and external consultants.

The objective of these trials was to investigate if it was technologically feasible to operate a system without the old paper tickets and also try and test a simple smart card system. At this point, no other transport smart card systems within transport were in operation anywhere, so the pilot was also designed to provide information to enable TfL to come up with the performance specifications for the smart card.

After the trials TfL had enough confidence to take the project to the tender stage.

The Government could not give financial support to the project, so TfL decided to go for a Private Finance Initiative (PFI) contract. TfL thought about involving a third party, through venture capital, but that was discarded as the third party would be unable to manage the project due to lack of technical know-how.

Procurement phase

The business case described the suppliers as partners and this was used all the way through the procurement phase.

A pre-qualification was advertised in the EU Official Journal in 1998 and the criteria were based on output specifications, which meant that TfL described the performance criteria and then asked the tenders to come up with a solution. Over 100 potential bidders replied, but none of the companies invited could provide a satisfactory solution.

TfL then asked the companies invited to declare an interest, also called notice of intent, and potential suppliers then attended meetings with TfL, who described the project in more detail.

All the information regarding specifications provided by TfL at the individual meetings was passed back to all potential suppliers.

At this point, no supplier could finance the project (PFI model) and none of the companies had the broad range of skills needed to run such a large project. There was a lack of specialist contractors and the main reason for this was that the Oyster card project was the first of its kind and the product and thereby specialist expertise did not yet exist.

TfL then decided to ask the companies to form consortia and make a new joint bid. In order to be allowed to bid the consortia were assessed on three different criteria:

- Financial (could they provide the financial backing for the project)
- Technology (did they have the technological expertise to develop a smart card system for such a major project)
- Background (did the companies involved in the consortium have a background in large projects)

Three consortia met the criteria. TfL then had to modify the scope through discussions with the potential suppliers. This was again done by describing the project in detail to the suppliers. After the scope discussions, which lasted for 6 months, two of the three consortia dropped out and left only one consortium, TranSys, to bid for the tender.

This left TfL in a position where they needed to assess if they would get value for money. TfL therefore undertook a cost comparator exercise, where they had to benchmark the proposal from the consortium against the cost of trying to develop a similar product themselves. This process lasted for one year and TfL had to buy expertise from the private sector in order to challenge the proposal.

The conclusion from this phase was that the consortium did offer value for money and they signed the contract with the TranSys consortium.

The contract awarded was a PFI contract, which will run for 17 years, including 4 years to develop and implement the system and 13 years of operation of the smart card system.

The Intellectual Property Rights (IPR) are owned jointly by TranSys and TfL during the contract period, but at the end of the contract the IPR will be handed over to TfL. TranSys are allowed to use the IPR for other projects in the contract period, but they report any technological developments back to TfL. After the contract period, TranSys will have to pay for the IPR and also report any technological advances.

TranSys have not used the IPR during the contract period, mainly because the single purpose of the consortium was the Oyster card project. There are currently no plans for TranSys to use the IPR for other projects.

Post contract phase

During the post-contractual phase the scope was changed several times in order to meet the requirement specifications. The progress in the projects was monitored by TfL and procurer and supplier met several times to discuss updates and make changes to the system.

In November 2002, 6,000 busses and 155 Tube stations were equipped to accept the new smartcards. After months of testing the Oyster card was given to almost 80,000 tube and bus staff in August 2002.

In May 2003, a limited public introduction was made to 200 users and a successful testing period led to a launch in June 2003 with cards available for sale through the Oyster card website. TfL are planning to use the IPR, but the plans are confidential.

Learning points

Risk reduction
The financial risks for the public buyer are reduced significantly when procuring through PFI contracts, especially when it is large projects and if the product procured does not yet exist.

It reduces the financial burden on the public sector body, whereas that is not the case in PCP if the product developed is bought. In PFI the supplier will develop the product, but also operate it until it is paid off.

TfL saw the PFI contract as a *partnership contract* and was hoping that TranSys would contribute with new ideas and developments, but the process showed that there is a clear divide between TfL and TranSys, as TfL have to provide a customer service and TranSys main objective is to make a profit.

Looking back, TfL did not get the expected benefits from using the PFI model, although everything was delivered as planned.

The main problem for TfL when deciding how to transfer the risks was the uncertainty of the economic future of London at the time. For future projects TfL will consider taking larger risks by developing their own products, but this depends of the economic situation.

Getting the scope right from the offset
The Oyster card project showed that the scope of the project has to be right from the outset and more time and resources will have to be spent on the research phase in order to reduce the amount of time eliminating suppliers and to make the development phase as easy as possible.

It was not only financial aspects that meant that single companies were unable to deliver the project, the lack of specialist suppliers were also an issue as they did not have the broad range of skills needed to deliver such a project.

However, TfL pointed out that the scope will never be exactly right in projects where a product does not yet exist.

R&D activities split

The project had R&D activities split between European and non-European R&D facilities, which would be an issue of interest if the project had to be carried out as PCP. The size of the Oyster card project and the level of investment needed would have made it hard to find suppliers only within the EU.

Interviews

- Peter Lewis, Project Manager, Transport for London, London (UK), 25/01/07 and 17/04/07
- John Stout, Director for TranSys, London, 16/04/07

6.9.6 *Public Safety Radio Network - Nødnett Norge*

Procuring institution
Nødnett Norway, which is a co-operation between the three Departments for Emergencies:

- The National Police Directorate
- The Directorate for Civil Protection and Emergency Planning
- The Directorate for Health and Social affairs

Supplier
Siemens

Presentation of the project

Nødnett Norge is a nationwide multi-agency public safety network, designed to ensure a common radio network for all citizens in Norway. The Public Safety Radio Project is a shared digital safety system in Norway in order for the authorities to be better able to assist the citizens in emergency situations. Traditionally, the different emergency response authorities in Norway have maintained their own analogue radio system, whereas this project will introduce a shared digital safety system. This is expected to improve the quality of the service for the general public.

The three 'nødetatene' (Departments for emergencies), namely The National Police Directorate, The Directorate for Civil Protection and Emergency Planning (which is responsible for the fire agency) and The Directorate for Health and Social affairs have bundled their demand in order to procure this public safety network, as it would not have been possible to buy the safety network for one of the departments alone.

In 1995, the Norwegian Ministry of Justice and the Police started a formal co-operation with the Ministries of Local Government and Regional Development, and of Health and Social Affairs, on the feasibility study "A common radio network for the public safety services". The conclusion from this study was that the current radio systems of the fire brigades, the police and the health agencies no longer met the operational communication requirements in terms of functionality and reliability. This feasibility study recommended that the public safety agencies should cooperate to investigate the possibilities of using a future shared radio system.

In June 2004 the project finished an external quality assurance (QA) process for public projects, and in November 2004 the government decided to forward a proposal for the Norwegian Parliament to procure a new digital radio communication system for the Public Safety Agencies and other organisations with civil preparedness responsibilities. The parliament decided in December 2004 to approve the proposal from the government.

The formal Request for Proposal (RFP) was sent to the market on May 3rd 2005, and the deadline for submitting tenders was October 17th 2005. Siemens was finally selected as supplier.

The procurement consists of the following elements:

- Realisation of the radio network with subsequent operation and maintenance
- Equipment for the control rooms of the services integrated in the network

- Radios for the users (hand-held and vehicle mounted)

This NOK 3.6 billion project (EUR 440 million) includes installation of new technology in 2000 existing telecommunication rooms, in aerial masts and in tunnels. New equipment needs to be installed in emergency control centres, emergency wards, and centres for doctors on call, and fire stations and police stations. Around 37000 vehicle-mounted and hand-held radios will be procured.

This means that the procurement project discussed here is a rather big project, consisting of several procurement procedures. For instance different types of framework agreements on consultant services have been procured. These services include expertise on technology, law, project management, finance. There was also a procurement procedure that led to the installation of equipment used in a pilot study in the Trondheim area.

In addition, the project ended up being about organisational development as well, as the different procurers needed tools to work together with the new shared digital systems.

The state will own the technical components which are needed in order to implement the public safety radio network whereas the supplier has the responsibility of the quality of the network.

The specification for the public safety radio network in Norway was initially technologically neutral. This means that the specifications only describe how the radio network should function for the end user. However, the departments of emergencies came up with over 4000 demands as to how the system should function, which left limited interpretation space for the potential suppliers. Moreover, the pre-study, feasibility study and pilot test all pointed to the fact that a TETRA-system was preferable. Nevertheless, one of the suppliers presented a solution for the project which included a different technology (EADS with its Tetrapol-solution).

As can be seen from the below, there are many pre-studies, pilot test etc. included in this project. However, the main focus will be on the procuring process where Siemens AS was selected as supplier.

Presentation of the buying institution and the supplier

Procuring institution
The procurement project is a joint cooperation between the Ministry of Justice and Police and The Ministry of Health and Care Services. The ministries' subordinate agencies, The National Police Directorate, The Directorate for Civil Protection and Emergency Planning (which is responsible for the fire agency) and The Directorate for Health and Social affairs, take an active part in the project and represent the core users within the emergency agencies. The procurement of the public safety radio and the subsequent maintenance of the project are organised in a project setup, Nødnett Norway, under the department for Justice and Police.

Supplier
The Siemens Group in Norway has around 3000 employees and is one of Norway's leading companies within high-technological and innovative solutions. Siemens AS works with the leading actors in Norway and is part of one of the world's largest groups with 475,000 employees in more than 190 countries.

The technology procurement process

Before the publication of a tender

As the Nødnett project was a large and complex project, the activities in the pre-commercial phase were rather comprehensive.

The pre-commercial activities include among others the pre-study carried out from 1995-1996, the feasibility study carried out from 1998-2001 and a pilot study carried out from 2000-2004 (where the tested configuration in the Trondheim area was operational between late 2000 and June 2003).

The pre-study
In 1995, the Norwegian Ministry of Justice and the Police formally initiated collaboration with the Ministries of Local Government and Regional Development and of Health and Social Affairs on a pre-study called "A common radio network for the public safety services". Experiences from other European countries including Belgium, UK, Finland, Sweden, Austria and Portugal were gathered.

In this report user requirements were gathered. The market was also surveyed for potential solutions. After a process where some technologies were regarded less interesting three main candidates were identified: A solution based on GSM 2+ or GSM-R, an improved version of GSM; EDACS, a system marketed by Ericsson; and finally the new pan-European ETSI standard TETRA. The TETRA option was subsequently chosen. It was also discussed if the procurement of three separate systems was feasible, but it was rejected as being too costly.

The feasibility study
1998 followed the initiation of the next activity, the feasibility study. Seven ministries were involved and two additional ministries had representatives in the steering committee of the project.

Under the project group one working group for each emergency agency (the police, fire fighting, and ambulance services) was set up as well as some other committees.

The project ultimately led to the publication of a report in March 2001. The report initially established the prevailing state of the Norwegian emergency agencies communication equipment. The report ended up suggesting that the TETRA solution should be chosen, among others because several other countries have chosen the TETRA standard, and in order to learn from the other countries it was suggested that Norway would do the same.

The pilot study
In 2000, a pilot project was initiated where a TETRA-based digital radio system was established in the Trondheim region. The system was operational from the autumn 2000 to June 2003. The purpose of the project was to evaluate technical, financial and organizational issues associated with the implementation of the safety network.

For the pilot study, an EEA-call for tender was completed, and after an overall evaluation a co-operation agreement was established with Telenor Mobil, with Nokia as a sub supplier.

The objective of the pilot study was to give all parties concerned a better understanding of the possibilities of a shared communication media for the departments of emergencies. Moreover, the aim was to develop a thorough knowledge of digital radio networks with associated applications and terminals.

The results and experiences from working with the pilot network was part of a recommendation in selecting the technical and organisational solutions for the expansion of a shared national public safety network in Norway.

Other preparatory actions include: Demand specifications, inclusion of academia in order to determine demand (one expert in economics and three experts in telecommunication), contact with other countries in order to learn from them, and participation in international for a. Moreover, the procuring institution identified well-respected evaluation tools in order to evaluate the subsequent proposals in the best possible way.

As the project is rather large industry lobbies have been very active. Industry and the other ministries had a long wish list but seldom knew what was feasible. The lobbyists were closer to the Norwegian Parliament (Stortinget) than Nødnett and much political 'noise' complicated this process.

The pre-specifications of the functionalities of the Nødnett were published prior to the actual call for tenders so that suppliers had the possibility of knowing in advance what Nødnett wanted.

Procurement phase

It was possible to identify 5-10 actors who could develop the systems needed for the safety network, but the actual numbers of bidders were lower as it was included in the specifications that the supplier should also operate the safety network. The fact that the suppliers should also operate the safety network, combined with high safety and technology demands implied that it was not possible for SMEs to bid for the project – they only functioned as sub-contractors in the project.

The procurement of the new public safety network was conducted pursuant to the public procurement rules for procurement after negotiation. This is a closed process. For reasons of competition, the results from the negotiations were not published until after the selection of a supplier.

Telenor/Nokia, EADS Secure Networks OY and Siemens chose to bid for the project. It would have been a reasonable assumption that Nokia/Telenor would have had an advantage in the tendering process given the fact that they did the pilot study. However, the consortium ran into problems.

Originally, Nokia was sub-supplier to Telenor with respect to the pilot project and also in the pre-qualification. However, after the call for tender was published in May 2005 Telenor no longer wanted to lead the consortium, as they felt that the conditions were too strict. Nokia then took the lead of the consortium (as a single supplier) and Telenor became a central sub-supplier to Nokia.

In the autumn of 2005, Nokia sold its Public Safety Radio division to EADS Secure Networks OY. EADS continued to work on Nokia's bid while at the same time working on their own bid. Hence, EADS had two different offers with two different technologies (Tetrapol and TETRA). EADS ended up loosing the contract to Siemens. The whole process had been very demanding for Nokia and it has probably helped Siemens that Nokia had great difficulties with their partner in the tendering process.
On 25 September 2006, Nødnett Norway decided that Siemens was its preferred supplier for the public safety network. Thereafter, the Ministry of Justice evaluated all three potential suppliers (with special focus on price) and found that Siemens *should* be the preferred supplier.

Prior to the recommendation of preferred supplier, the consultancy Gartner carried out an independent evaluation of the public safety network project, which focused on the risk of budget overrun with respect to the development and operation of the public safety network. The risk was deemed to be relatively limited. Also the three departments of emergencies have played a key role in selecting the final supplier.

Post-contract phase

In March 2007 a supplier contract was signed between the ministry of Justice and Siemens on the supply of radio terminals to be used in the first step of the expansion of the public safety radio network.

The time line for the public safety radio network is as follows:

Step one:
2005: Discussion with potential suppliers and contract negotiation with supplier
2007: Public safety network implemented in central parts of Oslo and environs
(30% of occupied areas / 25% of the users / 4% total radio network area)
2007/8: Evaluation – reading in the Norwegian Parliament (Stortinget)

Step two:
2008: Health region East
(36% of occupied areas / 34% of the users / 19% total radio network area)
2009: Health region South
(55% of occupied areas / 49% of the users / 32% total radio network area)
2009: Health region West
(76% of occupied areas / 69% of the users / 45% total radio network area)
2009/10: Health region Central
(90% of occupied areas / 85% of the users / 62% total radio network area)
2010: Health region North
(100% of occupied areas / 100% of the users / 100% total radio network area)

Commercialisation

The aim is to sell the public safety radio concept to other European countries. So far, Denmark is currently developing a public safety network based on the TETRA-technology. The Danish project is called SINE (SIkkerhedsNEttet or Safety Network) and the Danish Agency for Governmental Management (Økonomistyrelsen) expects that a supplier is found mid 2007.

Impacts

The most prevalent impacts that can be identified from the Public Safety Radio Network are as follows:

Seen from an employment perspective, the project has produced a number of new jobs, not least in the Nødnett Norway organisation, but in the long run a reduction of jobs on a national level is expected due to greater efficiency in the emergency services.

Also the productivity and efficiency within the three departments for emergencies are expected to improve, as the closer contact between the departments and better data communication enables restructuring of workplaces.

