

# **Review of Pre-commercial Procurement Approaches and Effects on Innovation**

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## **Abstract**

This paper is part of the Compendium of Evidence on the Effectiveness of Innovation Policy Intervention. The paper reviews the literature that discusses the effects of policies which employ pre-commercial procurement to encourage and stimulate innovation. Pre-commercial is public procurement of research that will lead to innovation, and does not involve the purchase of a good or service that already exists. One of the best known pre-commercial approaches is the US SBIR Programme. In Europe, there is increasing interest in pre-commercial procurement approaches, but here, a different legal framework results in important differences in the way pre-commercial procurement can operate. The paper is in four main parts: a) firstly a short definition of pre-commercial procurement is offered, and an explanation is provided of the link between pre-commercial procurement and other demand side initiatives of which pre-commercial procurement can be considered an example; b) the reasons for using PCP are then considered, i.e. the justifications for this type of policy; c) then the forms affecting implementation are considered, paying close attention to the legal rules that define its application; d) evidence of impact is then considered in a section that looks very largely at the US implementation of the concept, the US SBIR; e) in section five, some general lessons and observations are provided. Annexes contain various reference materials including a bibliographic review of publications, and at a glance list of evaluations and the references.

JEL Classification: O38

Keywords: Pre-commercial Procurement PCP Innovation

The Compendium of Evidence on the Effectiveness of Innovation Policy Intervention Project is led by the Manchester Institute of Innovation Research (MIOIR), University of Manchester, and funded by Nesta, an independent charity with the mission to make the UK more innovative. The compendium is organised around 20 innovation policy topics categorised primarily according to their policy objectives. Currently, some of these reports are available. All reports are available at <http://www.innovation-policy.org.uk>. Also at this location is an online strategic intelligence tool with an extensive list of references that present evidence for the effectiveness of each particular innovation policy objective. Summaries and download links are provided for key references. These can also be reached by clicking in the references in this document. Corresponding Author: Dr John Rigby, MIOIR, University of Manchester, Oxford Road, Manchester, M13 9PL, Email: [John.Rigby@manchester.ac.uk](mailto:John.Rigby@manchester.ac.uk)

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## Executive Summary

1. This report is a review of the literature on government procurement of R&D services that seek to stimulate innovation. This is an activity often termed pre-commercial procurement (PCP) and this term will be used here in this report to refer to this family of approaches.
2. PCP is not the purchase of innovation, what the European Union terms procurement of innovation or (PPI). The purchase of innovation (PPI) is not covered by this report but has been dealt with by other reports in this series, especially that by Edler ([2013](#)). Procurement of innovation both in Europe and outside it is undertaken to procure goods that are on the market (or very close to it) using procedures that comply with the Government Procurement Agreement (GPA) of the World Trade Organisation (WTO). This report does not consider PPI but looks at PCP. This report examines the rationales of PCP, its context – in demand side approaches to innovation, its operation, and its impact.
3. The report is in four main parts: a) looks at defining pre-commercial procurement; b) looks and why we are seeking to operate PCP; c) then the forms affecting implementation are considered, paying close attention to the legal rules that define its application; d) evidence of impact is then considered; e) section five provides some brief observations. Annexes contain various reference materials including a bibliographic review of publications, and an “at a glance list” of evaluations and the references.
4. The justifications advanced for PCP approaches are the following: externalities are generated from R&D support of the kind used by PCP although IPRs can be shared; market failures of information may be reduced; the testing of innovations reduces the risks for the public sector; increase in the quality of the public services is likely to with this approach than with traditional procurement; government develops technologies with a public good which are ultimately for private purchase where private markets don't yet exist; government procurement of technologies (ultimately from a PCP) may lead to wider private adoption; PCP approaches may in certain cases give greater access to small firms; they may also give greater access to minorities; firms taking part in PCPs may experience capability development; new employment and new firms are created by innovation activities; a major policy goal of increasing European innovation and economic growth and social cohesion, achieved with higher levels of research and development.
5. It is possible to see that within the evaluations that have been carried out, there is a strong focus upon economic impacts on the firms and sectors supported and a set of case studies showing examples of new technologies delivered. However, there is a significant gap in the evaluation literature both published and grey / non-peer reviewed of the following legitimate comparisons which are subject to either non or negligible attention: a) how well does pre-commercial procurement compare with existing forms of procurement in realizing the objectives of government; b) how does pre-commercial procurement compare with other forms of business support to firms such as R&D programmes, or taxation schemes.

This is not surprising in the case of countries outside the US, as the approach is very new. But it is surprising that more systematic evaluations have not taken place for the US.

6. Evaluation of the SBIR programme (of the United States of America) has led to increasing awareness of the role of the design of pre-commercial procurements. As programme designers have varied these aspects over time and in practice, programme managers have used the discretion inherent in the US scheme on a case by case basis. Overall, the US SBIR has tried to reduce proposal review time (funding gaps) at both Stage I and Stage II, Wessner reports that the US SBIR has adopted a target of reducing the Stage II gap from 11.5 to 6 months and the Stage I from 6.5 to 4 months ([Committee for Capitalizing on Science Technology and Innovation 2007](#), page 217.).
7. Impact of the US scheme is based on achieving a delicate balance, enough competition to secure innovation, and collaboration, but not too much competition that would deter entry. Enough time to deliver a solution against an organisation priority, but not so little time as to make innovation impracticable within the time allowed. The role of how much risk the government itself should take is an important issue raised recently ([Link and Scott 2010](#)).
8. Recent evaluations suggest that evaluators at the early stages of the development of their programmes are acutely aware of the need to encourage participation both on the part of firms who take part in the competitions and on the part of client / user government departments for whom pre-commercial procurement is a new policy tool they have been encouraged to operate by their respective pre-commercial procurement promoting departments, usually the ministry of innovation / industry.
9. The issue of proposal resubmission (at Stage I and Stage II) has been considered in the case of US SBIR as proposal re-submission has an effect on the engagement of firms in the programme, its reputation, and upon the capacity of the programme to gather and then support good ideas. Parts of the US Programme have some recycling of proposals whereby agency staff examine proposals rejected by one call and feed these into subsequent ones. Such activities require significant numbers of commercially and technically qualified staff within agencies / government departments.
10. PCP implementation within the European context currently faces a number of important and difficult choices although not all the choices are mutually exclusive. Those choices include the following: what is to be the locus of PCP and PPI decision making? What general approach is to be taken? What third party relationships (to conduct the procurement) are to be found? Is agency involvement (a relationship to operate and manage) to be sought? Will co-funding of a procurement be sought? What legal rules will be followed? Who will contract? What level is best to work at and can multi-level schemes regional, national or local be effective?
11. Evaluation of PCP is challenging because pre-commercial procurement activities are a diverse set of activities and do not constitute a single model of intervention. For example, the US programme varies to a significant degree across government departments in terms of

the technology area (not surprisingly) addressed and in terms of the management teams that operate the programme (as the programme is embedded within departments) and in terms of the rules that are applied. Over time there have been changes also to the operation of the programme, and, while the US does not have any official Stage III funding instrument as part of the programme, there are a range of instruments available that constitute follow-on funding which are not comparable to those in other countries where pre-commercial procurement is operating.

12. Furthermore, within the European case, there is the 16f option for pre-commercial procurement that could be compared with the existing national schemes and there are additional measures, separately negotiated, such as the Energy Technologies Institute.
13. Related to the third point in this section is the problem that within the European Union there are as yet few schemes operating for a long enough period that would allow comparison against each other and against the US model (even if this was a plausible evaluation strategy which is doubtful, given the variety of purposes to which pre-commercial procurement schemes have been and can be put).

## 1 Introduction

This report is a review of the literature on government procurement of R&D services that seek to stimulate innovation. This activity is often termed pre-commercial procurement (PCP) and this term will be used here in this report to refer to this family of approaches. PCP is not the purchase of innovation, what the European Union terms procurement of innovation or (PPI). The purchase of innovation (PPI) is not covered by this report but has been dealt with by other reports in this series, especially that by Edler ([2013](#)). Procurement of innovation both in Europe and outside it is undertaken to procure goods that are on the market (or very close to it) using procedures that comply with the Government Procurement Agreement of the WTO (within the EU the public procurement directive ([European Parliament and the Council 2004](#))). This report does not consider PPI but looks at PCP. This report examines the rationales of PCP, its context – in demand side approaches to innovation, its operation, and its impact. PCP in the European Union comprises various approaches to procurement a) according to the Commission’s Communication on pre-commercial procurement, b) procurement under the Article 16f exemption of the public procurement directive and c) other approaches. Interest in this family of approaches is growing in the European Union with scaling up of existing national initiatives and increasing adoption across Member States.

The report is in four main parts: a) firstly a short definition of pre-commercial procurement is offered, and an explanation is provided of the link between pre-commercial procurement and other demand side initiatives of which pre-commercial procurement can be considered an example; b) the reasons for using PCP are then considered, i.e. the justifications for this type of policy; c) then the forms affecting implementation are considered, paying close attention to the legal rules that define its application; d) evidence of impact is then considered in a section that looks very largely at the US implementation of the concept, the US SBIR; e) in section five, some general lessons and observations are provided. Annexes contain various reference materials including a bibliographic review of publications, and at a glance list of evaluations and the references.

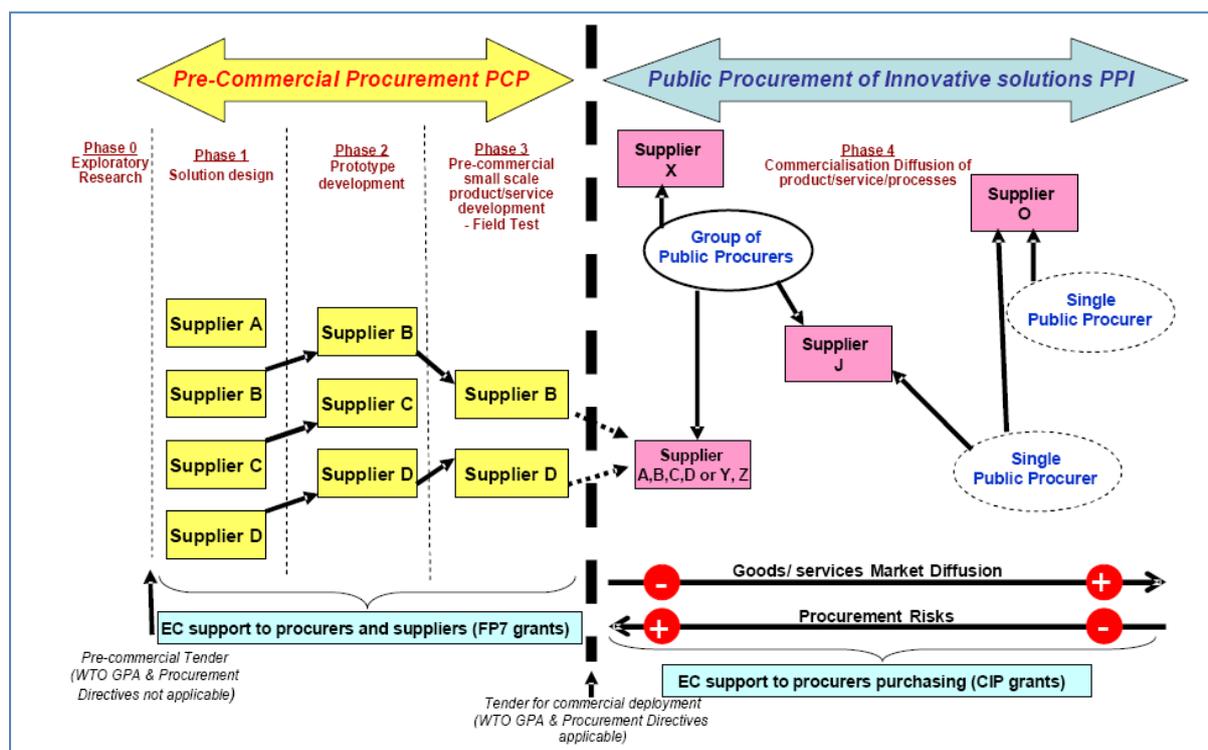
## 2 What is Pre-Commercial Procurement?

### 2.1 Definition

Pre-commercial procurement (PCP) (by which is meant the family of approaches in which there is public procurement of R&D services with other special conditions applying as to ownership of the results and payments) involves the purchase of research by a contracting authority which the contracting authority undertakes with the objective of stimulating innovation that the contracting authority or some other party may benefit from at a later stage when goods or services not currently available are developed from the outcomes of the research. PCP does not involve the procurement of goods that currently exist which is why the approach has been viewed by some researchers as not belonging *per definitionem* to the family of demand side policies ([Edquist and Zabala-Iturriagoitia unpublished](#)), although the proposal for Horizon2020 explicitly considers them as demand side (see page 19 of the [Proposal of the Council, COM\(2011\) 811 Final](#)). Where products or services that do exist or are close to existing, procurement of innovation (PPI) is taking place. In the diagram shown below, we make the distinction between PCP and PPI approaches using the diagram provided by the European Union to describe its particular approved approach to PCP.

In the figure shown below the distinction is made between pre-commercial procurement and procurement of innovation. On the left hand side are four stages of innovation, exploratory research being the first followed by three stages or phases that constitute the parts of a pre-commercial procurement. On the right hand side is PPI stage. At this point a technology or service has been developed to the point where it is regarded as commercially available.

Figure 1 EU Policy Making Options and the Phases of the Pre-commercial Procurement



As we note later in our section on the implementation of pre-commercial procurement, pre-commercial procurement is not just the purchase of research that might lead to the development of goods and services not yet in existence (to either the contracting authority or the wider public). PCP approaches in the European Union must by law involve the following: the contracting authority must not acquire exclusive rights to the development; and the contracting authority must not bear all the costs of the procurement.