The citizens are expected to benefit from the public safety network as the network will have a better coverage, which increases the safety for the citizens.

Learning Points

The project was based on functional specifications, which implied that Nødnett only stated that they wanted a public safety radio network that could cover the entire Norway. It was then up to the supplier to come up with alternative solutions. However, the project director stressed the importance of knowing as much as the supplier about the financial and technical possibilities for a public safety network. Moreover, the financials were not unlimited, why the suppliers had to find the most economically feasible solution combined with the best technical solution. Lastly, a pre-study, a feasibility study and a pilot test concluded that the TETRA network was the most feasible solution. Hence, it might be said that the pre-study, feasibility study and pilot test undermined the functional specifications. However, they did serve to give the supplier a free hand in finding the best solution for the Nødnett and one of the bidders actually came up with a solution that involved a different technology than TETRA. After contract conclusion, the specifications were non-negotiable.

The incentive schemes used in the Public Safety Radio project was benchmarking and gain sharing. Benchmarking implies that the Nødnett project is benchmarked towards similar projects in the EU. If the benchmarking shows that the product gets cheaper with time, the price in the contract will go down. However, the problem here is to identify the projects that the public safety network should be benchmarked against (in terms of environmental surroundings, stakeholders etc.). Gain sharing implies that if the Public Safety Radio Project over a certain period of time delivers a profit the supplier should share the profit with the procurer (Nødnett Norway). However, if the project loses money it will not affect the procurer. As Nødnett Norway stated: 'We share gain but we do not share pain'.

As previously mentioned, the three 'nødetatene' (Departments for emergencies), namely The National Police Directorate, The Directorate for Civil Protection and Emergency Planning (which is responsible for the fire agency) and The Directorate for Health and Social affairs have bundled their demand in order to buy this public safety network, as it would not have been possible to buy the safety network for one of the departments alone. However, the cooperation has been complicated by the fact that the three departments for emergencies each had a long list of functionalities that they wanted the public safety network to fulfil, but few of them knew what was economically feasible. Moreover, it was difficult to get three autonomous departments to work together.

An important lesson learned is that it has been very important to maintain competition in the phases leading up to contract conclusion. It is the perception of the procurer that had the competition not been fierce, the project would have been too expensive and the best solution might not have been found.

When asked about the applicability of the PCP-model in the Public Safety Radio Network, Nødnett Norway stated that the PCP model is mainly effective when it comes to radical innovation, which is often costly to develop. However, the public sector does not have unlimited financial means, and moreover, the Nødnett project was a large project which has great administrative costs as well. Hence, the project looked for similar projects in other countries and tried to reuse as much of their current knowledge as possible. In general, it is too costly to start from scratch in a single country. If the project had been on an EU-level, it might have been possible to finance a radical innovation.

Moreover, if all countries or MS start up their own innovation regardless of the practises in other countries, the systems (in this case, the public safety radio

systems) are not exportable or able to harmonise across borders. Hence, a certain amount of reuse is most economically beneficial.

Also, the suppliers are hesitant to be involved in a project where no commercial benefit is to be reaped. It would not have been possible in the Public Safety Radio Project to have suppliers invest time and money in the project, if they did not know beforehand that the project was to be realised and that they would be the supplier. It was the impression of Nødnett Norway that if suppliers should participate in a project without commercial benefits the only solution would be to pay for their R&D activities.

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Interviews

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- Interview with Terje Hoemsnes, Siemens Norway on 30 April 2007

6.9.7 Smoke Detection System

Procuring institution
The Danish Railways (DSB), Denmark

Supplier
Bravida Denmark A/S, Denmark

Presentation of the project
Between 2000 and 2006 The Danish Railways piloted an R&D project for the development of a train-mounted smoke detection system.

A smoke detection system is a hard ware and software-based system for the detection of smoke (not fire) around a train's engine and passenger cabin. The system consists of electronic smoke detection sensors linked to the primary train computer. If smoke is detected in either of the two areas the train conductor is informed and if no response from the conductor is observed the system will automatically bring the train to a halt. The system is designed to limit damage on passengers, cargo and train by identifying smoke formation before actual fire has started. This way the train can be evacuated earlier and any possible fire can be dealt with as early as possible.

Procuring institution
The Danish Railways (DSB) has been an independent public corporation since 1 January 1999. DSB is wholly owned by the Danish Ministry of Transport. DSB carries around 160 million passengers every year and operates approx. 80 per cent of passenger train services in Denmark. DSB provides urban, intercity, regional and international passenger rail services within Denmark, and across international borders, in particular into Sweden.

DSB is responsible for all operational tasks in connection with the train service with the exception of infrastructure provision. Aside from train operation DSB itself also manages all rolling stock maintenance, timetable, planning, marketing, ticket sales, stations and terminals, journey planning and station shops. In 2005, the DSB Group had a profit of DKK 993 million (EUR 133 million), up DKK 46 million (EUR 6 million) from the previous year. The company has a staff of more than 9.000 employees.

Supplier
Bravida is a large Scandinavian-based supplier of installation and installation services within the electricity, piping and ventilation sectors, providing services and solutions, from design and planning to installation, operation and maintenance. In 2005 Bravida Denmark had a turn over of DKK 1.3 billion (EUR 174 million) and a profit of DKK 37 million (EUR 5 million). The company has 8.800 employees and 244 departments in Denmark, Norway and Sweden. Bravida is fully owned by the private equity company Triton.

The technology procurement process
In the 1990s new public railroad technical requirements were introduced in Denmark. This, in addition new requirements for environmental documentation, led the procurer to pursue the development of a smoke detection system for all its intercity (IC3) trains. The expected decrease in maintenance costs and decrease in accidents related to train fires further supported the decision to initiate the project.

The IC3 trains in service at the time were designed in the 1980s when smoke detection was not a key focus for train developers. As a result of that the IC3 train where not fitted with a smoke detection system and no viable solutions

had been developed. This meant that any solution should be integrated into already developed trains with minimal consequences for the overall structure of the train and it should be installed during routine maintenance of the trains to keep costs down.

Before the publication of a tender/needs definition
Over a period of 3 months the procurer spent resources on scanning the market for current solutions. No solutions from the train industry were found but the search for adjacent solution identified possible technical solution applied in the off-shore sector and within residential housing. The procurer hosted informal meetings with companies in these two industries to identify possible cross-over technologies. Based on the information provided from internal technicians, scientists and the informal meetings with companies; the procurer was able to define the functional requirements for a smoke detection system for the IC3 trains.

Negotiation with potential suppliers
Only two potential suppliers were pre-qualified and negotiations with these partners took place both bilaterally and at joint meetings with procurer and both pre-qualified suppliers. In addition the two pre-qualified suppliers were invited to present their tender in front of a supplier selection board. The selection was based on pre-defined selection criteria and both tenders were given feedback on their score. The negotiation was based on a contract proposal provided by the procurer.

Contract conclusion (September 2001)
The contract focuses more on administrative issues (payments, deadlines) and less on technical aspects of the system. The contract was intended as a guideline for instances where the normal interaction between supplier and procurer could not the solve issue. The contract was only minimally changed based on feedback from the potential suppliers.

The procurer paid 100% of the R&D costs which is the most often applied approach by the DSB when acting as procurer under the condition that the product under development in not a core competence of the supplier. Otherwise the procurer argues that it would be difficult to find interested suppliers. To counteract this, the procurer included a license agreement (royalties) into the contract whereby the supplier was required to pay the procurer a fixed sum per smoke detection system sold to other procurers. The amount payable was revaluated annually based upon a fixed percentage of the original licence fee.

Research phase
After contract conclusion an organisational setup were developed consisting of two different project groups. The day-to-day operation and the interaction between supplier and procurer were handled by the project leaders of the two organisations in an informal manner (phone and e-mail). In this forum all issues concerning technical specifications, prototype development, testing and validation were handled.

The second group consisted of representatives from the law and economy departments of the procurer and supplier. This group met more formally when contractual or larger economic issue were to be discussed. In practice the latter group was more often used when the first group could not resolve an issue and the partners therefore found the need to look into the contractual agreements and terms.

The solution proposal phase

The supplier developed a solution proposal based on the R&D conducted in the technical annex of the tender. The system outlay was then discuss in great detail with the procurer and finally approved for prototype development and testing. During the process of approval technicians from the procurer and supplier interacted face-to-face and corrections were made immediately. The approval process relied less on a formalities and more on technical discussion of selected issues. This meant that the approval process only took days instead of traditionally weeks.

Prototype phase (Mid 2003)
This system was then installed into one IC3 train which ran for about 6 months. During this period the train collected data on first a closed system (running without passengers) followed by a period in normal operation (with passengers).

During this time the National regulation for passenger transport was changed and additional documentation and technical requirements were put in place. This meant that the prototype already in testing had to be altered. The project had to be halted because of the confusion about the content of the contract amendments needed. The contract amendments were requested by the supplier but the procurer quickly realised the necessity of the contract amendment and drafted contract amendment I. The project was hampered by the change in the external framework conditions but informal cooperation meant that the contract amendment could be agreed upon fairly quickly.

Commercialisation
After test completion a slightly modified smoke detection system was then built into 96 IC3 trains (First batch). Again a new contract amendment for the installation of the 96 systems was needed. In the beginning of the project the procurer envisioned to install the systems themselves using own facilities and technicians. This decision was made because the installation of the smoke detection system had to be during routine maintenance for the train where they were called in for service. The installation period would hence be several months and most of the work would have to be completed during the night-time maintenance. As the project progressed the procurer saw a cost-saving opportunity in having the supplier install the systems as well. An additional contract was drawn up stipulating that the supplier was to install all systems. The connection to existing train systems (Hardware interfaces and cabling) were however still to be done by the procurers technicians. The process of the additional contract amendment was, as opposed to the first two, concluded without delay to the project.

After project completion the supplier has received a time-limited maintenance contract on the smoke detection systems. This contract was awarded without competition and based on the experiences from the R&D project.

A few attempts have been made from the supplier's side to commercialise the smoke detection system to other European and international railway companies. In these commercialisation attempts the procurer has supported the supplier by being present at system presentation meetings and by presenting the system at different international events. This participation has been pro-bono.

Impacts from the project
The development of the smoke detection system has decreased the number of fires in trains because dangerous situations are dealt with earlier (already when smoke develops). This has had positive social impacts on the public users of the trains.

The insurance premium on both equipment and personnel has decreased because both material and personnel is increasingly protected by the smoke detection system.

This has contributed to greater work safety and greater satisfaction among employees.

PCP learning points

Limited amount of potential suppliers forces procurer to disregard risk sharing
The procurer in this case had difficulties in identifying potential suppliers in related and non-related industries (no one were identified in the train industry). In addition the preliminary talks with companies developing and producing adjacent solutions led the procurer to the conclusion that risk sharing with a supplier would not be a feasible solution. Companies not currently working within the specific technical field viewed the economic risks too high when there was no clear commercialisation potential associated with the R&D contract. This made them reluctant to participate in a risk sharing scheme with the procurer. In this specific case a licence agreement could be made because this was, by the supplier, seen as a rather risk neutral solution that would still mean that 100% of the R&D costs would be paid by the procurer.

Limited use of the contract when it is based on performance requirements
When the contract is primarily based on performance specifications it may be limited in its use when solving technical or economic disputes between project partners. In this case study the informal communication between supplier and procurer meant that the contract was rarely used; and when used it was to support discussions on financial and legal issues. A flexible contact hence may open up for more informal cooperation between project parts but may also make disputes harder to solve.

The level of "flexibility" in the contract and the project partners' willingness to discuss contract content and possible contract amendments during the project is however, as seen in the case study, of utmost importance. In this case study both project partners were, for the beginning of contact negotiations aware of the volatile nature of externalities and informally agreed to view the project more as a continuously developing project. IN this light the initial contract should be seen as the first in a series of contracts leading up to the final delivery of the system.

Changes in external frame-work conditions calls for flexible contracts
The procurer experienced an unforeseen change in the security requirements for passenger transport during the contract period. In order to take into account the new requirements changes to the smoke detection system had to be made. Additional supplementary contracts (three in all) were drawn up to cover the additional R&D costs of changing the prototype. The procurer were aware of the additional workload put upon the supplier as a result of these changes in external framework conditions and was therefore prepared to compensate the supplier for this.

In this instance; again the informal working relationship between procurer and supplier and the flexible contract made it possible to quickly draw up contract amendments without greatly halting the ongoing development work.

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6.9.8 TERA-10 Super Computer

Procuring institution
CEA (Commissariat à l'énergie atomique), France

Supplier
Bull, France

Abstract
The TERA-10 is a supercomputer developed for computer simulation of nuclear testing. In 1996, the French President decided to stop nuclear testing and the French Nuclear Energy Commission known as CEA was asked to set up a computer-based program that would guarantee the safety and reliability of deterrent weapons. The program, funded by the French Ministry of Defence, will run for 15 years, until 2010.

The simulation program fulfils two essential requirements, a) it can replace current weapon systems when they come to the end of their life, b) it will maintain the advanced scientific capability in order to guarantee the reliability and safety of current systems and future systems.

It is regarded as a technical innovation, although there was another supercomputer in use; the requirements for the supercomputer were tenfold those of the existing model at CEA and any other available.

The TERA-1 supercomputer was built in the late 1990's and the TERA-10, which was 10 times as powerful, in 2005.

The tender process was in two stages and a prototype was built before the contract was signed. After the contract was signed CEA and the supplier, Bull, collaborated on development of the TERA-10 until it was finished in 2005.

The results of the R&D in this project are already being used for the development of the next supercomputer, the TERA-100, which is due to be finished in 2010.

The project
In 1996, when France decided to stop nuclear testing, CEA set up the Simulation program in order to guarantee the safety and reliability of deterrent weapons. The program, funded by the French Ministry of Defence, will run for 15 years, until 2010. The central part of the program is the development of a numerical simulator of the functioning of a nuclear weapon.

In 1996, this demand of computing power in 2010 was far away (and considerably above the predicted development path), so in order to fill this gap, CEA set up the TERA project.

The TERA project goal is to deliver in 2010 the necessary computing power for the simulation program whatever the different capability and policy of the big computer vendors – which, in 1996, were all American or Japanese which made it even more difficult to influence them.

The TERA project is regarded as technical innovation; although there were already supercomputers in use, the requirements for the supercomputer was tenfold that of the existing model at CEA and any other available.

The project was established with 3 milestones: TERA-1 to obtain in 2001, with a new architecture, a jump of a factor 100 with existing power, then, keeping the same architecture, TERA-10 in 2005 and TERA-100 in 2010.

In 1997 the architecture of "Cluster of SMP" was chosen, tested and validated with two US vendors: IBM and DIGITAL.

IN 2000 the TERA-1 supercomputer was ordered after a procurement procedure identical to the one used for TERA-10.

The TERA-10 project was very complex due to the technical nature of the project and because the product did not exist on the market. Several separate R&D projects were carried out in order to write the output specifications. This included both the current supplier and other companies that answered the tender. This phase took up to 3 years and has been a very important part of the whole project, even though it was prior to the tender process. Two main feasibility demonstrations, financed by multilateral cooperation between CEA, a vendor, university labs and industrials with public aid (Ile de France region, Ministry of Industry).

Once this phase terminated end of 2003, complete specifications were written by the CEA TERA team and a call for tender was issued beginning of 2004. After the contract was signed, CEA and Bull collaborated on development on the TERA-10 until it was finished end 2005.

The results of the R&D in this project are already being used for the development of the next supercomputer, the TERA-100, which is due in 2010.

The buyer (procuring institution)
The CEA is the French Atomic Energy Commission (Commissariat à l'énergie atomique). It is a public *technological research body* established in October 1945 by General de Gaulle. The CEA is active in three main fields: Energy, fundamental research, health technologies, and defence and national security. In each of these fields, the CEA maintains a cross-disciplinary culture of engineers and researchers, building on the synergies between fundamental and technological research.

In 2004, the civilian programs of the CEA received 55 % of their funding from the French government, and 35 % from external sources (partner companies and the European Union). The remaining 10 % was provided from a fund dedicated to the decommissioning and clean-up of civilian nuclear plants. The defence programs are funded directly by the French Ministry of Defence.