In the section on the implementation of PCP we will go into this in more detail and explain why the law is as it is. We do this because the legal issues have, in principle, an effect upon the ways the policy can be implemented and therefore upon its likely impact. For the moment therefore we consider that PCP is a public procurement of R&D, undertaken under certain specific conditions only, which have the possibility of variation, to support innovation.

One of the best known examples of the procurement of research and development, undertaken by public bodies (they would be known as “contracting authorities” in the European Union), is the Small Business Innovation Programme (SBIR) of the United States of America. This is not PCP in the sense in which it is meant though in the European Union however. Nevertheless, aspects of the US approach have been adopted in a number of the implementations of pre-commercial procurement seen in Europe, most notably, a competitive element in stages. As has been noted above, the legal

issues defining the ways in which pre-commercial procurement can be implemented will be discussed in a later section.

## 2.2 Contexts of PCP

PCP is termed a demand side measure. This is because it takes the form of public demand and uses public demand to achieve a number of objectives. These objectives we consider in the next section under justifications for pre-commercial procurement. Demand side measures are varied. As the Figure 2 Pre-commercial Procurement, Characterizing Approaches indicates, PCP can be seen as a measure that is prior to procurement of innovation of existing goods and services (for which the public procurement directive is the legal framework). But PCP should be seen in two ways: as the necessary first part of procurement stage, leading to the procurement of innovation, and in some circumstances as an alternative to procurement under the directive. PCP is an option on procurement therefore and an option for procurement organisations to follow in the event that the organisational need they wish to satisfy cannot be met by the market as it is.

There has been increasing interest in demand side measures over the last decade. PCP in common with other demand side measures is attracting the interest of many governments, including the European Union. A wide variety of writers have provided commentary on the prospects for demand side measures including policy makers, writers on innovation and those conducting studies for governments on how to implement policy. ([Dalpe 1994](#); [Gavras et al. 2005](#); [Wilkinson et al. 2005](#); [Bos and Corvers 2006](#); [National IST Research Directors Forum Working Group 2006](#); [Edler and Georghiou 2007](#); [Georghiou 2007](#); [Bodewes et al. 2009](#); [Tsipouri et al. 2009](#); [Apostol 2010](#); [European Commission 2010](#); [Stern et al. 2011](#); [Rigby et al. 2012](#); [Yeow and Edler 2012](#)). As I have noted above however, there are still concerns about how to categorize PCP and whether it is by definition a demand side measure ([Edquist and Zabala-Iturriagagoitia unpublished](#)) or may constitute a genuinely hybrid form, with implications therefore for attempts to develop indicators of innovation ([Edquist 2013](#)).

## 3 What is the purpose of Pre-Commercial Procurement?

### 3.1 The Justifications for Pre-Commercial Procurement

The rationales for pre-commercial procurement (PCP) are various. As pre-commercial procurement approaches fund research and development activities, PCP may create positive externalities – potential spin-offs and leakages of knowledge that benefit other firms and users in the economy. This justifies government support albeit within limits. As pre-commercial procurement may support small firms that suffer from shortages of capital created by market failures of information, government awards to the firms involved in the PCP process may help private investors direct their capital to those small firms most capable of using it.

Other justifications have been advanced for PCP approaches. It has been suggested that PCP might in principle increase the rate of innovation of the public services by directing public funds to R&D, rather than to the procurement of existing services. PCP might also allow the government to undertake procurements of R&D that private organisations fail to do because of lack of incentives to develop a technology (incomplete markets). This is a form of government leveraging of innovation

and is a form of *catalytic procurement*. PCP as a process involving testing of approaches inherently allows the public sector to examine and test technologies before wider adoption and use.

Assuming that PCP derived innovation develops technologies that are used first in the public sector but which might have wider benefits, PCP may be an approach that facilitates testing and demonstration for wider private usage, in effect a leverage or *catalytic procurement* effect. PCP may also allow small firms greater access to government procurement activities. It has been argued that in the United States, PCP approaches “foster and encourage participation by minority and disadvantaged persons in technological innovation”. Participation in PCP approaches may also enhance the capabilities of small firms, leaving them more able to innovate and grow in the future. Pre-commercial procurement approaches have also been argued to support major policy goals such as the Lisbon goals to which increasing investment in research and development to a target of 3% was felt to be vital ([Kok et al. 2004](#)). In the Kok Report, the emphasis was on green procurement. In the later Aho Report, the emphasis moved to government procurement and procurement of innovation although it did not identify pre-commercial approaches explicitly ([Aho 2006](#)). The innovation supported by such approaches may lead to increasing employment, and the formation of new firms. In the following table we list these justifications.

**Table 1 PCP Justifications**

Justification	Explanation
Externalities from R&D support	Public goods aspects of innovation
Reduces market failures of information	Government support identifies firms most likely to benefit from investment from venture capital (post PCP competition)
Testing of innovations reduces risk for public sector	
Increases the quality of the public services	Innovation rate of public services is increased with PCP approach over other less innovation activities
Government develops technologies with public good for ultimately for private purchase where private markets don't yet exist	Government acts as sponsor for a product ultimately sold to the public (catalytic procurement) only
Government procurement of technologies (ultimately from a PCP) will lead to wider private adoption	Government supports innovation, ultimately acquires the technology and this demonstrates the technology leading to greater private adoption
Gives greater access to small firms	Style of operation and scale of PCP approaches encourages small firm participation
Gives greater access to minorities	PCP approaches may by being open to small firms encourage greater participation in the economy by minorities
Capability development of participating firms	Participation in PCP approaches gives small firms enhancement of their capabilities
New employment	PCP opportunities may lead to the creation of new jobs
New firms	PCP opportunities may create new firms and, in the long term, new industrial sectors
A major policy goal of increasing European innovation and economic growth and social cohesion, achieved with higher levels of research and development	The Lisbon Strategy argued that the European Union must be "the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion" by 2010

### 3.2 Justifications of Other Related Policies and Programmes

In the literature on the US SBIR programme - the US programme has some common characteristics with the EU based PCP family of approaches - research on the justifications and impacts of the programme has been conducted by a large number of researchers with the best known being that by Lerner ([Lerner 1999](#)). Lerner notes the following reasons for the US approach: subsidies are appropriate when externalities are likely as they in the production of research and development;

subsidies / government intervention is justified when there are information problems that may reduce the – a gap between firms and investors, programmes such as SBIR in effect subsidize the costs of information provision performing a certification function. The US SBIR Program material explicitly acknowledges that it seeks to address two types of market failures: (1) innovation market failure (for early-stage technologies) and (2) market failure with respect to the provision of financial capital for new enterprises seeking to commercialize early-stage technologies (Professor Donald Siegel (2011)). In addition, the 1982 Act which establishes the US SBIR states the following objectives of the program:

#### Box 1 Original Aims of the US SBIR

- To stimulate technological innovation.
- To use small business to meet Federal research and development needs.
- To foster and encourage participation by minority and disadvantaged persons in technological innovation.
- To increase private sector commercialization of innovations derived from federal research and development.

Since the inception of the US SBIR, a number of additional goals have been adopted for the policy, some of which are implications of the original goals, others representing a widening of the goals / aims of the SBIR. The following objectives generally represented this wider set of goals and aims that have emerged in evaluations and analysis of the role of the SBIR over nearly three decades of operation:

#### Box 2 Acquired Priorities for the US SBIR

- Creation of firms
- Capable of Targeting Small Firms
- Risk Sharing
- Ability to raise greater capital
- Reducing Costs at the firm
- Employment
- Increased Investment Levels within the Firm (input additionality)
- Survival of the firm
- New processes
- Growth of firms
- New products

In the UK, the following justifications are advanced ([Technology Strategy Board 2013](#)), namely that the public sector and thereby the public interest is more effectively served by innovative procurement, that the public sector can bear part of the risk of developing technologies that will ultimately have wider use, including by itself: “The business gets finance to develop its ideas, and the public sector gets more innovative solutions to its needs. SBIR encourages public sector organisations to take the lead customer role helping to develop and de-risk innovative solutions for which it might be the potential future customer.”

## 4 How is Pre-commercial Procurement Implemented?

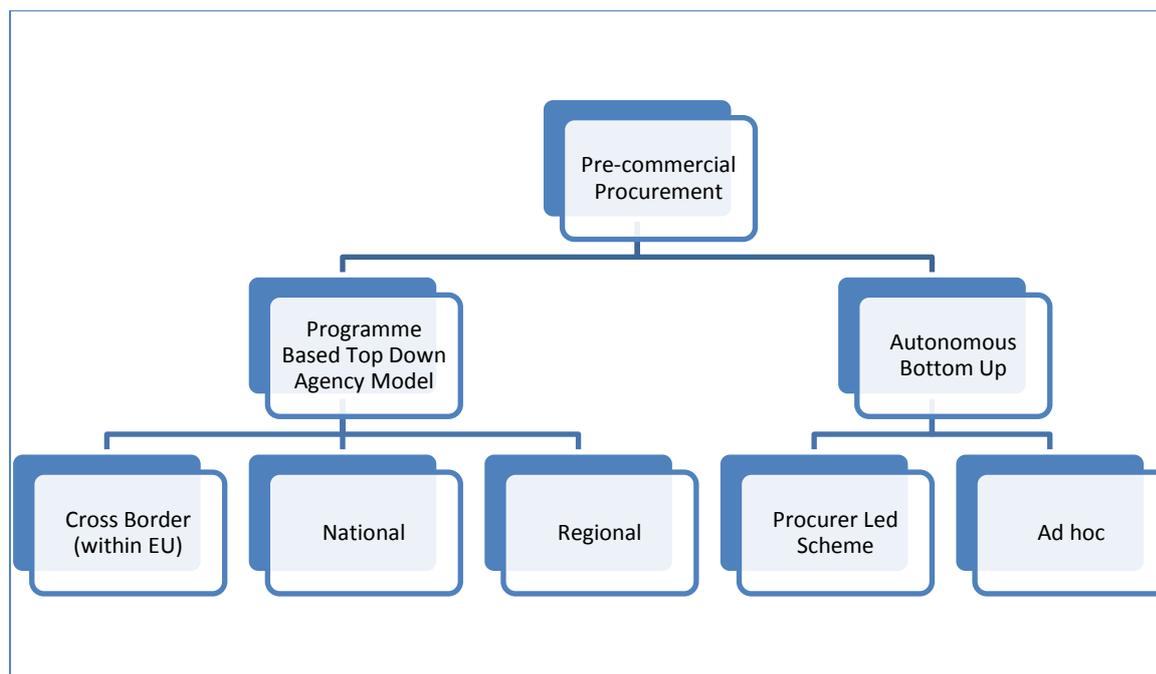
### 4.1 Implementation: Various Approaches Possible

The policies concerned with the procurement of research and development by government within the EU and in the rest of the world and especially the United States are governed by frameworks of law (mainly the Government Procurement Agreement of the World Trade Organisation) which are intended to ensure openness and free markets. However, there are a number of important exceptions and legal alternatives within the frameworks which vary from country to country. These exceptions and alternatives give government scope to realize further and subsidiary goals aside from the original aim of procuring research and development that would help the government realize a public benefit (or reduce a social cost). A report by the FP funded project led by Sloth ([Sloth 2011](#)) gives important insight into the forms in which PCP is being implemented currently. The legal researcher Apostol has also examined the scope for implementation of PCP ([Apostol 2012](#)), and has noted certain difficulties for implementation.

As has been noted above, pre-commercial procurement can be facilitated in a number of ways and we further refine these distinctions in the following way: 1) by the existing legal order; 2) through the use of specific procedures and guidelines that have been developed to achieve other objectives; and 3) through approaches that could be said to constitute programmes in that one or more of the following apply: a) there is a dedicated information and advice function to assist public procurers in formulating an approach to their pre-commercial procurements; b) there is a dedicated agency to provide assistance to public procurement organisations in the form of subsidization to carry out their R&D procurements. It should be seen that PCP approaches, because they are a major form of intervention by government, can take many forms. The variety in forms will lead to uncertainty but there is flexibility, allowing countries to implement according to circumstances.

Thus, it is important to note that pre-commercial procurement is an activity that is already allowed under EU law. But there is no at present no means of operating pre-commercial procurement to favour small firms to the extent of disbarring large ones from applying for procurements as is the case in the US. Below we present a classification of approaches which is similar to what the European Commission has proposed as an organising framework for PCP activities.

Figure 2 Pre-commercial Procurement, Characterizing Approaches



There are three main approaches to the implementation of pre-commercial procurement. On the one hand there can be autonomous or bottom up approaches where contracting authorities use the legal framework to run a pre-commercial approach (according to the Communication or under the narrower 16f form or indeed in some other form). There are also top down approaches where a contracting authority has help from an agency, usually a government agency. Amongst top down agency programmes it is possible to include some of the best known schemes such as the US government's SBIR, the Dutch government's scheme (called the SBIR) and the UK government's SBRI operated and managed by the UK's Technology Strategy Board. Amongst cross-border activities are FP7 based pre-commercial procurements which are normally co-funded by the European Union Framework Programme. These co-funded pre-commercial procurements are part financed by the European Union but are organized bottom-up. They are therefore a mix of bottom up and top down activities. Horizon 2020 promises to broaden these approaches significantly ([European Commission COM 2011 810 Final](#)). To help with understanding the variety of forms of pre-commercial procurement, in the following table some of the major and interlocking choices for implementation of the policy are identified.