CEA plays a major role in sustaining the French nuclear deterrent capability in the long term. Since nuclear testing was finally ended in 1996, the reliability and safety of weapons in the French deterrent force will be guaranteed by means of computer simulation. To this end, the Simulation program has been made up of three elements:

- The development of predictive physical models for each stage of operation of a nuclear weapon
- Computer simulation, which uses complex software to integrate these models. This demands a high level of computing power, which is offered by the Tera supercomputer facility based at the CEA's DAM Ile-de-France centre

- The experimental validation of the calculations, obtained on the basis of the results of past nuclear testing and new experimental facilities.

The Supplier
The French company Bull is an information technology company helping corporations and public sector bodies develop open and secure information systems to sustain their business strategies. The premier European-based global IT supplier, Bull has a worldwide presence in more than 100 countries, and is particularly active in the defence, finance, healthcare, manufacturing, public and telecommunication sectors. The annual turnover was €1,173m in 2005. The geography of the turnover is mainly concentrated in Europe, 47% in France, 40% in the rest of Europe followed by 6% in Asia/Africa and North America (5%), South America (2%).

The company has R&D labs in France, USA, Brazil, Italy and Germany.

The technology procurement process

Research phase
The research for the TERA-10 started as soon as the first TERA-1 computer was completed. CEA met up with a number of possible suppliers and experts in order to test the future architecture of the basic server for the TERA-10.
It took a lot of resources to get European companies interested in the TERA-10 project, which is a general tendency for High Performance Computing (HPC).
The TERA-10 project was very complex due to the technical nature of the project and because the product did not exist on the market. Prior to the official tendering process, CEA ran several (7-8, including 3 important ones with external funding) R&D projects with suppliers, universities and industry experts in order to find out the best technical specifications. This phase took up to 3 years and was a very important part of the whole project.

Two of the suppliers involved in the subsequent procurement process were also involved in the R&D projects.

Two main feasibility demonstrations were carried out, financed by multilateral cooperation between CEA, a vendor, university labs and industrials with public aid (Ile de France region, Ministry of Industry).

Once this phase terminated towards the end of 2003, complete specifications were written by the CEA TERA team and a call for tender was issued at beginning of 2004.

It was important for CEA to have a lot of output specifications, as the TERA-1 project showed what can happen if the procurer does not have the technical ability to assess the supplier prior to signing the contract. CEA were not able to evaluate in detail the proposals in the TERA-1 project and although they had penalties for time delays in the contract, the proposal submitted by the winner turned out not to be realistic (according to the procurer, the supplier had already calculated the penalty costs into their budget).

Procurement phase
The purchase was the result of a call for tender, following the French rules for public sector procurement called 'request for procurement on performances' (RFP).

A call for procurement (RFP) was issued mid March 2004, specifications sent to seven of the eight (one was rejected for administrative reasons), with an answer requested early May. In this "initial answer" vendors had to give their best technical proposal with its cost, not knowing the budget target.

During the second stage of 2 months, 3 set of 'discussions' occurred between CEA and each of the vendors. Every change accepted by CEA with one vendor has to be communicated to all others in order to keep equality.

During this process one vendor gave up and only four gave a 'final answer' within the budget at the beginning of July. It was on this 'final answer'that the four vendors were judged.

The last was to verify that the vendors' proposals would fulfil the 258 criteria (output specifications) that CEA had set up. The final choice between the two finalists was made by comparing the results on 52 selected benchmark criteria. At this point, the vendors had developed a prototype of one of the 544 servers, which are connected in the TERA-10 today.

The contract between Bull and CEA was signed in December 2004.

Post contract phase

In the contract the timeframe for completing the development and installation of the TERA-10 was one year.

During that year there was little development ongoing, because the TERA-10 consists of over 500 servers which were very similar to the prototype. Thus, it was a case of producing a large amount of servers similar to the prototype and making them work as one entity.

However, Bull and CEA worked closely together and CEA had employees whose only job was to make sure that everything was in the right order and that the deadline was met. The TERA-10 was installed at CEA Ile de France on December 19th 2005, a couple of days ahead of schedule and passed all acceptance tests.

The development of the next HPC, the TERA-100, has already started and it is to replace the TERA-10 in 2010.

PCP learning points

Functional specifications
The tender specifications were a list of 258 questions regarding the functions of the TERA-10. CEA did not have the technical ability to set out the technical specifications as the product was not yet developed, so the majority of the specifications were functional. The choice of suppliers was based on their ability to answer the output-based specifications.
The TERA-1 project showed the importance of understanding the technology in the project, in order for the procurer to be able to assess the suppliers' proposals before the contract is signed.

Definitions
CEA suggested that some PCP elements need to be explained in detail in order to be able to define the pre-commercial phase. Examples of this are the definition of the prototype phase and what is defined as a European company. In HPC, it is often consortia who bid for projects and all companies involved in HPC are large companies with offices around the world.
Another problem with HPC procurement is that there is no competition inside the EU, which will make it hard to find companies to participate in the PCP funnel model, where several suppliers are developing a prototype at the same time and especially if they must also be European companies.

In general CEA can see the potential of pre-commercial procurement, but definitions will have to be clear and it is not always possible to get European companies to bid for the projects. Therefore, the prospect of having 3-4 European suppliers is weak because of the complexity of the technology and the product.

Interviews
Jean Gonnord, Director for Numerical Simulation & Computer Sciences, CEA, Paris, 08/02/07

Documents
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CEA 'Defence' Annual Report, CEA 2006
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6.9.9 *Variable Message Signs (VMS)*

Procuring institution
The Highway Agency, England

Supplier
VMS Ltd., England
COLAS, England

Abstract

The message signs on roads in England were out-dated towards the end of the 1990's and the increased usage of cars meant that the Highway Agency decided to make changes in order to minimise congestion.

The Variable Message Signs (VMS) project was commissioned and funded by the Highway Agency (HA) in 2002. The aim of the project was to communicate information and advice to drivers about emergencies, incidents and network management, aimed at improving safety and minimising the impact of congestion.

Prior to the tendering stage the Highway Agency held a series of workshops in order to find out the ideas and concepts in the market at the present time. The output from the workshops led to the tender output specification. The tender was advertised in the EU Official Journal.

The production cost for the development of the prototype was covered by the Highway Agency, including the test phase. Two suppliers, VMS Ltd. and COLAS were awarded a contract to develop the variable message signs.

VMS Ltd. has subsequently sold the variable message signs developed in the project to foreign markets, including the Athens Olympics and in projects in New Zealand. COLAS also bought the license and have used it to bid for other projects.

The project

The primary purpose of the Variable Message Signs (VMS) on the Highway Agency's network is to communicate information and advice to drivers about emergencies, incidents and network management, aimed at improving safety and minimising the impact of congestion.

Strategic VMS are located at key points on the network and are designed to provide drivers with sufficient information to re-route or change their travel plans. Strategic VMS can be used to improve the performance of the network by redistributing traffic efficiently when congestion occurs and spare capacity is available elsewhere on the network.

<u>The buyer (Procuring institution)</u>

The Highways Agency, established in 1994, is an Executive Agency of the Department for Transport (DfT), and is responsible for operating, maintaining and improving the strategic road network in England on behalf of the Secretary of State for Transport.

The Agency's purpose is to provide safe and reliable long distance journeys on strategic national routes by managing the traffic using roads as well as administering the network as a public asset.

Suppliers

VMS Ltd.

Variable Message Signs Limited specialises in the design, manufacture and installation of a range of LED based products used in traffic management control.

The road traffic product range covers applications in the highways, urban, and traffic management equipment sectors, whilst their developing rail products feature an LED long-distance rail signal and track information variable message signs. VMS Ltd. has been a supplier for the HA since 1992 and are in regular dialogue with the HA. VMS is an SME with approximately 75 employees.

COLAS Ltd.

Colas Limited operates throughout Great Britain as a service provider to the highways and airfields sectors.

Colas worked with the CMI (controlled motorway indicator) displays which were developed on behalf of the Highways Agency in 1995 for a trial of Variable Speed Motorways in the UK.

Colas SA is the parent company and is based in France and the Colas Group has approximately 60,000 employees.

Prior to the VMS project Colas Limited had not made any variable message signs but only controlled motorway indicators, so they joined up with the parent company Colas SA who has experience in producing variable message signs in Europe.

The technology procurement process

Research phase

The Highway Agency talked to industry and technical consultants and also held workshops in order to define the specifications for the variable message signs. The specifications were output-driven. The output and input was set, but it was up to the suppliers to come up with a solution on how to interpret the data information and display it.

Only one of the two suppliers selected for this project was involved in the workshops prior to the tender stage. The output specifications were used for the call for tender, which was advertised in the EU Official Journal in 2002.

Procurement phase

Only three companies entered the competition and the selection process was based on price and quality, 40% on price and 60% on quality.

The Highway Agency decided to award a contract to two of the three companies, COLAS and VMS Ltd. The R&D process was quite different for the two companies. COLAS had to do a lot of R&D before the tender stage in order to meet the requirements, whereas VMS Ltd. had more experience in the field and had to do less R&D in preparation for the tender.
One of the reasons for the decision to split the contract was that the Highway Agency wanted to spread the risk in the development phase. In several previous projects, suppliers had pulled out or gone out of business. Another reason for

having multiple suppliers is that it gives the procurer the option to be more selective and also improve the chances of a better quality product.

There were no obligations to buy the product from any of the suppliers as the first contract only included the development of a prototype. A separate contract was made for the supply and maintenance of the variable message signs.

The two suppliers received £2 million (EUR 3 million) each to develop a prototype and this phase was funded 100% by the Highway Agency. However, one of the suppliers had to invest time and money prior to the tender in order to find out how to meet the outline specifications. The two prototypes were developed in parallel and the only obligation for the Highway Agency was to buy the prototype, if it lived up to the specifications.

Post contract phase

Several tests were carried out in this phase, both at the suppliers' own premises, and in the Highway Agency's research facilities. There was no collaboration between the two suppliers during the development phase.

The second stage of the project was the development of the variable message signs from the prototype and for supply of the finished products, including a maintenance period. The overall budget for this stage was £21 million (EUR 30 million) and contracts were awarded to both suppliers.

The Highway Agency was able to do this because the specifications in the tender were output driven. This meant that they could use the two different variable message signs although they collected and displayed data in two different ways. The two suppliers only met to make sure that the mechanic connections were identical.

Commercialisation

In the contract between the suppliers and the Highway Agency it is stated that the IPR rest with the procurer. However, there is a clause which enables the two suppliers to apply for commercial exploitation of the IP.

It was not a part of the contract that all new developments on the variable message signs, where the IP has been used, have to be reported back to the Highway Agency. However, if there has been an advance in the technology, the companies will normally report back to the HA.

The two suppliers have to pay for the IP, but it was a symbolic amount.

VMS Ltd. used the IP for projects including the Athens Olympics, New Zealand and Australia. COLAS also bought the license and have used it to bid for other projects.

The Highway Agency share the IPR with other Government agencies in the UK and it has been used in all the other countries within the UK.

Learning points

Two suppliers/risk sharing

The project had two suppliers all the way through the process from developing the prototype to the supply and maintenance of the finished product. This was done to spread the risk, but the development phase was funded 100% by the Highway Agency, so there were no risks for the suppliers.

The Highway Agency chose to grant both suppliers a supply contract as both products met the requirements set out in the prototype phase. It was not an issue that the products were different, because the prototypes had been developed on the basis of the same functional specifications and thus both lived up to the requirements of the procurer.

Both companies are market leaders within the variable message signs field. One of the suppliers did not see it as a problem that more than one supplier were involved in the prototype phase, mainly because the costs were covered by the procurer.

However, the other supplier mentioned that the IP is in the public domain when more than one supplier is involved and a lot of technical knowledge is passed on to the competitors. This is a problem for the supplier, but it is not unusual for project within this field to have more than one supplier in the UK. This is not the case in the non-UK countries the supplier is working in, as only one company is involved.

When asked if they would bid for projects if they have to pay for the prototype phase themselves with more than one supplier involved, the suppliers mentioned that paying for the R&D and prototype phase was not a problem, but they wanted a promise to buy from procurer or a very good business case that shows a large potential market.

In regards to the funnel model, the companies were concerned, as a lot of the leading edge knowledge would be lost and given for free to the competitors.

Availability of suppliers

The procurer mentioned that the availability of suppliers within the industry is very limited and one of the main reasons is that there is a difference in the specifications in each country, so the price of using a company unfamiliar with the UK system would be expensive compared to a local supplier.

The Highway Agency is currently working with agencies in other countries in order to try and use the same specification for very similar systems.

However, one of the companies mentioned that another reason for the lack of suppliers bidding is that in the UK, there is a severe amount of testing required and it requires a large company to be able to carry out these tests. The amount of severe testing in the UK is also a reason why many overseas suppliers choose not to apply.

There are not a large number of suppliers in general, mainly because the number of potential customers is limited, so although many of the contracts are large, it will not secure a business in the long run. This is also why many suppliers go out of business during projects.

Knowledge gathering

The Highway Agency also highlighted that involving experts and industry in the early stages of the project provided them with the tools to asses the suppliers.

IPR/commercialisation

The Highway Agency made the IPR available to all other Government agencies within the UK. The specification of the variable message signs differ and sharing IPR will help toward getting a uniform system across the UK.

This will improve the chances of getting more suppliers and also give the opportunity of bundling of demand procurement.

Both suppliers have used the IPR for proposals and projects outside the UK since completion of the project.

The suppliers mentioned that it is the norm that the procurer gets the IPR. This is not seen as a major problem when bidding for projects, as long as the suppliers have cheap access to the IPR. The problem is larger when the IP is shared between the suppliers, because their input may not be the same.
This is a vital issue for the PCP funnel model.

Resources

Interviews
James Tromans, Project Manager, the Highway Agency, Bristol (UK), 25/01/07
Ian Gibson, Colas Ltd., West Sussex, UK, 19/04/07
Roger Stainford, Deputy Chairman, VMS Ltd., Hebburn, Tyne & Wear, UK, 04/05/07.

6.9.10 *Environment-friendly tumble dryer*

Granting institution

The granting organisation is the International Energy Agency, however, Van Holsteijn en Kenna (VHK), external consultants for the Netherlands Agency for Energy and the Environment (NOVEM) managed the project

Supplier
AEG

Presentation of the project

The environment friendly tumble dryer invented by the German company AEG (today Electrolux) was originally initiated by a competition, "Dryer Promotion Competition" arranged by the International Energy Agency, IEA and the Netherlands Agency for Energy and the Environment, NOVEM (Today SenterNOVEM) under the Annex III[90] of the Demand Side Management Programme (DSM), called "Cooperative Procurement"[91].

The political and economic rationale behind the competition can be traced back to The Energy Memorandum (1997) of the Dutch Ministry of Economic Affairs which emphasized the discrepancy between efficiency and consumption; over a period of 20 years, the increase in efficiency had not led to a decrease in total electricity consumption. On the contrary, electricity consumption had since mid 1970s until mid 1990s risen by 1.8% per year. Therefore, with support from the IEA, it was decided in the 3rd National Environmental Policy plan (NMP3) by the Dutch government[92] that manufacturers should be encouraged to produce and supply environment-friendly products and services. Novem, an agency of the Dutch Ministry of Economic Affairs promoting sustainable development and innovation, "outsourced" the project management of the competition to Van Holsteijn en Kemna, VHK.

A conference held by IEA in 1996 was the kick-off for the further development. The result of the conference was manufacturers' promise to concentrate on the development of super-energy-efficient tumble driers. Shortly after, the competition was initiated.

[90] The objective of Annex III was to establish a cooperative demand-pull procedure to bring more energy efficient and environmental-adapted demand side management technologies to the marketplace, as well as to rank innovative candidate technologies for competitive procurement activities, and to produce key DSM technology options that have not yet reached the market in order to demonstrate and test the procedure developed. The Annex III focused on three main areas, namely Wet appliances, Industrial Motors and Copiers. Annex III is also regarded as the most promotional aspect of the DSM programme. Throughout Annex III it has been essential to make sure that government, sales organisations, and energy companies are prepared to organize promotional activities in order to create market demand for appliances in question.

[91] The following countries and organizations have taken part in the Annex III: Denmark, Danish Energy Agency; Finland, Motiva; Korea, KEMCO,; Netherlands, NOVEM; Spain, ENHER; Sweden, Swedish National Energy Administration (STEM, former NUTEK); United Kingdom, DETR, BRE and ETSU; U.S, DOE and EPA, European Commission, DG XVII, Energy.

[92] Ministers of department of Housing, regional Development and Environment (VROM), Agriculture and Fisheries (LNV), Transport and Public Works (V&W), Economic Affairs (EZ) and Development Cooperation

A feasibility study made by IEA on technological alternatives to traditional tumble dryers revealed that a heat-pump technology should be introduced to the market. The technology is however app. 20 % more expensive than the highest price of traditional tumble dryers and, therefore, the ambition of the Dutch government was to stimulate demand for energy-efficient tumble driers by lowering the price to the level of mass-produced appliances. This differed from the typical American way of organising technology procurement, where groups of buyers often guarantee a certain purchase of e.g. environment-friendly products.[93]

Presentation of the buying institution and the supplier

Granting institution
The Netherlands Agency for Energy and the Environment, NOVEM, is an entity under the Dutch Ministry of Economic Affairs promoting sustainable development and innovation, both within the Netherlands and abroad. It is the aim of NOVEM to achieve tangible results that have a positive effect on the economy and on society as a whole. The tumble dryer competition was a part of the National Environmental Policy plan (NMP3) and was supported by IEA.

One of the tasks of NOVEM/VHK was to establish a buyers group, where leading buyers from each of the participating countries (Finland, the Netherlands, Sweden, UK, US and Switzerland) had have expressed interest in purchasing the dryer. The project is was intended to match those buyers with suppliers of efficient dryers, and to provide opportunities for public recognition of the manufacturers who meet the specifications.

Supplier
Since its foundation in 1887 in Germany, AEG has developed advanced electrical engineering in consumer products. In 2004, appliances from AEG became designated AEG-Electrolux to signify the link with Electrolux. AEG mainly produces household appliances and is represented most European countries.

The technology procurement process

Before the publication of a tender

A couple of years before the granting scheme were initiated; feasibility studies were conducted in order to prepare for the actual competition. Comprehensive technical specifications were developed. However, many of the specifications were standard specifications for tumble dryers and the only aspect challenged compared to conventional tumble dryers was the energy consumption.

Numerous stakeholders were involved. Basically, all relevant stakeholders who had knowledge of tumble dryers were involved, including industry lobbies and industry organisations.

After the feasibility study, a report was produced and NOVEM and the Swedish NUTEK (Swedish Agency for Economic and Regional Growth) stated that if a company was able to meet the technical specifications laid out in the report, they would commit to subsidising the grantee with 200,000 €. Hence, the people behind Annex III decided that the contest should be held.

Procurement phase

[93] U.S. Department of Energy: U.S. Energy - Efficient Technology Procurement projects: Evaluation and lessons learned, February 1999

In the procurement phase, the granting organisation did aim for including numerous suppliers. However, only AEG managed to fulfil the technical specifications put forward by the granting organisation. Other suppliers did not have a project that met the technical specifications and one supplier (Whirlpool) did not have their bid ready in time.

Post-contract phase

As mentioned, AEG won the first round in 1998 as it was the only bidder fulfilling all criteria put forward by the government (NOVEM). The invention by AEG, the eco dryer - also known as the *ÖkoLavaterm* - was shortly after prototyped and in 1999 launched. It consumes 50% less electricity than other household driers and earlier models. The machine furthermore had the distinction of receiving the first EU Energy Class A Label.

Commercialisation

The supplier AEG stated that the commercial output of the dryer afterwards was very limited and that they lost money on the development of the dryer. The granting organisation furthermore stated that the dryer had been so expensive that even though the supplier was guaranteed a subsidy, it was not sufficient to finance the development of the dryer, the reason being that in order to be energy-efficient; many components had to be specially constructed.

The dryer was, however, on the market for a couple of years without much success before it was eventually withdrawn. AEG re-launched the dryer in late 2006 at a lower price, but so far without major commercial success.

Despite the high production costs of the dryer, which was well-known to the granting organisation, the granting organisation chose to award the dryer anyway, as the technology had the potential of being used in other areas. According to the granting organisation the technologies developed in connection with the dryer has subsequently been used by AEG, thus creating a spin-off from the project. However, according to the supplier the technology did already exist prior to the competition and the main barrier has been the commercialisation of it, not inventing the technology. Thus, the spin-off benefits of developing the technology have been quite small for the supplier.

The granting organisation stated that the motivation for AEG was not simply commercial, but also to develop new, innovative technologies. The incentive for doing that was the award, which functions as a seal of approval of the innovation. This view, however, does not correspond to the view of the supplier. The supplier was already familiar with the technology and its aspiration was primarily to get the possibility of introducing the technology to a broad audience, to commercialise it. Therefore, the resulting low sales was disappointing for the supplying company which states that a first buyer agreement / sales guarantees could possibly have helped overcome the uncertainty related to sales.

Impacts

As the innovation was not very successfully commercialised, the impacts are rather limited. The potential environmental impacts are rather large, but have not been realised to a very large extent.

PCP Learning Points

Funnel model
The granting organisation aimed at including numerous suppliers; however, only one met the technical specifications. The limited number of suppliers may have hampered innovation, as one innovative dryer was produced, but turned out to be too expensive for commercialisation due to the need for specially constructed components. Numerous suppliers might have solved this problem by coming up with a more economically feasible solution.

Risk sharing
The supplier was guaranteed a fixed sum (subsidy) of EUR 200,000 by the granting organisation after having finalised the dryer. In return, the supplier had to bear costs relating to the development of the dryer. In this case, the subsidy was however not enough to cover the costs for the supplier, and the subsequent limited commercialisation success made it an economically very unfavourable project for the supplier. Given the knowledge that the drier was very expensive compared to other driers in the market, it might have been foreseen that the commercial potential (and as a consequence, the energy-saving potential) was limited. It could thus be argued that the project should not have received the award. However, according to the granting organisation it should, as the technology developed in the project was highly innovative and was subsequently used by the supplier, a view that is not shared by the supplier. According to the latter, a clear additional sales guarantee agreement would have minimised the risk for AEG associated with producing the technology.

Stronger first buyer agreement
In the present case, the identification of possible buyers who were willing to sign a letter of intent had not been successful. This implied that the supplier did not benefit very much from the project, as the technology behind the Environment-friendly Tumble Dryer had been developed prior to this project and was hence just put into a new context. According to the supplier, a stronger first buyer agreement would have made the project successful for them. Instead of stimulating demand for energy-efficient tumble driers by lowering the price to the level of mass-produced appliance, an actual guarantee a certain purchase (often seen in American cases) would according to the supplier have been more beneficial.

Also, had the supplier conducted a stronger business case it would have clarified e.g. demand for the supplier before entering the project and the supplier could have conducted a cost-benefit analysis in order to assess if the project seemed feasible in the first place.

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U.S. Department of Energy: U.S. Energy - Efficient Technology Procurement projects: Evaluation and lessons learned, February 1999

6.9.11 Sundhed.dk eHealth platform

Procuring institution

- Danish Regions - lead (DK)
- Danish Ministry of Health and the Interior (DK)
- Department of Health (DK)
- Capital Region of Denmark (DK)
- Municipality of Copenhagen (DK)
- Municipality of Frederiksberg (DK)
- Association of Danish Pharmacists (DK)

Supplier

Consortium led by ACURE (DK)

Project sum

DKK 50 Million (App. EUR 6.7 Million)

Abstract

The development of the public eHealth portal Sundhed.dk represents a procurement of incremental innovation based upon a project competition. The lessons learned are primarily regarding the difficulties with bundling of demand, multiple suppliers and limited knowledge among procurers to challenge potential suppliers.

Presentation of the project

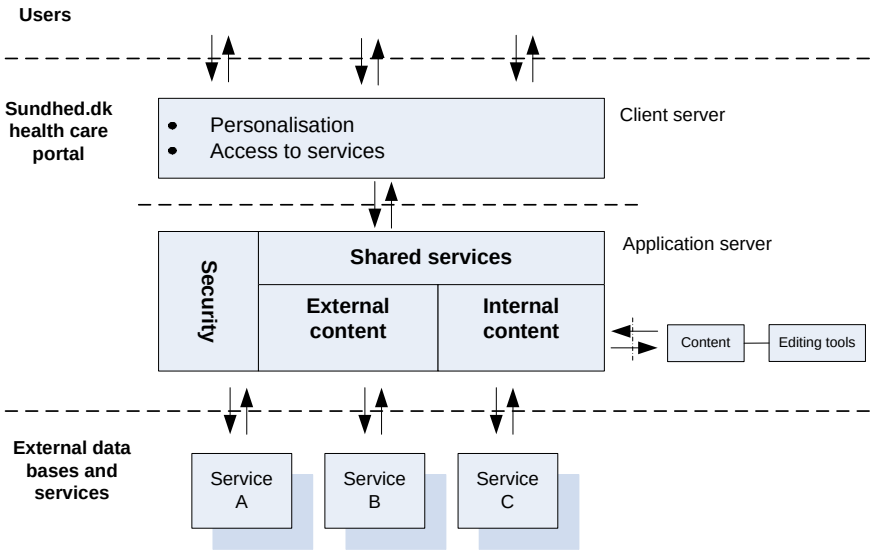
In 2002 Danish Regions along with several public agencies decided to support the development of an IT system that could:

- Bring together all communication between patients and the public health services
- Act as a communication platform for the stakeholders in the public health sector
- Present professional information to the parties in the public health services.

Previous national IT-projects focussing on patient/public health services integration had been under development in Denmark in the period 2000-2002 and limited experiences from the United Kingdom were available. These experiences were, however, not very useful for the Sundhed.dk project that basically had to start from scratch. The previous experiences could be not used because they were not national and not complex enough to constitute lessons learned.

The project operated with three levels of stakeholders. Thus, a supplier (consortium) that could provide services to all three levels was preferred. The users of the platform (citizens, patients, health care professionals) were to interface with the portal's many features. The portal would then draw upon existing and new databases from procuring institutions (see above). The structure can be illustrated as below:

Figure 2: The structure/architecture of the Sundhed.dk eHealth portal



Source: Sundhed.dk Tender Material, 2002

Procuring institution
Danish Regions represents the interests of all 13 Danish Regions[94]. It promotes and supports the principles of regional autonomy and acts as spokesman for the regional councils in matters related to the central Danish government.

More than 120,000 staff is employed by the regions which makes the regions one of the most significant public employers.

Supplier
The supplier of the Sundhed.dk eHealth portal is a consortium led by ACURE, which is an IBM-owned company developing clinical solutions for the healthcare sector. The company acted as consortium leader with among others IBM, LEC, Maersk Data and Novo Nordisk IT.

ACURE Company was established in 2002 as a merger of the companies Medfork A/S and LEC A/S and currently has about 150 employees on three locations in Denmark. The other consortium members are major companies.

The technology procurement process
The development of the Sundhed.dk eHealth platform was divided into several phases.

Phase 1 focused on developing a platform where users could access eHealth information. In addition, phase 1 focused on developing IT-based tools that supported general practitioners and patients. IT-based support tools for selected patient pathways and patient/doctor interactions were also developed in phase 1. Specific solutions in phase 1 were, among others, booking, presentation of clinical tests, and access to clinical image material via Sundhed.dk.

[94] As of 1 January 2007, the number of regions has been reduced to 5 (through mergers) following a"structural reform" of Danish local authorities.

Subsequent phases focused on the electronic communication between health services and on developing electronic access for patients to their medical records. This required the application of digital signatures and electronic patient records.

Before the publication of a tender
Prior to tender publication a process was put in place to select the tender procedures. Two different tender procedures were considered:

- Project competition with subsequent negotiations
- Restricted tender

The project competition was considered as being applicable in situations where the procurer has a well-defined need and demand specifications. In this tender procedure it is up to the tendered to define the technical solution to meet these needs. The procurer is obliged to negotiate with all selected suppliers from the project competition.

A restricted tender was considered a useful solution in situations where the procurer can define precisely the components and solutions required. On the other hand this solution is, according to the procurer most useful in procurement of off-the shelf products and service.

Based on an analysis of pros and cons of the two abovementioned tender procedures the project competition with subsequent negotiations was selected because it made more room for innovation on the part of the supplier.

Pre-qualification
A prequalification procedure was conducted and the notice of invitation to tender was published January 31, 2002.

The procurer received 16 proposals of varying quality which was viewed as satisfactory. The procurer expected to pre-qualify six participants but after receiving the pre-qualification bids only five were pre-qualified.

Publication of tender
The tender was a category 7 tender (IT-Services and IT-related services) published according to EU rules for tender publication. The tender material was only sent to the five pre-qualified participants. The five potential bidders had about four months to develop a final project proposal.

Contract conclusion
Of the five pre-qualified bidders, three were selected as preferred bidders. Contract negotiations were then conducted in parallel with all three. Of the five incoming tenders' one was not seen as being in accordance with the terms of reference and one was rejected.

The received tenders generally covered two different innovative approaches to development of eHealth portals. One was based on state-of-the-art information from launch date and the other focused more on the gradual development of the data integration features.

The consortium headed by ACURE was selected after the contract negotiations and the contract was signed at the beginning of 2003. This consortium represented an offer focused on the development of the data integration aspects of a public health portal.

The contract included three elements; development, operations and upgrade. The last module (upgrade) has not yet been fully utilized due to current discussions on the timing and extent of such an upgrade.

The contract included a "shared" IPR scheme where the supplier holds the IPR right but pays a royalty to the procurer for usage. This sharing of IPR is only to be applied in cases where the procurer or supplier sells elements of the eHealth portal. The supplier is expected to administer the IPR but the procurer is aware that the actual application of the IPR sharing scheme is still to be tested in practice.

The two losing tenders were invited to a post-competition meeting were the strengths and weaknesses of their failing proposals was discussed. Both losing tenders expressed a degree of discontent with the no one-off payment of tender development costs.

Research phase/ solution proposal phase

Overall the development went rather smoothly due to an honest and open discussion on technical and organisational challenges between the procurer group and the consortium of suppliers. There were, however, two challenges in connection with two key points in the development:

The procurer tried actively to force/promote that the software and the integration solutions developed by the supplier should were based on *open source and open standards*. The procurer encouraged the group of suppliers to fully apply the national health data network standards (also known as MedCom standards). During the R&D phase the procurer, however, realised that the group of suppliers were increasingly applying proprietary standards based on individual firm capabilities. The R&D resources were, to some extent, spent on developing proprietary standards that would make a multiple supplier strategy difficult.

In relation to that the second key focus point of the eHealth portal, being *multiple suppliers with overlapping competencies*, would also not work in reality. The use of proprietary standards simply made it more difficult to play the suppliers within the consortium off against each other. The procurer selected a consortium of suppliers in the anticipation that the overlapping competencies of the different IT firm constituting the consortium would promote competition within the consortium and give the procurer more options.

In addition the subsequent upgrade of the eHealth platform was a difficult area in the development and operations of the eHealth portal. Due to a rather weakly formulated contract on the issue of software, hardware and content upgrade the procurer and supplier had to resolve the issue using legal assistance.

Commercialisation

The developed eHealth platform was launched on 10 December 2003. Since its launch the eHealth portal has had a rising number of unique users currently at about 250.000 a month.

The technology and process developed for the eHealth platform has not been sold to others. The shared IPR scheme dictates that the supplier pays 30% of the contract sum in royalties if the content is developed by the supplier and an additional 15% if the content being commercialised is developed/co- developed by the procurer.

In order to support the commercialisation of the technologies the procurer has participated as key note speaker on some 30 conferences and events. The lack of success in commercialising the technology is, by the procurer, attributed to the special setup of the Danish health services, for which Sundhed.dk has been developed. This setup and the framework conditions for health services in Denmark makes for a relatively low degree of transferability of the system.