Table 2 Choices in PCP Implementation

Choices in PCP Implementation				
Locus of PCP and PPI decision making	Would have “platform based approach”	scheme “platform based approach”	Assumption in favour of PCP	Assumption in favour of procurement under directives or other mechanism (funding by grant through other routes)
General Approach	Ad hoc procurement	Systematic approach		
Third Party Relationships (to conduct the procurement)	Develop own procurement,	Work with other CAS,		Include suppliers
Agency involvement (a relationship to operate and manage)	Use an Agency			
Co-Funding of a Procurement	Take co-funding	From the Member State		From the EU
Legal Rules to Follow	Use PCP Communication	16f Procedure (not competitive, for example)		Some other format
Competitive or single contractor (largely affected by the legal route PCP versus 16f)	Competitive procurement e.g. PCP Communication or UK SBRI	16f style single contractor		
Contracting	CAs Procurement	Agency Procurement		
Regional, National or Local levels for action	X border procurement,	x border supply		

## 4.2 Well-known examples of the Programmes

The two best known examples of SBIR concept programmes (sub-types of PCP) are that of the United States and that of the United Kingdom. As the following table indicates, these are SBIR style programmes which promote pre-commercial procurement, the US programme having a mandatory operation, the UK version being advisory or optional.

Table 3 Comparison UK and US Institutionalized PCP Approaches (Courtesy TSB, 2013)

	UK SBRI	US SBIR
<b>Date established</b>	2001 (Re-launched in 2009 with pilots from 2008)	1982
<b>Coordination</b>	Technology Strategy Board	Small Business Administration
<b>Mandated?</b>	No, discretionary take-up by public sector bodies	Yes, 2.5 per cent of Federal R&D budgets over €100 million
<b>Eligible organisations</b>	EU companies of all sizes (SBRI is exempt from advertising contracts in OJEU)	over \$100m Small businesses (< 500 employees) at least 50% owned by US citizen
<b>Value of contracts awarded per year</b>	1190 contracts worth £99.4m (April 2009 – December 2012)	4,000 contracts a year average, worth \$2 billion (£1.4 billion) <sup>19</sup>
<b>Phase 1</b>	Feasibility testing for typically up to 6 months. Contracts typically up to £100,000 but can exceed depending on challenge	Feasibility testing for up to 6 months Contracts < \$150,000 (£104,000)
<b>Phase 2</b>	Development of prototype or Contracts typically < £1 million (but subject to unique needs of competition) demonstrator for up to two years	Development of prototype or demonstrator for up to two years Contracts typically < \$1 million (£694,000)
<b>Phase 3</b>	No Phase 3	No additional SBIR funds but follow through from sponsoring government department – with support for technology development, and potentially additional (non-SBIR) funding

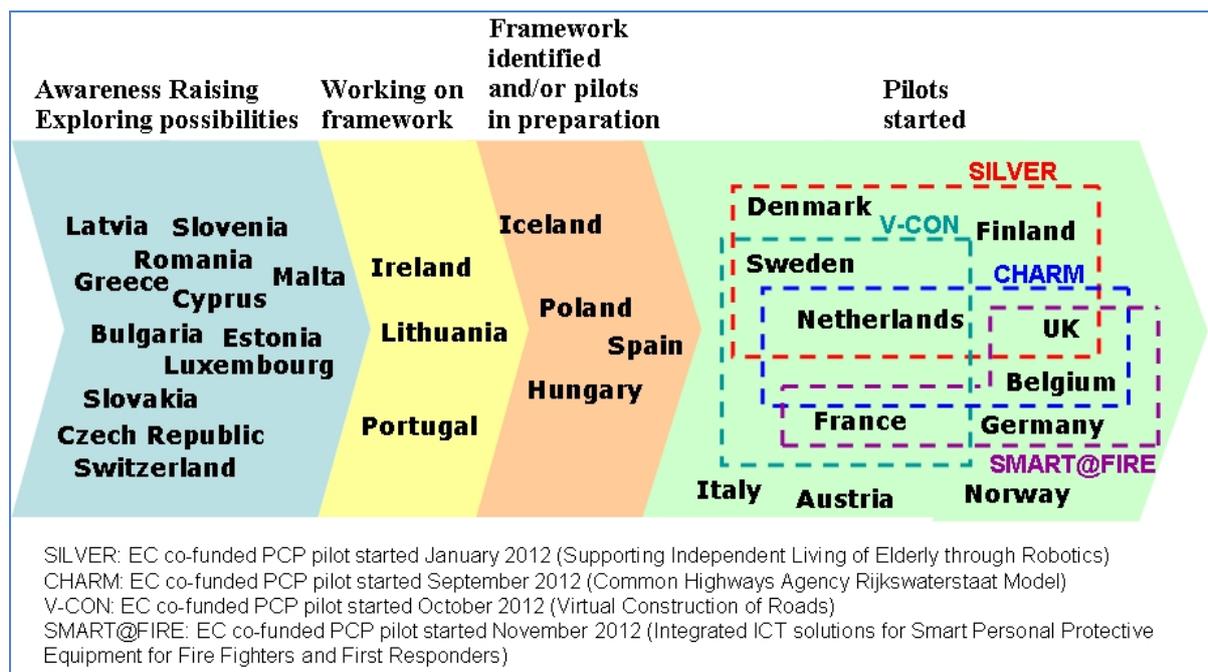
While there is now one very well established programme in the US and others established in Europe (the UK and the Netherlands), there is increasing interest in the concept and a variety of schemes under development based on the US scheme. We note that the US scheme defines three phases, and the European Union's PCP procedure also has three phases with provision for the third phase to be funded within the framework of a single competition. However, unlike the US scheme and the UK scheme, the European Union's Phase 3 funding is part of a single process and does not rely on separate funding schemes.

### 4.2.1 European Union Observation of Pre-commercial Procurement Initiatives

The European Union is seeking to exchange information on the operation of schemes at the European Level and amongst Member States. The following diagram indicates the rate of progress that has been made amongst Member States and through the Framework Programme. A current survey outlining the approaches to PCP undertaken in Europe can be found here.

[http://cordis.europa.eu/fp7/ict/pcp/msinitiatives\\_en.html](http://cordis.europa.eu/fp7/ict/pcp/msinitiatives_en.html)

Figure 3 Current Approaches to PCP in Europe



Source: <http://cordis.europa.eu/fp7/ict/pcp/docs/arrow-pcp-implementation-endnov2012.jp>

## 5 Findings

### 5.1 Classification of Findings

Various classification schemes for the reviews examined here could have been adopted a priori. For example, the types of schemes (agency led versus bottom-up) could have been used as could a classification based on the openness of the approach (i.e. exclusively SBIR type versus various approaches including SBIR but not confined to it), or by the main intended recipient of the technology, i.e. whether government department as main user or private user with public interest. However, given the very recent interest in pre-commercial procurement outside the US, the UK, the Netherlands, and Flanders, there are no formal, extensive evaluations which use effective counterfactual methods to assess impact. The approach to the classification and presentation of the material has therefore been undertaken with the US scheme particularly in mind. Again, a priori, comparisons might have been expected to be made between the SBIR programme and other grant-based (direct measure) policies such as R&D grants on the one hand and actual procurements of innovation done as for existing goods and services that embodied some novelty in their makeup but which were not so new as to require research and development activities (and in particular experimental development). However, the comparative research on the basis of the policy mix and

policy comparison approach ([Aschhoff and Sofka 2009](#)) has not been undertaken and therefore such a structure for the presentation of findings is not possible.