Impacts from the project

The development and launch of the eHealth platform has greatly impacted citizens, patients and health professionals' access to relevant eHealth related information in an easily accessible format.

It is argued by the procurer that the main benefits of the portal are to be found among the general practitioners acting as primary gate keepers in the national eHealth system. Via the eHealth portal they have been given IT-enabled tools to more efficiently and effectively counsel and screen patients.

In addition Sundhed.dk, through the use of national e-health standards provided by MedCom, is increasingly able to support more efficient flow of information, electronic prescriptions, electronic medical appoints etc. The savings for the national public health system from this has been estimated at several hundred million euros.

As an indication of the success of the eHealth platform, Sundhed.dk has received several awards; among others the prize as innovation of the year within public e-health (Computerworld Honors Award)

Learning points

The application of a project competition is expensive for the supplier

The rejected potential suppliers being cut at a late stage in the negotiation process received no financial compensation for their invested resources in tender development, technology pre-development and negotiation. The losing tenders expressed some discontent with this.

Based on this experience the procurer argued that project competitions should only be applied when it is essential to the success of the project that the market (several potential supplies) comes up with different solution proposals from which the procurer can select the best one.

It is difficult to benefit from a consortium of suppliers

For competition reasons the procurer requested a consortium of suppliers with overlapping competencies. In real life the potential benefits from overlapping supplier competencies are, from a procurer's point of view, very difficult to achieve.

Even with overlapping competencies innovative technologies cannot easily be transferred from one supplier to another. The bargaining power of procurer is hence diminished and no competition between the consortium suppliers occurs.

Projects are difficult to control when bundling demand

The case study had 7 project owners bundling resources but also requirements and expectations. All procuring partners needed their individual impact on the structure and setup of the eHealth portal.

Late in the project some procuring partners realised that the eHealth portal would only indirectly brand the procuring partners. This led them to start parallel eHealth projects of their own to gain more brand awareness among citizens and patients. This can especially be observed among public institutions, currently focused on articulating and communicating their basis of existence.

High level of knowledge with the procurer is needed to challenge industry in complex technology procurements
Knowledge (or lack thereof) with the group of procurers was a contributing factor to the use of proprietary standards and the limited value of the overlapping competencies in the consortium of suppliers in terms of competition and added innovativeness.

The procurer argues that if the procurer is to maximise the value of the procurement it must invest in knowledge about technologies, trends and market research. Only then can a procurer challenge the market, evaluate incoming tenders and provide relevant feedback in the development phase.

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- *www.danskeregioner.dk*
- *www.sundhed.dk*

6.10 US cases

6.10.1 US High Performance Computing Procurements

This case study was prepared by DG Information Society.

Analysing the mid-long term public sector needs and drawing up a strategic plan

Since the invention of the first computers, US governments have regularly confirmed the key role of computing technology in delivering top quality public services of strategic importance, both in military and civilian related areas.

High-end computers provide hundreds of thousands of times more computational power than today's personal computers. They are used for calculation-intensive tasks in applications of public interest such as national security challenges (e.g. image processing of satellite data and simulation of crisis management plans), the analysis of environmental systems (e.g. modelling of policy options for fighting climate change), the study of biological systems (e.g. analysis of the effects of pandemics), studies on renewable energy sources (e.g. analysis on bio-fuels, wind and solar energy) as well as nuclear fission and fusion energy sources and weather forecasting. In order to ensure an appropriate level of support to the above critical applications, the public sector needs high-end computers hundreds times faster than what is available in the market.

The US government regularly estimates its overall federal needs for high-end computing power. Long term strategic plans[95] are drawn up based on the mid-to-long term requirements of all government agencies[96] whose operations are heavily dependent on high-end computational resources. In such plans the agencies commit to pull resources together to encourage industry to push the boundaries of state-of-the-art high-end computing. The plans include roadmaps outlining the core technologies needed to support government's computing-intensive applications in the next 10 to 15 years[97]. Technology suppliers across the whole value chain are then mobilised to provide a new generation of enabling technologies in such areas as microelectronics, computer manufacturing, software and services.

Choosing the appropriate instrument

Based on the arguments that the government is the first main buyer of high-end computers and the targeted applications are largely public goods, the US government has developed a policy framework that allows direct public intervention to spur continuing technological progress by demanding ever higher levels of technical performance[98]. The government has set itself the ambition to be not simply a passive customer in these markets but to actively seek to stimulate the pace of the technological change.

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[95] E.g. the Strategic Computing Initiative (SCI) of the 80s, the federal High Performance Computing and Communications (HPCC) program and Accelerated Strategic Computing Initiative of the 90s, the 2004 Federal Plan for high-end computing.

[96] Dept of Defence, Energy, Health, Commerce, Environmental Protection Agency

[97] Beginning of the 90s the milestone was set to achieve Teraflop (Trillions of operations per second) computing speed by end of the 90s, it was achieved end of 1996. The current Federal Plan for high-end computing sets the milestone to develop Petaflop computers by 2010.

[98] See chapter 8 'policy framework' of the book 'Getting up to speed: the Future of Supercomputing', Committee on the future of supercomputing, National Research Council, 2004

The possible options for government intervention were analysed taking into account that direct public intervention in a technologically dynamic sector can be costly and disruptive and can substantially limit the efficiency and incentives provided by competitive markets. The analysis[98] showed that in areas where government has a strategic interest in technology developments because of the close connection to mission-critical tasks, public procurement is a more effective instrument as compared to grants, tax incentives or IPR related innovation policy measures. For the high-end computing case, a procurement model was sought where government could acquire new technology beyond the state of the art, while taking advantage of competition between firms on the basis of cost, performance and quality of the offer.

The benefits of competition in procurement

Analysis before starting the **high-end computing procurements** showed that committing to only one firm would increase the risk of giving a single vendor the possibility to exercise market power and set a price above marginal cost. Therefore a competition instead of a sole sourcing approach was chosen, based on experiences from the military. Analysis of competitive US defence R&D procurements[99,43] shows that the threat of losing business to a competitor is an effective performance inducement that results in increased innovation, performance and quality improvements, net cost savings and steeper learning curves for all competing suppliers.

Competition has the distinctive effect of improving value for money[43]: during the R&D phase it leads to lower cost designs, evidenced by a lower first-unit cost; during the later production time, it lowers the final cost-per-unit, especially for large production runs. Analysis of more than 60 years of defence procurement cases[42,43] show average unit cost savings of 20 to 30 percent when competitive sourcing is used in the R&D phase (when multiple suppliers develop in competition in the R&D phase) compared to single sourcing cases. When competition is maintained during the production phase an additional net saving of 12-50 percent is observed compared to single sourcing (substantially larger cost reductions for larger volume orders). These are real cost savings, from which the costs for establishing a competitive framework have been deducted. As the latter are non-recurring costs, the competition approach is found to be particularly effective for large volume production projects, whereas single sourcing may be a more effective approach for selected "few of a kind" systems[100].

An example of a successful IPR risk-benefit sharing deal in R&D procurement

In addition to competition in procurement, a risk benefit sharing strategy that results in a win-win for all stakeholders involved (procurers and suppliers) is key to success. In terms of benefit sharing, especially the IPR strategy is important to seriously analyse in the definition phase of R&D procurement as it largely influences the opportunities for commercialisation and take-up later.

[99] For a historic overview of the benefits of competitive sourcing across a series of US acquisitions: 'Competitive Dual Sourcing', Jacques Gansler, former US Under Secretary of Defence for Acquisition, Technology, and Logistics, Professor at the Centre for Public Policy and Private Enterprise, University of Maryland, 7/10/2007

[100] For more detailed economic analysis of cost savings of introducing competition during development and maintaining it during production in US defence procurements, see Annex G of 'International Armaments Cooperation in a era of coalition security', report of the Defence Science Board, August 1996.

Intel, for example, owes its success today to a customer funded development. In 1969 Intel financed the development of the world's first single chip microprocessor with a $60,000 contract from the Nippon Calculating Corporation. NCC's demanding technical requirements for electronic calculator chips helped Intel's engineers come up with the revolutionary design for the Intel 4004, the first programmable chip on the market for use in a variety of products.

Intel offered NCC a lower price for the chips in return for securing the rights to the microprocessor design and the rights to market it for non-calculator applications. Intel's business today is largely based on this product's successors. The first processor on a chip was the beginning of a revolution in personal computing, ultimately impacting practically every electronic device made.

Several generations of Intel chips followed, each one more powerful and larger than the last until the 8088 was selected for the IBM Personal Computer in 1981. In less than 10 years an accident of opportunity was transformed into the beginning of an engineering revolution. The IBM PC was so successful that by 1983 Intel decided to abandon the memory business and focus all its energy on the microprocessor business. This decision propelled Intel into becoming the largest semiconductor manufacturer in the world.

Transforming strategy into action

A number of sources[101,102,103] provide historic overviews that illustrate how - from the 60s onwards - the US government has regularly awarded high-end computing contracts to a number of competing companies.

[101] 'A brief history of supercomputing' chapter 3 of the book 'Getting up to speed: the Future of Supercomputing, Committee on the future of supercomputing', US National Research Council, 2004

[102] ' May 2006 report for the US Centre of Research and Development Strategy ', Gerald Hane, Special Assistant in the Office of Science and Technology Policy of the Executive Office of the US President on the interaction of trade and security on international science and technology policy, May 2006

[103] 'A policy for Government support of computer systems R&D: A look at 50 federally funded computer systems research projects over 30 years', Stanford University Press, Gordon Bell, Principle Researcher at Microsoft Research San Francisco lab, February 1995

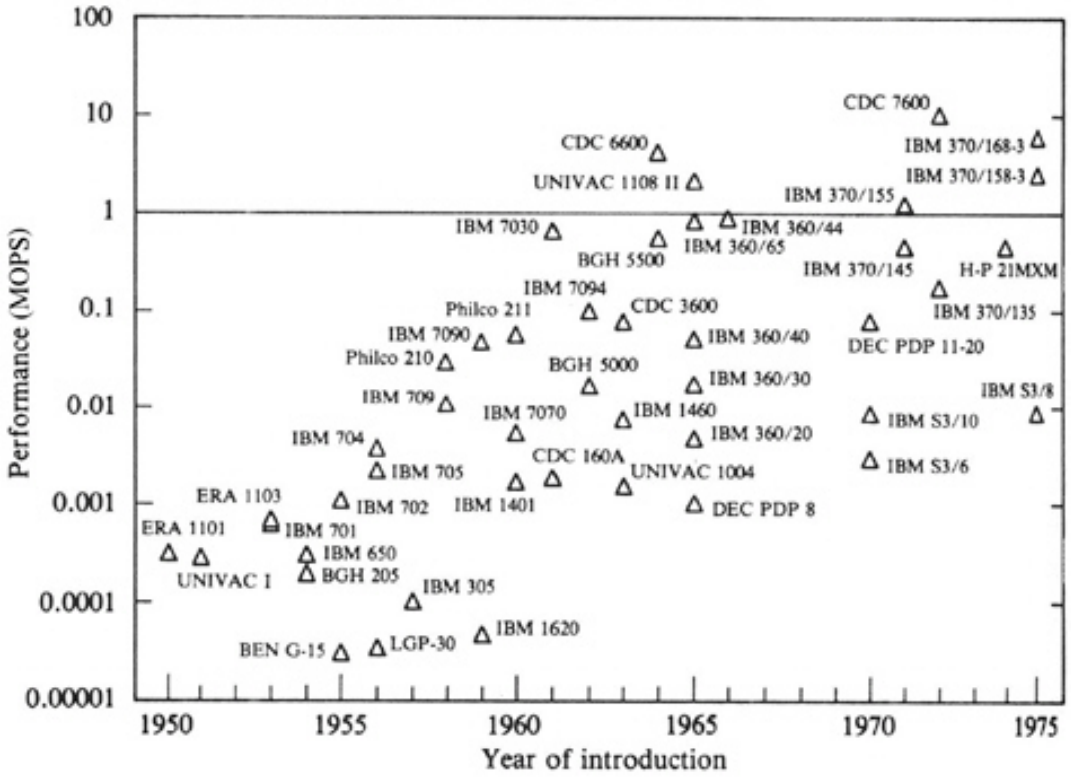

FIGURE 1: Early computer performance. Included in this figure are the best-performing machines according to value of installations, number of installations, and millions of operations per second (MOPS). SOURCE: Kenneth Flamm. 1988. Creating the Computer: Government, Industry, and High Technology. Washington, D.C.: Brookings Institution Press.

In the decade after the Second World War, the development of computer technology in the US was inextricably linked to US military procurements e.g. related to cryptographic code deciphering, nuclear design applications and ballistic missile early warning systems (e.g. Figure 1: UNIVAC 1, ERA, IBM 7030/7090). American engineers involved in this effort included Ralph Palmer, who would become the principal technical architect of **IBM**'s move into electronic computers in the 1950s. William Noris, Sperry Rand and Seymour Cray, who would later plant the seeds in the 60s and early 70s to form a new company - **CDC** and its offspring **Cray** Research. Massive US defence and NSA intelligence procurements in the 1950s were critical to the rapid rise of US companies in the computing field.

From the late 50s, however, Department of Energy (DOE) procurements started to play a leading role at the frontiers of high-performance computing. A joint procurement with the National Security Agency (NSA) required IBM to meet the needs of two different customers (and applications) in one system. It was said that balancing those demands was an important factor in the success of IBM's system 360. Beyond setting generic milestones for increased computing speed, the government's computing requirements identified concrete software and hardware problems in the most advanced computing systems available on the market and challenged companies to address them in the next round of R&D procurement. The concrete problems identified by the procurers included memory contention, capacity limitations of hardware interconnects to supporting devices, limits of data visualisation algorithms, etc. As the next generation of machines overcame these problems, the machines delivered in the early 1960s

(e.g. Figure 1: UNIVAC LARC and IBM 7030) established a pattern often observed in subsequent decades: the supercomputers were produced in very limited numbers and delivered primarily to government users, but the technology pioneered in these systems would find its way a generation or two later into industrial mainstream and in commercial PCs. Techniques such as multiprogramming, memory protection, generalized interrupts are now used in today's most advanced microprocessors such as the Intel Pentium.

Out of UNIVAC also a new powerhouse emerged that came to dominate US supercomputers in the 1960s, the Control Data Corporation (CDC) and its offspring in 1972 called Cray Research. The CDC 6600 and Cray-1 machines shipped in 1966 and 1976 achieved major design breakthroughs (e.g. vector processing). Today still, video game consoles and consumer computer-graphics hardware rely heavily on vector processing in their architecture.

Beginning 1970s IBM retreated from the supercomputer market, to commercialise its newly developed technologies in the fast-growing and highly profitable commercial computer business. As CDC and Cray started to dominate the global supercomputing industry, the DOD and DOE started attracting more companies to participate in their computer related R&D procurements. Many of the commercial array processor companies that emerged in the late 1970s were spinoffs of these efforts, such as Digital Equipment Corporation (**DEC**). It produced the most popular minicomputers for the engineering communities in the 70s and 80s (e.g. Figure 1: DEC PDP). DEC was acquired by Compaq in 1998, which later merged with **Hewlett Packard** in 2002. As of 2007 its product lines are still produced under the HP name.

A new wave of competition from overseas inspires a new wave of innovation

In the early 70s the Japanese government launched a program to boost Japan's electronics and semiconductor manufacturing capabilities. It was with some concern that the US viewed Japan's announcement of the government Fifth Generation Computer System and Superspeed projects. By importing key bits of IBM computer technology to Japan and selling computers in a government protected Japanese market, by the mid 80s Japanese computer companies such as Fujitsu, Hitachi and NEC were producing cost effective computer systems that were competitive with Cray and IBM products.

The prospect of serious competition from Japanese computer companies led to renewed US government action to stimulate a new burst of innovation. In an effort to mobilise maximum resources both supply side and demand side approaches were tried. It was observed[103] that demand side driven initiatives "we need this product/technology in order to accomplish x" worked better than supply side initiatives based on a "Field of Dreams: build something better and a customer will come later".