The approach to the analysis of the reviews undertaken here has been to focus on specific issues raised right across the studies, reports and papers, and to comment on each of these with reference to the evidence that has been gathered. The first issue raised is that of the need for evaluation in the case of SBIR and the critical role which evaluation could play in the operation of the programme; the second is that of the technical design of the programme and its impact upon access to and success of firms that participate in competitions; the third issue covered is that of the impacts generally and especially on innovation, including questions of definition, and how much impact can be attributed to the scheme.

Within the literature on the evaluation of the US SBIR programme, and in relation to other pre-commercial procurement schemes from around the world, three major issues have arisen: a) the difficulty of ensuring and emphasising the comparability of findings; b) the evaluation process; and c) the apparent absence of evaluations early in the lifetime of the measures used.

### 5.1.1 Diversity

In relation to the first, pre-commercial procurement activities are a diverse set of activities and do not constitute a single model of intervention. They are therefore difficult to compare. For example, the US programme varies to a significant degree across government departments in terms of the technology area (not surprisingly) addressed and in terms of the management teams that operate the programme (as the programme is embedded within departments) and in terms of the rules that are applied. Over time there have been changes also to the operation of the programme, and while the US does not have any official Stage III funding instrument as part of the programme, there are a range of instruments available that constitute follow-on funding which are not comparable to those in other countries where pre-commercial procurement is operating. Furthermore, within the European case, there is the 16f option for pre-commercial procurement that could be compared with the existing national schemes and there are additional measures, separately negotiated such as the Energy Technologies Institute.

Related to the third point in this section is the problem that within the European Union there are as yet few schemes operating for a long enough period which can be compared against each other and against the US model (even if this was a plausible evaluation strategy which is doubtful, given the variety of purposes to which pre-commercial procurement schemes have been and can be put). And where there are such schemes, no (econometric) evaluations have been undertaken comparing participant firms with non-participants or comparisons of the pre-commercial approach with other forms either of early stage VC support or of government procurement.

### 5.1.2 Evaluating Pre-commercial Procurement as Procurement

It is possible to see that within the evaluations that have been carried out, there is a strong focus upon economic impacts on the firms and sectors supported and a set of case studies showing examples of new technologies delivered. However, there is a significant gap in the evaluation literature both published and grey / non-peer reviewed of the following legitimate comparisons which are subject to either non or negligible attention: a) how well does pre-commercial procurement compare with existing forms of procurement in realizing the objectives of government;

b) how does pre-commercial procurement compare with other forms of business support to firms such as R&D programmes, or taxation schemes.

There is evidence that within the broad range of studies covering the operation and performance of the US SBIR, there has been consideration given to the first of these points. For example, evaluation work on the extent to which pre-commercial procurement as procurement of research and development support agency missions has been undertaken and is referred to by the US National Committee in a series of evaluations specific to the major agencies ([Committee for Capitalizing on Science Technology and Innovation 2007](#)), and an overview ([Committee for Capitalizing on Science Technology and Innovation 2008](#)) but the extent of such evaluation is very limited.

The general absence of such forms of comparison within the evaluation literature and in terms of the grey literature should sound a warning to policy makers about the efficacy and legitimacy of the pre-commercial procurement measure.

### 5.1.3 Availability of Data and Collection Issues

It is possible to observe that in spite of great interest in the SBIR as programme and evaluation, the history of the early development of the programme provides little evidence of a strong commitment to thorough and detailed collection of data: “According to Eveland, who reviewed the US scheme, “the major effect of this (the first evaluation) study was apparently to cause SBIR program officials and supporters in NSF to lose all interest in empirical assessment” ([Eveland 1986](#)) [9, pp. 202-2031.” quoted in [Roessner \(1989\)](#). Furthermore, according to Eveland, in the early phase of its development “SBIR [.was.] an excellent example of a program that everyone is willing to call a success, although no one wants to look at it too closely or define too precisely the criteria by which that success..[is achieved]...”.

Furthermore, the long links in the chain of causation between government purchase of R&D (though pre-commercial procurement) and the technologies that result suggest that evaluators and programme managers should take care to understand the factors outside the programme that affect its success. As Bearse and Link have noted: “Identifying the specific outcomes resulting from an early stage R&D program such as SBIR is challenging. The long lag between input (funding) and output (possible products and services), combined with the frequent need for multiple inputs for successful technology development, make definitive assessments of the link between a single input and a complex output difficult. In addition there are very substantial data collection problems, as awardees and agencies cannot consistently capture outcomes for all supported projects. Many early stage research projects generate little that is tangible in the form of products and services while a few projects can generate very large returns. The large skew means that anything short of an all-inclusive analysis risks missing important contributions from the program” ([Committee for Capitalizing on Science Technology and Innovation 2007](#)).

In the case of the US SBIR and for the Department of Defence’s scheme, a number of evaluations were conducted in the period at the end of the first decade of the programme’s operation, see box below.

**Box 3 Early Evaluations of the DOD SBIR ([Committee for Capitalizing on Science Technology and Innovation 2007](#))**

GAO/RCED-92-37 SBIR Shows Success but Can Be Strengthened. This is the first baseline study of the program. It surveyed 100 percent of all Phase II awards from 1984-1987. It was conducted in 1990-91.

GAO/RCED-95-59. Interim Report on SBIR. Based on agency interviews conducted in 1994 and 1995, this report examined the quality of research and the duplication of projects.

GAO/RCED-98-132 Observations on the SBIR This report compared BRTRC's 1996 DoD survey (100 percent of Phase II awards from 1984-92) with the original GAO 1991 survey. It included an agency SBIR award database and interviews.

GAO/RCED-99-114 Evaluation of SBIR Can be Strengthened. This assessment focused on use of commercialization records in proposal evaluation.

GAO-07-38 Small Business Innovation Research: Agencies Need to Strengthen Efforts to Improve the Completeness, Consistency, and Accuracy of Awards Data.

## 5.2 Technical and Design Issues

Evaluation of the SBIR programme (of the United States of America) has led to increasing awareness of the role of the design of pre-commercial procurements. Pre-commercial procurements are usually although not exclusively, as has been noted above, phased procurements (undertaken through competition) where government funds (set at various thresholds) are provided (although in some cases private funds may also be given) at certain time intervals. Programme designers have varied these aspects over time and in practice, programme managers have used the discretion inherent in the US scheme on a case by case basis. Overall, the US SBIR has tried to reduce proposal review time (funding gaps) at both Stage I and Stage II. Wessner reports that the US SBIR has adopted a target of reducing the Stage II gap from 11.5 to 6 months and the Stage I from 6.5 to 4 months ([Committee for Capitalizing on Science Technology and Innovation 2007](#), page 217).

The rules of the programme are set to ensure a delicate balance, enough competition to secure innovation, and collaboration, but not too much competition that would deter entry. Enough time to deliver a solution against an organisation priority, but not so little time as to make innovation impracticable within the time allowed. The role of how much risk the government itself should take is an important issue raised recently ([Link and Scott 2010](#)).