The "supply-side" approach characterized by DARPA's Strategic Computing Initiative (SCI) in the 80s or High Performance Computer and Communications Initiative (HPCC) in the early 90s is much flawed and failed to develop technology, products, or lasting companies. All of the 20 HPCC projects failed. The reason was[103] that the development efforts were de-coupled from concrete customer needs and the contractors had no compelling problem to solve to design the State Computers for.

The "demand-side" approach worked. It is estimated that sales to US universities accounted for 80 percent of SUN Microsystems revenues in its first years of business[102]. By imposing demanding performance requirements universities ef-

fectively influenced technological advances in timesharing, computer graphics and artificial intelligence. Out of these efforts companies such as **Silicon Graphics Inc (SGI)** emerged. The DOE labs as well continued their efforts since the 60s as demanding R&D buyers. It was found that a demanding and tolerant customer with compelling user requirements to address concrete user needs works best to influence and evolve products.

A recent example of the DOE supercomputing procurement strategy is the Accelerated Strategic Computing Initiative (ASCI) of the 90s. It aims to develop and accelerate technologies that are either not in the current business plans of manufacturers or not expected to be available in the timeframe or scale required, in particular for performance simulation and virtual prototyping applications. In ASCI DOE procures R&D on a cost-sharing basis from all major competing players: **HP/DEC, IBM, SGI, Cray, and Sun Microsystems**. Blue Gene is an ASCI project designed to produce several next-generation supercomputers, designed to reach operating speeds in the petaflops range. In September 2004 IBM announced that a Blue Gene supercomputer prototype had overtaken NEC's Earth Simulator as the fastest computer in the world.

The 2004 Federal Plan for High-End Computing intends to create bigger leverage by federating resources from a number of government agencies (Department of Defence, Energy, Health, Commerce, and the Environmental Protection Agency). The petaflop computers which this new wave of R&D procurements should develop will help to address a new set of computationally intensive public sector challenges such as simulation of crisis management strategies (e.g. Tsunami), modelling of policy options for fighting climate change or switching to alternative energy sources, analysis of the effects of pandemics or bioterrorism attacks.

Lessons learnt: did the supercomputing procurements bring value for money?

Two types of impact can be observed from the supercomputing R&D procurements: an improvement of the quality and effectiveness of public service applications requiring high-performance computing power, an effect on stimulating industrial innovation in the computing sector at large.

The public sector represents the largest market for the supercomputing industry. For a public procurer achieving better value for money means getting more computing power for a lower cost. Figure 2 shows the cost / performance improvements that have been achieved over 60 years of supercomputing procurements. Sustained public demand for ever more performing computing power has reduced the cost per unit of computing power a trillion times over 60 years time. This has brought enormous cost savings to computing intensive government departments, as well as large spill-over effects to the affordability of personal computers for the private consumer segment.

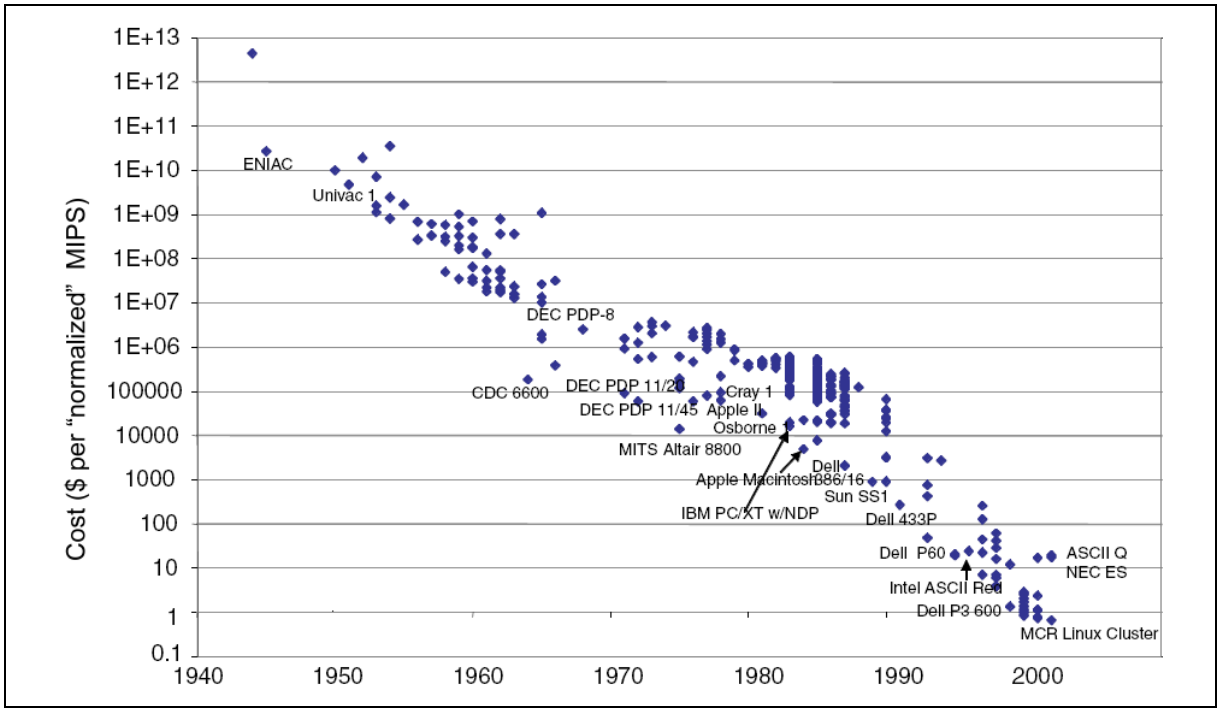

Figure 2: Evolution of cost versus performance over time
Source: 'Getting up to speed: the future of supercomputing',
Committee on the future of supercomputing', US National Research Council, 2004

The second type of impact is the effect these supercomputing procurements have had on stimulating the innovativeness and competitiveness of the US computing sector at large. Figure 3 provides a historic overview of companies whose early days' computer systems R&D was supported by US government purchases, the companies with whom they were competing and the technology breakthroughs that were developed as a result of those procurements.

Figure 2 provides a historic overview of companies whose early computer systems R&D was supported by government purchases, the companies with whom they were competing and the technology breakthroughs developed as a result of the procurements.

Public Procurer	**Competing Companies**	**Technologies Developed**
DOD - DOE - NSA (50s-60s)	IBM, CDC/ETA	Multiprogramming Memory protection General Interrupts
DOE Laboratories (70s)	Cray, IBM	Vector Processing
DARPA, Universities (80s)	DEC, CDC, IBM, UNIVAC	Timesharing
Universities (80s)	SUN, DEC, HP, IBM	Work stations
DOE (90s and beyond)	HP, IBM, SGI, Cray, SUN	Teraflop (petaflop?) machines

Figure 3: Computer systems development supported by government purchases.
SOURCE: ' May 2006 report for the US Centre of Research and Development Strategy ', Gerald Hane, Special Assistant in the Office of Science and Technology Policy of the Executive Office of the US President on the interaction of trade and security on international science and technology policy, May 2006

Those US companies have become the major players of the computing industry globally (see Figure 3): IBM, CDC/Cray, SUN, SGI, DEC (now HP). Figure 4 (produced after the ASCI procurements) provides an overview of how those companies' market shares have evolved over time with the pace of the super-computing procurements. Anno 2008 those companies are still leading the top 500.According to experts it is ultimately the demanding first buyer policy of the DOE that provided the largest demand-pull for high-performance computing power and thereby effectively created the supercomputing industry[103].

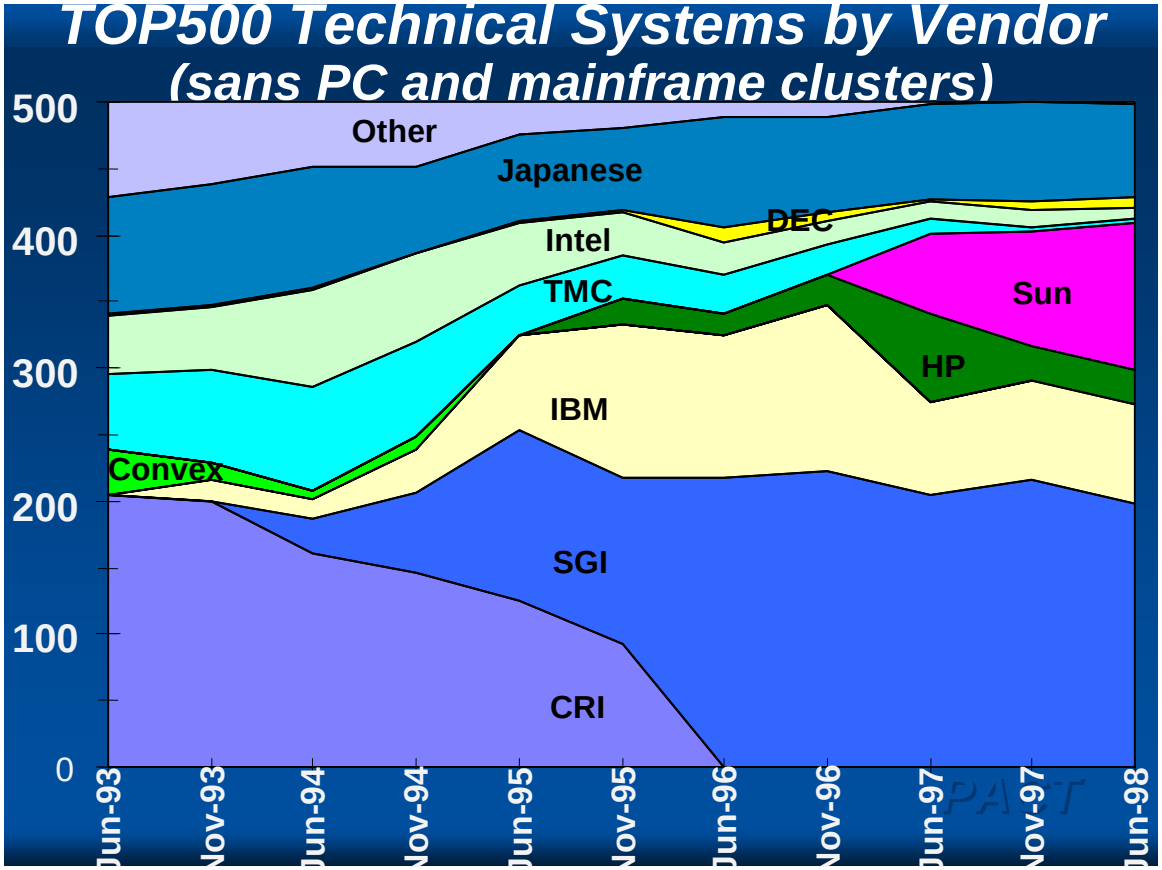

Figure 4: Vendor overview
SOURCE: 'Parallel Architectures and Compilers Techniques', Gordon Bell, 1998
(CRI = Cray Research Inc, SGI = Silicon Graphics Inc,
DEC = Digital Equipment Corporation, acquired by Compaq, and later merged with HP)

6.10.2 Snap-Fit Composite Connections

Granting organisation
US Department of the Navy, United States

Grantee
Ebert Composites Corporation

Abstract
This case study represents a successful use of the US SBIR initiative in development of a new composite connection technology.

Presentation of the project
Since 1982, the U.S Small Business Innovation Research program (SBIR) has helped fund research and development project with the purpose of developing military technologies and products for the US military. Many of the R&D project initiatives under the SBIR programme have subsequently been developed into civil applications and commercialised.

The "Snap-Fit" composite connections, developed and patented by Ebert Composites Corporation is an example of such successful commercialisation of a technology developed for the US armed forces. The Snap-Fit technology allows for rapid assembly and improved mechanical integrity of large, load-bearing composite structures. These connections do not rely on secondary bonding or fasteners; instead, fibre architecture, combined with low-cost machining, produces joint connections with mechanical strength.

Lightweight composite towers, based on the Snap-Fit technology, can be installed quickly, resulting in savings of manpower and maintenance costs. Environmental benefits include on-site placement by helicopter and reduced magnetic fields. The Snap-Fit technology fulfils the US Navy's space, weight, strength, shock, noise, and vibration requirements.

Application of the Snap-Fit technology:

- Shipboard structures, supporting equipment, and decks
- Roll-on, roll-off ramps
- Lightweight bridges
- Transmission/communications towers
- Platform trailers
- Transportation vehicle frames
- Cooling towers

The total SBIR investment for the Snap-Fit was USD 350.000 and the generated revenue was been USD 5.250.000 until now.

Granting organisation
To small businesses in their efforts to develop technologies and products for the Military, the Department of Defence funds over USD 550 million in R&D through its SBIR program annually. The SBIR program is designed to provide funding that may stimulate technological innovation in small businesses to meet government research and development needs.

The US Navy SBIR program is headed by the Office of Naval Research (ONR). The mission of the Office of Naval Research is to foster, plan, facilitate and transition scientific research in recognition of its paramount importance to enable future naval power and the preservation of national security.

Headquartered in Arlington, Virginia and responsible for a Fiscal Year 2006 budget of roughly USD 1.7 billion, the ONR coordinates, executes, and promotes the science and technology programs of the United States Navy and Marine Corps through partnerships with schools, universities, government laboratories, and non-profit and for-profit organizations. ONR provides technical advice to the Chief of Naval Operations and the Secretary of the Navy and works with industry to improve technology manufacturing processes.

In addition to the SBIR programme the US Navy and Marine Corps, through their acquisition programs works to increase the implementation of SBIR-funded technologies into the US Navy.

Grantee

Ebert Composites Corporation is a research and development company with offices in three US locations. Since 1990, Ebert has been involved in the development of several innovative solutions to structural problems by using composite materials. Through SBIR sponsorship by ONR, commercial sponsorship by Southern California Edison and San Diego Gas & Electric, and follow-on support from two NIST ATP grant awards; Ebert has advanced the designs and techniques for producing its new generation of composite structures and mechanical connections.

Ebert's first commercial product was an electrical transmission tower. As a result of this commercialization, in 1998 a joint venture company was formed with Strongwell Corporation to manufacture and sell the towers.

The innovation process

A classic innovation process for a SBIR grant follows a predefined path set out by the granting organisation participating in the SBIR program. The granting organisation is this case study is the Office of Naval Research (ONR) under the US Navy.

Selection of grantees

Back in 1990 Ebert Composites Corporation filed an application for the development of composite connections based a list of predefined themes published by the ONR. The number and magnitude of these themes are decided by the ONR SBIR programme manager. Currently no more than 1 topic per $1 Million SBIR funding is published. The Ebert Composites Corporation met Navy guidelines and had at least three government technical points of contact. For the topic of composite connections where Ebert Composites Corporation had applied only 1 other company was selected in that round to work on SBIR-funding R&D into composite connections.

Ebert Composites Corporation received a notification of grant in 1990. The grant description was also published on the Navy SBIR website. A technical point of contact (TPOC) was assigned to Ebert Composites Corporation and phase I procurement action was initiated within a few weeks of selection.

Contract conclusion

Ebert Composites Corporation received a unilateral 6-month, firm-fixed-price Purchase Order for Work up to USD 70.000 as a Phase I base award. A 3-month "bridge" option of up to USD 30.000 was awarded as an option.

SBIR phase I

Phase 1 was seen as a start-up phase with focus on exploring the technical merits/feasibility of the composite connection technology. The R&D work undertaken in Phase 1 stretched over 6 months and included 2-3 face to face meetings with the assigned TPOC from the ONR and frequent telephone conferences. In addi-

tion several report-based program reviews were conducted as part of the program assessment.

The communication between Ebert Composites Corporation and ONR was straightforward and technical challenges were discussed in open forums between the technical staff of Ebert Composites Corporation and the TPOC of the ONR.

SBIR phase 2
Phase 2 of the SBIR funding to the composite connection technology was focused on the development of the technology along with an evaluation for the commercialisation potential.

The SBIR funding for a phase 2 project is bigger than a phase 1 project because more costly R&D work is expected to be concluded. Ebert Composites Corporation viewed the communication in phase 2 as more stringent from both grantee and granting organisation because the financial and technological implications of the project were bigger.

Commercialisation
Concerning commercialisation Ebert Composites Corporation views themselves more as "the hunter than the farmer" meaning that Ebert Composites Corporation is focus on R&D and not production. Therefore the company has licensed the technology out to an American company called Strongwell. This company then produces products with a civil application based on the Snap-Fit technology developed under the SBIR program.

Impacts from the project
Ebert Composites Corporation views the development of the Snap-Fit technology as a great civilian commercial success even though the financing came from the armed forces. The civilian market proved more ready for the Snap-Fit technology than the defence market and Ebert Composites Corporation views the SBIR grant as essential in the civilian success of the technology.

The development of the Snap-Fit technology has impacted both the US Navy as SBIR granting organisation as well and the commercial market.

Through the SBIR program the US Navy received highly relevant information on new composite materials with better properties than existing materials currently used in ships and ground installations. Different defence-related products are now being developed based on the Snap-Fit technology and these products are expected to improve performance and durability of many different defence applications from ship hatches to infantry river-crossing materiel.

The civil commercial market has gained from the development for the Snap-Fit technology as well. Especially the transmission /communications towers market has been impacted by the development of the Snap-Fit technology. Several new transmission /communications towers have been brought to the market with better performance, less weight and less negative production impact in terms of emissions.

Learning points
The US SBIR project of Snap-Fit opens up for some interesting learning points in relation to European technology procurement in general and the PCP concept. The success of the Snap-Fit development is to some extent contributed by the framework conditions of the US along with the financial and organisational setup of the programme.

100% public funding is a necessity due to SME cost of capital
As argued by Ebert Composites Corporation the company would not have been able to develop the Snap-Fit technology without external financing. The risk-profile of the private equity and venture capital market may have been too high to find an interested partner. In addition the SME cost of capital and the size of the company would have made it difficult for Ebert Composites Corporation to cash-flow finance the development.

Based on this it could be argued that a public programme aiming at raising the innovative capabilities of SMEs should be based on a 100% procurer/granting organisation setup. Otherwise the attractiveness of the programme, in the eyes of an SME, may be limited.

SMEs must obtain proprietary rights
Another aspect brought forward by Ebert Composites Corporation is the discussion on ownership of proprietary rights. The case study indicates that the commercial success of the technology rest upon the fact that Ebert Composites Corporation owns all proprietary right to product, services and documentations developed under the SBIR grant. This puts Ebert Composites Corporation in a position to commercially exploit the technology with a joint venture partner fast and efficient. The granting organisation has licence free access to all information with does not hamper a civilian commercialisation. This setup opens up interesting perspectives on the use of proprietary right and licence-free access to technology. In a European context one could discuss whether the licence-free access for public procurer might not be an interesting approach to public technology procurement from SMEs.

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6.10.3 Symantec

Granting organisation
The National Science Foundation (NSF)

Grantee
Symantec

Presentation of the project

Symantec, now a major international software company based in Cupertino, CA., is a spin off from a Small Business Innovation Research (SBIR) grant for research on the first natural language understanding (English) for microcomputers in the 1970s. SBIR is founded by the National Science Foundation (NSF). Hence, the Symantec project can be seen as an example of radical innovation.

Symantec Corporation is a world leader in computer and information security. It was founded in 1982 from a Small Business Innovation Program (SBIR) research project funded by the National Science Foundation. In 2007 Symantec has a net worth of $7.7 billion, sales of $1.4 billion and 6500 employees. It has more than 50,000 partners, distributors and relationships with original equipment manufacturers, Internet service providers, and retail and on-line stores with operations in 40 countries.

In 1979, in the second SBIR solicitation, Symantec, then Machine Intelligence Corporation, submitted a Phase I proposal to NSF entitled "Microcomputer-based Natural Language Understanding." The Cupertino, CA firm located in Silicon Valley was an advanced robotics firm. The project's objective was to create innovative software that would sort English words in alphabetical order which had never been done except by a Cray supercomputer.

The original 1979 SBIR award was originally allocated with another small company that proved unsuccessful and had a high risk of its own. [104] The driver behind awarding Symantec was that it was a radically innovative project. SBIR funds projects on the idea stage and only gives one award per project. There is no public need present and the project is designed by the applicant and approved by NSF. Hence, the use of multiple suppliers is not an option here.

The project of developing a natural language understanding research involved a group of Stanford University researchers led by Dr. Gary Hendrix and was funded first by the Department of Defence Small Business Innovation Research (DOD SBIR). The outcome of the project was the development of Q&A software, which was regarded as a breakthrough in software.

In 1982 the company Symantec was founded by Dr. Gary Hendrix as direct spin off of the project, with 6 employees from Machine Intelligence Corporation based on the belief that the early results could generate venture capital of its own. The establishment of Symantec was based on the commercialisation of the Q&A software. Q&A that is an integrated business-productivity tool developed for the IBM PC/XT/AT and includes a file management system, a report generator, a word processor, a spelling checker and an "intelligent assistant" that lets the users manipulate databases and produce reports by command or questions in English.

[104] Hendrix, G., founder of Symantec (1986)

According to the founder of Symantec, the NSF SBIR project was vital for the development and commercialisation of the Q&A technology by providing intellectual and commercial interest that worked as a catalyst. Furthermore, it was of significant importance that SBIR provided extremely high risk start-up capital for the complex idea of Q&A to be developed.[105] Q&A's significant sales and earnings allowed Symantec to rapidly expand and diversify through acquisitions. Symantec's founder and first president said that "the NSF project had the intellectual and commercial 'little something' that served as a magic catalyst for thinking big about the company's potential."

Q&A quickly became a very successful commercial product generating millions of dollars of sales. It still is, by far, the most popular commercial application of natural language processing in the world.[106]

Symantec quickly went after top quality technical and marketing staff and venture capital, and ultimately 19 acquisitions. "SBIR provided the extremely high risk, start-up financing for a very complex idea that had many exciting, potential applications and great economic leverage, if successful." It provided the early financing and profits from Q&A for Symantec to pursue rapid growth and recruiting, as Symantec later managed to attract 12 scientists and engineers from academia as well as skilled marketing people and $3.5 million of venture capital from Kleiner, Perkins.[107]

The profits from Q&A sales supported the company's early development and Symantec grew from a small, four-person start-up to a large, diversified software firm. Symantec's initial success with Q&A led to an initial public offering of $10.5 million that was followed by 19 acquisitions. The company had record sales of $455 million in 1995 and cumulative sales are now approximately $2 billion. Total employment is nearly 2000.[108]

Today Symantec is a major international broad-based software firm with $2 billion in cumulative sales and about 2000 employees. The success took place, interestingly, in spite of the original SBIR award being made in 1979 to another small company which was unsuccessful in its own high risk effort. However, Machine Intelligence Corporation spun off the NSF natural language understanding project with six employees as Symantec in 1982 because it believed that the idea, its potential and the early results were so promising that it could attract its own venture capital. It promptly did so and obtained $3.5 million of venture capital in 1982 followed by an IPO of $10 million in 1987. Symantec, an SBIR start-up, is a world-class commercial success.

Gary Hendrix has said that the key factor in their success was that "NSF was willing to fund this radical, high risk idea that clearly had enormous potential. The potential had real 'pizzazz' which was sufficient, with the project's technical progress in Phase I and Phase II, to attract top-flight management, engineers, and marketing staff, and the $3.5 million of venture capital, $10.4 IPO and $174 million in public offerings. Early success was the magical catalyst which attracted acquisitions and about 12 excellent scientists and engineers from academia. The project had the intellectual and commercial pizzazz that made it all possible. Early technical and commercial success was also the catalyst for thinking big and making such plans very early in the company's life. Most, if not all of the academic scientists and engineers, remained in the private sector, two making major contributions.

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[105] Tibbetts (2000), SBIR http://books.nap.edu/openbook.php?record_id=9701&page=129
[106] SBIR Pioneer info: http://www.inknowvation.com/Tibbetts/tx960061.html
[107] Symantec.com
[108] SBIR Pioneer info;http://www.inknowvation.com/Tibbetts/tx960061.html

According to Roland Tibbetts, Symantec would not have attracted the top-notch staff and financing that was responsible for its growth without the SBIR funded idea and its technical and commercial potential. The acquired companies might have stayed independent or joined with others, but few companies have been as successful as Symantec. Gary Hendrix attributed most of the growth to the scenario and catalytic value of the early and continued success.

Symantec achieved a major technology breakthrough by creating Q&A software that could sort English words in alphabetical order for other than the Cray supercomputer. The software in turn significantly increased the efficiency and capability of smaller computers at that time and maybe today. Symantec is a great example of what SBIR can do to contribute to national need s in innovation and technology breakthroughs, and to stimulate significant private investment, create thousands of quality jobs, economic growth and leadership, particularly in challenging new and emerging technology areas.

The Granting Process

Before the award

NSF, the granting organisation, sends out a solicitation for research proposals. The SBIR programme is based on funding ideas and hence, there is not necessarily a public need for the inventions. There are some guidelines, though, the most important one being that the applicant should be able to exploit the R&D into technologies and thereby have a commercial angle. Pure science projects cannot be funded.

Symantec was funded along with 39 other proposals.

After the awarding

The awarded projects are fully funded by NSF, which was also true for Symantec. This is different from for instance the Dutch SBIR programme, where the grantees themselves have to fund a certain percentage of the development themselves.

In the case of Symantec, there was a technical person and a grant person following the project. They were not intensely involved in the project, but checked upon the grantee approximately once a year.

Phase 1

Symantec was one out of 40 grantees given 25,000 USD at the time to further develop their idea. However, besides the economic support no dialogue or assistance existed between NSF and Symantec. At the end of phase 1 the Symantec project was evaluated and the development of the project was so promising that phase 2 was initiated. All of this is normal procedure for SBIR awards.

The NSF reviewers of the company's Phase I proposal did not believe that the firm had the capabilities to achieve what universities and large computer and software firms had not been able to do. The $25,000 proposal initially was not recommended for award for this reason. In the committee's final review, it changed its mind and recommended funding because it was so important. Phase I results were promising as was the Phase II proposal and its commercial potential and it was funded for $219,820.

Phase 2

Again, Symantec did the development work themselves, and NSF was not very involved in the procedure. However, the project was evaluated at the end of the phase and the technical person and the grant person did check up on the project, as is standard SBIR procedure.

In 1981 the company was on the verge of bankruptcy. The president and executive VP of Machine Intelligence of the company discussed how promising and important the project was and requested that NSF continue their Phase II funding to a new small company plan with the same four employees in the same laboratory until completion of the project. They also thought the company would be able to attract follow-on venture capital fairly quickly because of the results. I and NSF agreed. Symantec became the name of the new company and Q&A the name of the coming software. Symantec was able to obtain $3.5 million in venture capital on completion from a top venture capital firm, Kleiner Perkins Caulfield and Byers, of nearby Menlo Park in Silicon Valley.

Commercialisation

Symantec had to develop a marketing/dissemination plan for phase 3, which is after the project is out of NSF's hands. The marketing plan was presented and approved by the NSF in phase 1. Phase 3, where the project is commercialised, is private money, and the NSF is no longer involved in the project. NSF did not work together with Symantec to commercialise the development but were available for support (but not financial!) if Symantec needed it.

The IPR stayed with Symantec, which is normal in the SBIR programme, but actually changed American law when SBIR was introduced. Before SBIR, when a project was developed with government money, the government also had the IPR.

The grantee actually had problems in this phase, as the project was quite difficult to develop further without funding from NSF. The company went bankrupt, but committed people saw the potential in the project and invested in it in order to further develop the project. Hence, committed people which believed in the project were also a key success factor in the commercialisation of the Symantec project.

Significant sales of the highly profitable software allowed the company to hire 12 excellent university scientists in fields of interest who soon became entrepreneurs. It also had the money to fund internal R&D, provide new facilities and equipment, cover licensing costs in many countries, and increase the management and marketing staff. Q&A success had been the key to the rapid growth and the necessary financing that went with it - the $3.5 million venture capital, a $10.4 million IPO in 1987, and $174 million in public offerings between 1990 and 1995.

This resulted in six new software products and memory cards with cumulative Q&A related sales exceeding $50 million. Hendrix said the Q&A concept and software made major contributions to 20 other Symantec products. The sales were extremely profitable and financed Symantec's acquisition of 15 companies of interest, 14 between 1990 and 1995. Most were small firms, but they also acquired Norton Utilities, a much larger company that badly needed money to expand and promote its computer security protection software. Symantec made that possible and Norton sales tripled the next year.

Hendrix said that the Q &A concept and software made major contributions to 20 other Symantec products. The company acquired or merged with 19 compa-

nies between 1982 and 1996, 14 since 1990. He estimated that total sales through 1995 attributable to the single NSF SBIR project were $335 million. This compared with total company sales over the same period of $1.4 billion, including foreign sales exceeding $100 million. In 1995 Symantec sales were $877 million and the company had 1500 employees.

Impacts

The impacts have been large on *citizens*, as the natural language understanding programme was a radical innovation and eased the utilisation of computers for the users.

The development moreover created jobs in Symantec that grew very fast in the years following the SBIR award.

Learning points from the SBIR project (key success factors)

According to the interviewee from NSF, the following key success factors made the Symantec project successful:

Full funding
According to the interviewee, the full funding provided to Symantec by NSF made it possible for Symantec to develop a product that was so good that it could attract venture capital by itself afterwards. The full funding reduces risk for the grantee and hence makes the grantee take greater chances with their products. Risk tolerance is vital for developing radically innovative projects.

Good review
A good review process is crucial as well in order to ensure that the projects have the best possible opportunities of getting funding afterwards. This review process is ensured in both phases of the SBIR programme.

Technological focus
The projects funded must have a technological focus and cannot be pure science projects. This is again due to the fact that the projects need to stand on their own two legs after phase 2 and thus need to raise venture capital on their own for phase 3.

Resources

Interview with Roland Tibbetts, former SBIR Program Manager and founder of SBIR, National Science Foundation, 6 July, 2007.

6.10.4 iRobot – Roomba

Founded in 1990 by Colin Angle, Helen Greiner and Rodney Brooks, Massachusetts Institute of Technology robotics, iRobot Corporation specialises in behaviour-based robots that help people complete tasks with better results.

DARPA, the Defence Advanced Research Projects Agency, is the central research and development organisation for the US Department of Defence and pursues research and technology where risk and payoff are both very high and where success may provide dramatic advances. When DARPA's tactical mobile robotics program contracted a few companies (one of them iRobot) to develop in competition robots that could walk autonomously through urban environments, all companies came up with the traditional Cartesian (very computationally complex) algorithms. In contrast, iRobot came up with a computationally very simple but revolutionary heuristic algorithm. They won the procurement and winning the award eventually led to the development of the iRobot PackBot, Tactical Mobile Robots which have been delivered to a broad range of military and civilian customers around the world. These robots have performed tens of thousands of missions in Iraq and Afghanistan and are credited with saving scores of soldiers' lives. However, the company did not focus only on military robots and afterwards successfully commercialised this new robotics algorithm in the civilian market.

In September 2002 the company introduced one of such civilian products – the iRobot Roomba Vacuuming Robot. iRobot was the first practical and affordable home robot, which uses the same technology found in the manufacturer's military robots, as some of the hazard-avoidance technology comes from the defunct mine-sweeping robot. iRobot is the leading example of a company that has funnelled its DARPA-funded projects into an appropriate consumer product using off-the-shelf parts.

Until now robots have been created largely for research and industrial purposes. Roomba, introduced in 2002, provided a user-friendly way to do a chore that most people hate -- vacuuming -- at a price they could afford.

Roomba was the company's success, leading to the boost of its financial situation starting from the year 2003. In October 2004 sales of iRobot Roomba Vacuuming Robots surpassed 1 million units. Several other products such as the iRobot Roomba Discovery Series and the iRobot Scooba (a floor washing robot) have been introduced and since 2003, the company's revenue has grown by 248%, from 54.3 million in 2003 to 189 million in 2006. Moreover, in May 2006 sales of iRobot home robots surpassed 2 million units.