Recent evaluations suggest that evaluators at the early stages of the development of their programmes are acutely aware of the need to encourage participation both on the part of firms who take part in the competitions and on the part of client / user government departments for whom pre-commercial procurement is a new policy tool they have been encouraged to operate by their respective pre-commercial procurement promoting departments, usually the ministry of innovation / industry. The issue of proposal resubmission (at Stage I and Stage II) has been considered in the case of US SBIR as proposal re-submission has an effect on the engagement of firms in the programme, its reputation, and upon the capacity of the programme to gather and then support good ideas. Parts of the US Programme have some recycling of proposals whereby agency staff examine proposals rejected by one call and feed these into subsequent ones. Such activities require

significant numbers of commercially and technically qualified staff within agencies / government departments.

The recent review of the Victorian Smart SMEs Validation Programme ([Berman and Squire 2011](#)) suggests that the design meets its objectives in terms of encouraging sufficient firms to participate and also in terms of participation by government (user) departments in what the US SBIR scheme terms “topic choice”. There is a clear link between departmental preparedness and use of the programme. This scheme also appears to have had success in generating interest in firms not previously engaged with government funding, a finding also of the Netherlands SBIR programme review ([Holland 2010](#)). How this widening of interest and broad appeal is obtained is not disclosed by the review or by any documents that it has been possible to view for this study.

The Victorian scheme awards the grant to a single firm, contrasting with the SBIR approach taken more widely in for example the US or EU schemes (although it would be allowable under EU law to award to a single firm). Similar variety amongst the new schemes is not surprising, for example the new Finnish scheme operating from 2008 is hard to characterize according to [Ikävalko \(2010, page 2\)](#) whose comments on the second phase of the Finnish model are as follows: “The latter phase (operative acquisition or Implementation of Procurement) *seems to some extent to be the equivalent of the PCP prototyping phase or even the commercial procurement itself*. It deals with the implementation of the procurement. It is used e.g. for implementing new solutions or for creating new operational models” [this author’s italics].

Other research shows the importance of varying the thresholds ([Archibald and Finifter 2003](#)) on outcomes for firms’ success in terms of the rate of successful commercialisation, an issue also noted by (Bears and Link 2010) whose conclusion is that higher rates of award at Stage 2 (Phase II in the US system) will lead to an overall increase in commercialisation of 8%. Early work by Lerner however showed limited effects of grant size upon commercialisation ([Lerner 1999](#)), but this is not surprising, as, it was noted later, grant size varies with the scope of ([Link and Scott 2009](#)) the R&D challenge.

In addition to discussion of the technicalities of implementation of pre-commercial procurement, there has been uncertainty over the legality of approaches by the EU under the Competitiveness and Innovation Programme in its support by DG Enterprise for EU contracting authorities ([Rigby et al. 2012](#)), the correct operation of the Commission’s PCP procedure in regard to the Flanders scheme ([Vermeulen 2011](#)), and over the precise form of the EU’s approaches ([Inno Partnering Forum 2010a](#); [Inno Partnering Forum 2010b](#); Inno Partnering Forum 2010). General observations about legal uncertainty are covered in the detailed paper of the legal scholar [Apostol \(2012\)](#).

### 5.3 Impacts

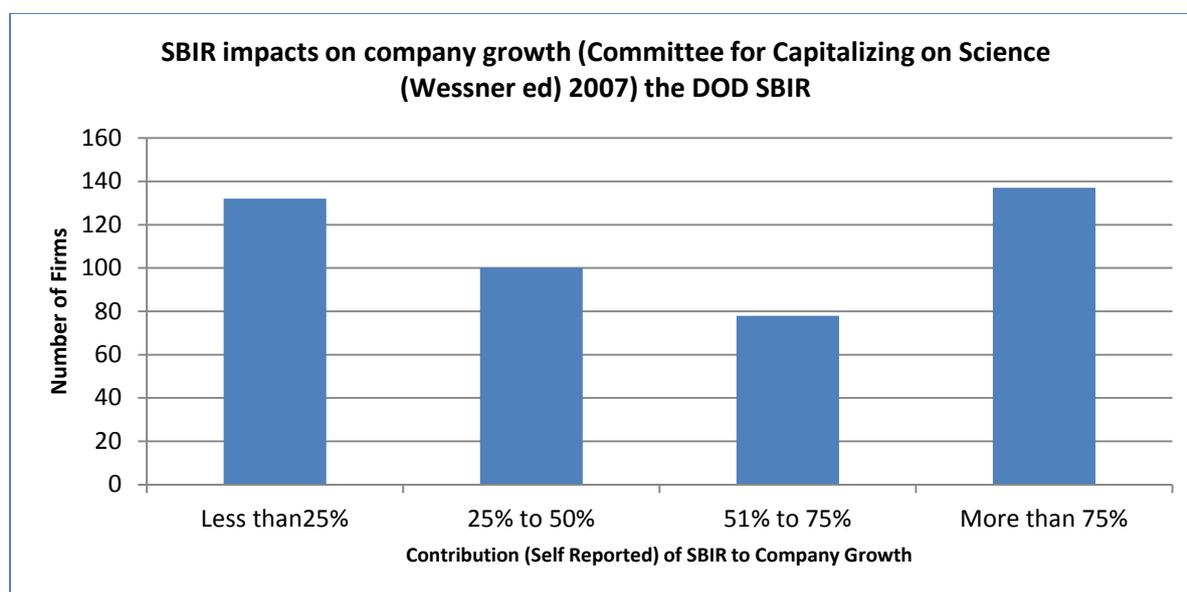
The academic and grey literatures cover a variety of impacts with early research examining the narrow claims of the programme and later research broadening out to expose new impacts that were not initially suspected or prioritized. Initial research focused on the impacts on the firm, but much of the emphasis on and attention to the impacts of the SBIR in the US came with the work done by Lerner on the certification effect, ([Lerner 1999](#)) whereby participation in pre-commercial procurement appears to signal the suitability of small firms for investment by venture capitalists. The study was carried out on a database of firms provided by the Government Accounting Office

which was limited to certain technology areas, and two control groups created by Lerner. This study is one of a small number in the bibliography employing control groups. Here the control group is one involved a matching of participants to non-participants.

Major reviews of the SBIR undertaken by the National Research Council ([Committee for Capitalizing on Science Technology and Innovation 2007](#); [Committee for Capitalizing on Science Technology and Innovation 2009](#)) suggest significant economic impacts but the studies forming the basis of the evidence here are observation based and use case studies and self-reporting of additionality.

For example, in relation to the impact on the growth of firms, an indicator of innovation, albeit an imperfect one, the SBIR appears on self-reported data to contribute to the growth of firms. The data below are similar to that achieved by the NIH programmes.