Since its foundation iRobot has won numerous awards for innovation and design.

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6.10.5 eVA e-procurement system

Procurer
Commonwealth of Virginia

Supplier
CGI (previously American Management Systems, AMS)

Presentation of the project

The eVA is a web-based electronic procurement system, funnelling purchasing by state agencies, institutions of higher education, local governments, and other public organisations through a single electronic portal. For the procurer, eVA is a service; the software is owned and hosted by the supplier.

Prior to the introduction of the system in 2001, the Commonwealth of Virginia's procurement activities were decentralized across 171 state agencies and institutions, as well as a large number of other public bodies such as local governments, schools, airports, etc. All of these organizations operated largely as autonomous entities. Throughout the Commonwealth, day-to-day procurement activities used a variety of desktop applications, automated purchasing systems and manual processes. There was no overview of the prices paid by individual organisations, and no public visibility. The decentralized procurement environment was also a burden to vendors doing business with the Commonwealth, who were required to register with multiple individual agencies, institutions and public bodies.

Virginia engaged AMS (now CGI) to provide a comprehensive, integrated solution addressing the Commonwealth's vision for electronic procurement. The project was quite advanced since. Electronic procurement was in its infancy, and the Commonwealth wanted to take it to the next level.

The initial investment in the project was USD 300,000, which was subsequently raised in stages to USD 9 million. However, the investment has subsequently been recovered from the fees paid by the users of the system. There are fees in place for both supplier and agency users. The fees are kept at a low level in order to encourage the use of the system. Since the system has had a very good take-up among the users, it is now self-funded; the income generated from the fees is large enough to cover *both* the payment to the supplier for the continuous service delivery and further development, as well as internal expenses within the Commonwealth.

Presentation of the buying institution and the supplier

<u>Procurer</u>
The Commonwealth is the state Government of Virginia. The Department of General Services, Division of Purchases and Supply are responsible for the procurement, development and continued operation of the eVA system.

<u>Supplier</u>
Originally, the contract was won by American Management Systems (AMS), a large business and information technology consulting firm based in Fairfax, Virginia (approx. 9,000 employees worldwide in 1999). In 2004, AMS was acquired by Canada-based multinational CGI. CGI has a strong focus on government

business, and most of its operations in this sector in the US today are based on previous AMS operations.

The technology procurement process

Before the publication of a tender

The process leading up to the publication of the Request for Proposals (tender) took approximately 12 months. The procurer prepared very thoroughly, involving an unusually wide spectrum of stakeholders in the process. A design team was set up, involving not only key IT and procurement expertise but also finance people and procurement managers from the institutions, auditors, and others. The design team aimed to identify problems from an enterprise perspective. The objective was to formulate a statement of stakeholder needs, not how to execute the requirements. According to the procurer, the stakeholders contributed significantly to the process.

A project office was set up with a core team including the director of procurement, the director of information systems and the agency controller. The core team was to work together for the whole lifecycle of the project and is still in function, overseeing the implementation and further development of the system.

The statement of needs was published on the internet and input invited. In addition, public meetings were held with suppliers (i.e. the future users of the system) and potential system vendors to gain additional input for refinement of the Request for Proposals.

Procurement phase

The procurement procedure took place in strict accordance with the procurement rules. Nine bids of varying quality were received; some vendors seemed not to have quite grasped the assignment, while some of the very large players offered off-the-shelf products which would not fulfil the ambitions of the Commonwealth. American Management System provided by far the best approach, and the contract was signed on 31 October 2001.

Post-contract phase

The contract was based on relatively detailed performance specifications. However, the approach was flexible in the sense that the contract was modified along the way in accordance with the learning taking place during the development phase.

The contract also contained explicit exit/transition strategies, e.g. provisions for what to do in case a new solution emerges, the supplier goes out of business or other developments occur that change the situation. Thus, the procurer has multiple exit strategies in place to respond to different situations (e.g. buying the technology and developing it further themselves).

Both the procurer and the supplier state that the co-operation went extremely well, not least due to the fact that the procurer and supplier had "mirror project teams" matching each other throughout the process. It is also worth noting that the procurers dedicated team in place has taken on a permanent role, staying both during the development process and afterwards managing and participating in the further development of the system after its implementation.

The thorough preparation paid off in the development process, and less than five months after contract signature, a pilot version of the system was operational. It was rolled out at full scale in September 2001.

Commercialisation

All intellectual property rights emanating from the project stayed with the supplier, including the rights stemming from the contribution of the Commonwealth to the common development process. This was a deliberate strategy on the part of the procurer in order to make the product more marketable and thus contributing in more general terms to the development of e-procurement. It was also a natural choice because the Commonwealth did not wish to own and operate the system themselves; from the beginning, they wanted only to buy the *service*, with the new system hosted and operated by the supplier.

Impacts
The impacts of the introduction of the eVA throughout the state procurement system in Virginia have been considerable.

A number of vendors have reported savings on e.g. paper catalogues, and this has resulted in lower prices. The increased visibility of prices and purchase conditions in the system has also contributed to increased competition and lower prices.

Thus, the total reduction in costs (prices) of goods and services procured by the Commonwealth and its agencies during the lifetime of the project amount to a total of approximately USD 188 million.

To this should be added administrative savings/higher efficiency. These savings have not been measured or estimated but are thought to be of a considerable size. Finally, a number of local communities within the state did not have ERP or electronic procurement systems in place before the introduction of eVA and have thus been spared having to invest in such systems.

PCP Learning Points

Strong top-down backing, but operational decision-making left to project team
The project enjoyed very strong support from the top of the organisation; the governor pushed hard to have the task accomplished very fast. For this reason, the project team had the resources, the motivation and the decision-making power to drive the project through in record time, without bending the procurement rules or slacking on quality requirements.

Strong project team with the right competences is vital to success
The project team possessed the required technical, procurement and project management skills, as well as the resources to devote their time 100% to the project in the development phase, and to a large extent also in the operation of the system. This was vital to the excellent co-operation with the supplier which resulted in the only really successful state-wide e-procurement system in the US being implemented so far.

Broad stakeholder involvement
All stakeholders – external as well as internal – were involved in the process right from the start, working together to define the system requirements. Both suppliers, external users (companies), procurement staff, auditors and anyone else who somehow were to use the system were included, and this resulted in a very clear picture of what the system needed to be able to do, which again helped put the right requirements to the potential suppliers.

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6.10.6 Sub-Compact Fluorescent Lamps

Procuring institution
US Department of Energy via Pacific Northwest National Laboratory

Supplier
A number of lamp/light bulb manufacturers

Abstract
The primary objective of the project was to induce lamp manufacturers to introduce to the market new screw-base Sub-Compact Fluorescent Lamps (Sub-CFLs) that were significantly smaller than the existing generation of CFLs (energy-saving lamps), which were both expensive and failed to fit many common US lighting fixtures, which meant that consumers had little incentive to replace non-energy saving lamps with CFLs. The project succeeded in causing several manufacturers to introduce new, very small products to the market, and at a price significantly below the then prevailing market retail prices for CFLs. Sales of the new lamps exceeded all expectations and has completely changed consumer behaviour towards buying the energy-efficient lamps.

Presentation of the project

The CFL technology has existed at least since the 1980s but never got a foothold in the market because the products were expensive and had performance issues (flicker, poor light output, too big to fit in sockets, early failure) in relation to traditional, non-energy efficient products. In preparation for the project, the procurer looked at the market barriers, how the existing products could be improved and what buyers were willing to buy at the right price. There was no anchor buyer in the project, but a number of utilities were involved who committed themselves to promote an improved products.

Procuring institution
The project is funded by the US Department of Energy, but carried out by the Pacific Northwest National Laboratory (PNNL) in Portland, Oregon. The PNNL is a DOE intuition, originally established to do research into nuclear power, but nowadays working with other aspects of energy research. The PNNL has carried out a series of similar projects regarding procurement of energy-efficient products, of which the Sub-CFL is the latest and the most successful.

Supplier
Initially, a number of smaller lamp manufacturers; in Phase 2, most of the large producers joined as well.

The technology procurement process

The project was not set up as a traditional technology procurement project (although the PNNL saw this as a continuation of their previous technology procurement projects). The specifications for what the new products should be able to do were developed by PNNL, and initially, all the major manufacturers were approached – the market was dominated by a handful of very big players. However, the major manufacturers were not immediately interested. Thus, in a second round, smaller manufacturers were included. These were more willing to change than the dominant market players and agreed to participate. Both marketing and development (engineers) staff were approached, in order to ensure that both aspects were included in the development process. Thus, prior to release of the request for proposals, industry had been involved, having been shown drafts of the RFP etc.

In Phase I, only 3 products passed all the tests. The PNNL analysed the lamps that failed the tests and wrote a report that went out to the whole industry, including guidance on how to fix these failures. This led in Phase II to a lot more submissions of lamps for testing. Before the "winners" were announced, the lamps went through comprehensive performance testing.

Impacts from the project

The impacts from the project were significant. The new products developed as a result of the project were both technically superior to and cheaper than the existing, non-energy efficient products. As a result, prices have fallen significantly, and with the promotion support of the utilities involved, buyers have now shifted their preferences towards the CFLs, completely changing the market structures. All manufacturers – including the ones that did not participate initially – are now producing the new types of products.

Learning points

Influencing the market forces is key

The project clearly demonstrates the potential of working with not only the technology side, but also the market side. The suppliers' marketing people were involved from the start on an equal footing with the development departments, and this ensured the success by focusing on what buyers would want, not only what was technically possible.

Securing the involvement of key procurers/promoters

Although the utilities which were involved in the project were not directly procurers, their involvement was key both to convince manufacturers that the new products would be promoted and to informing the public about what had become available. Thus, in this case, the utilities had much of the same function as a "buyers group" in more traditional technology procurement cases.

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Annex IV: References

Note: The references cited here are those used for the report in general; sources which are specific to individual case studies are listed at the end of each case study.

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Annex V Interviews

Note: The interviews listed here are those used for the report in general; interviews which are specific to individual case studies are listed at the end of each case study.

Name	Title	Organisation	Date for interview conducted
Marc LaFrance	Head of DOE Window and Building Envelope R&D	DOE (Department of Energy), USA	06 September 2007
Michael Caccuitto	SBIR Program Manager	DOD (Department of Defense), USA	Several contacts during winter 2006-spring 2007
Charles F. Cleland	SBIR National Program Leader	USDA (US Department of Agriculture), USA	10 January 2007
Jo Anne Goodnight	NIH SBIR/STTR Program Coordinator	National Institute of Health, USA	17 January 2007
Roland Tibbetts	SBIR Founder	Formerly SBIR (Retired), USA	06 September 2007
Errol Arkilic	Ph.D. Program Manager Division of Industrial Innovation and Partnerships	Small Business Innovation Research National Science Foundation, USA	Ongoing contact July 2006
Peter Freeman	Assistant Director	Directorate for Computer & Information Science & Engineering (CISE/OAD), SBIR Energy, USA	18 January 2007
Valerie Carter	Manager, Government Relations	PMI (Project Management Institute), USA	15 August 2007
Rick Grimm	CEO	NIGP (National Institute of Governmental Purchasing), USA	22 August 2007
Paul Brennan	Director of Purchasing	Rockland County, USA	03 September 2007
Ron Bell	Director, Division Purchases and Supply	State of Virginia Department of General Services, USA	31 August 2007 (+ case interview 5 Sept. 2007)
Rick Berry	Executive Director for Construction and Procurement Service	Old Dominion University, USA	29 August 2007
Kirk Buffington	Director of Procurement Services	City of Fort Lauderdale, USA	28 August 2007
Kelly Loll-Jones	Director, Knowledge Center	State of Georgia, Department of Administrative	21 August 2007

Name	Title	Organisation	Date for interview conducted
		Services, USA	
Gregory K. Spearman	Director of Purchasing	City of Tampa, USA	27 August 2007
Tom Youngs	Manager, Purchasing Services	University of Pittsburgh, USA	22 August 2007
Mikkel Hippe	Senior Consultant	National IT and Telecom Agency, Denmark	July 2006
Jacob Primault	Head of Department	Danish IT, Denmark	June 2006
Jens Christian Led	Head of Department	Greater Copenhagen (HUR), Denmark	June 2006
Jens Rørbech	Professor	Technical University of Denmark	June 2006
Mads Thimmer	Founder	Innovation Lab, Denmark	June 2006
Nelleke Corbett	Ministry of Economic Affairs	Directorate-General for Enterprise and Innovation, the Netherlands	27 April 2007
Corry van Driel	SBIR contact person	SenterNovem, the Netherlands	July 2006
Hans Haveman	eHealth expert	Ministry of Health, Welfare and Sports, the Netherlands	July 2006
Patricia Roemer	SBIR contact person	Ministry of Education, Culture and Science, the Netherlands	July 2006
Marjolijn van Valkenhoef	Innovation expert	Dutch Ministry of Economic Affairs, the Netherlands	July 2006
Sander van Sluis	Procurement expert	PIANOo, the Netherlands	June 2006
Max Rolfstam	PhD. Student	Circle, University of Lund, Sweden	02 August 2007
Egil Ofverholm	Expert, IEA	STEM (Swedish Energy Agency), Sweden	28 June 2007
Stefan Jönsson	Analyst, legal improvements	NUTEK, Sweden	10 November 2006
Karin Rydén	Programme Manager	NUTEK, Sweden	10 November 2006
Hans Sundström	Chief lawyer	Verva, Sweden	10 November 2006
Neil Griffiths	Audiology Category Manager	NHS Purchasing and Supply Agency, UK	September 2006

Name	Title	Organisation	Date for interview conducted
Gaynor Whyles	Procurement expert	DTI Environmental Industries Unit, UK	August 2006
Chris Hendry	Professor, Associate Dean (Research), Director of Centre for New Technologies, Innovation & Entrepreneurship (CENTIVE)	Cass Business School, England	10 July 2007
Billy Noone	Assistant Principal	National Public Procurement Policy Unit, Irish Department of Finance, Ireland	7 November 2006
Grainne McGuckin	Principal Officer	National Public Procurement Policy Unit, Ireland	July 2006
Ernst Bürger	Head of Division, Information Society and eGovernment	Ministry of the Interior, Germany	July 2006
Michael Unger	Head of Division, Information Technology and Contract Management	Procurement Agency, Germany	July 2006
Norbert Niemeyer	Project Manager	Media@Komm, Germany	July 2006
Gérard Soisson	Director of the eLuxembourg Strategy and Communication department	Department of eGovernment, Luxembourg	July 2006
Pentti Itkonen	Special Advisor	Ministry of Social Affairs and Health, Finland	August 2006
Roberto Sacerdoti	Procurement Expert	Public Procurement Authority (Autorità per la Vigilanza sugli Appalti Pubblici), Italy	August 2006
Roberto Pizzicannella	Responsible manager of Unit for e-government Programme in Regions and Local Authorities	CNIPA, Office for Innovation in Regions and Local authorities, Italy	23 October 2006
Peter Strickx	Director-General, Systeemarchitechtuur en standaarden	FEDICT, Belgium	August 2006
Cristina Gil	Technical Superior	Directorate-General of European Affairs, Foreign Office, Portugal	August 2006
Jindriska Koblihova	Vice-Chair, Office for the Protection of Com-	Public Procurement Department, Czech	August 2006

Name	Title	Organisation	Date for interview conducted
	petition	Republic	
Eva Kubisova	Chairman of the Appealing Commission	Office for the protection of Competition, Czech Republic	August 2006
Andràs Nagy	Legal advisor	Council for Public Procurement, Hungary	July 2006
Auralija Krisciunaite	Chief specialist of methodological and training division	Public Procurement Office, Lithuania	August 2006
Joseph Meli	Assistant Director	Department of Contracts, Malta	August 2006
Andrej Dolinsek	Deputy Director	Public Procurement Office, Slovenia	3 November 2006