Figure 4 SBIR Impacts on participant company growth DOD [Committee for Capitalizing on Science \(Wessner ed.\) 2007](#)

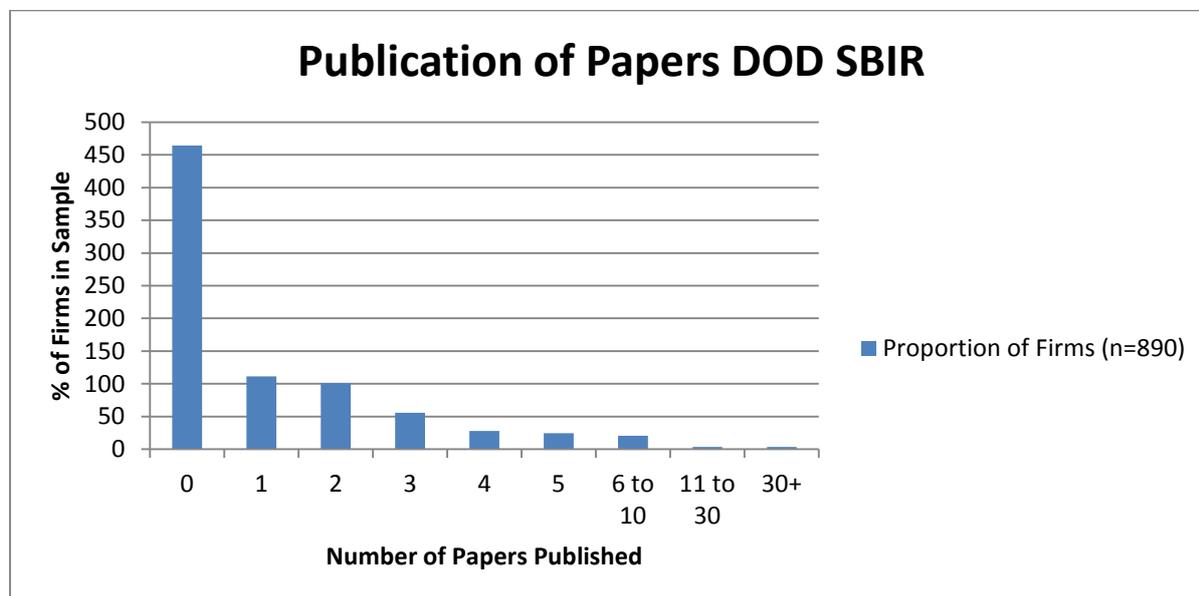


Later work has examined the impacts in terms of indirect effects of the pre-commercial route such as entrepreneurship ([Audretsch et al. 2000](#); [Audretsch et al. 2002](#)) with later writers noting the limitations on commercialisation activities of scientists within the SBIR programme ([Toole and Czarnitzki 2008](#)) when the academics are predominantly research rather than business focused.

Concern has been evident within the SBIR programme administration and evaluation that subsidy of research and development (pre-commercial procurement) may generate new ideas but fails to produce commercialization. The conclusion of the review published by Wessner et al ([Committee for Capitalizing on Science Technology and Innovation 2007](#)) is that this has not happened, the evidence being that when asked (firms were not audited) whether firms had marketed a product and also engaged in registration of IPR, there was no significant differentiation in these activities by firms and that IPR related activities occurred amongst many of the firms also engaged in marketing a product. The Committee for Capitalizing Science on Science Technology and Innovation (the Wessner studies) also report the production of scientific papers by the two programmes ([Committee for Capitalizing on Science Technology and Innovation 2007](#); [Committee for Capitalizing on Science Technology and Innovation 2009](#)). Publication of scientific papers is a measure of the innovation effect of the SBIR

programme, and it is clear from the SBIR DOD project that publication does take place, however the majority of firms do not publish papers (noted in the survey) as shown in the following figure which uses the Wessner report data.

Figure 5 Publication of Papers DOD SBIR



On employment, studies show overall that impacts on employment creation are limited ([Link and Scott 2012](#) page 265) with data from the National Research Council for five federal agencies. The authors report: “Our analysis shows that on average over two-fifths of all projects retained zero employees after completion and over one-third retained only one or two employees. Thus, on average, the direct impact of SBIR funded projects on employment is small, especially when compared to the mean number of employees in the firms. However, there are substantial cross-project differences in the number of retained employees that are explained by differences in the firms and their SBIR projects. We find across many of the funding agencies reviewed that projects with intellectual property—patents, copyrights, trademarks, or publications - retained more employees after completion of the project.” This is a similar finding to that noted by Wallsten who found that there was no effect of SBIR grant winning on employment and who also noted the additional problem that grants crowd out private investments ([Wallsten 2000](#)).

Wallsten’s approach points out the difficulties involved in R&D procurements where there is not only a government procurement requirement but also a market failure that justifies a subsidy. He notes that in the US, the Federal Regulations that apply to the operation of the programme require officials to select projects “on the basis of their technical merit and potential for commercial success - the same criteria a private investor might use. The guidelines do not distinguish between marginal and inframarginal projects (i.e. those that would not be funded privately because they are at or under the marginal of profitability for private investment)” ([Wallsten 2000](#), page 86). The difficulty here is that the criteria for project support are likely to lead to the financing of projects that do not need additional grant aid to develop them, and financing of projects leads to the support of activities that would otherwise be successful.

Importantly, however, Link and Scott noted that employment was more likely to be generated when government procured at Phase IV – Stage Four of the process, buying the goods and services that the pre-commercial procurement had created ([Link and Scott 2012](#)).

The question of additionality of the research supported by the SBIR has been investigated by Audretsch, Link et al who, without using control variables in their study of 2002 and which was confined to DOD concluded that there is significant additional research that would not be otherwise carried out as a result of the SBIR programme ([Audretsch et al. 2002](#)).

Concern that the US SBIR creates dependence amongst research intensive small firms or that future success is entirely the result of further procurement contracts – what have been called SBIR mills - has led to changes in procedures for applicants to the programme. The issue has been investigated empirically by Lerner whose review of this issue is part of his ([Lerner 1999](#)) detailed analysis of impacts using control groups. The analysis conducted suggests that, in the case of NSF sponsored competitions, Phase II award winners' longer term success compared with controls (2 forms of firms) does not come from further government contracts and therefore must result from commercialization. The differences in performance are however larger than other differences observed in other comparisons, and the explanation of this is based partly on Lerner's correspondence and discussions with agency officials.

There are within the literature a range of case studies of successful implementations of technologies through PCP activities (both in the academic literature ([Yeow and Edler 2012](#)) on the blood donor chair and in the reports of government agencies (for example the report of the NL Agency on 25 innovation procurements ([NL Agency 2011](#))). Such evidence suggests that schemes are operating successfully in their own terms, but not how well such procurement compares with other forms of procurement (for example under the directives) or other mechanisms for support of research, development and innovation.

## 6 General Lessons Learned

Pre-commercial procurement is a generic form of procurement of which the most well-known example is that of the US SBIR and closer to home, the UK's SBRI. In Europe a number of schemes are operating that are similar to the US scheme, but comparison between them and with the EU scheme is problematic in that the schemes differ significantly in terms of design, management, and operation.

Evaluation of pre-commercial procurement programmes is limited for a variety of reasons and while much has been written about the US scheme, there remain many uncertainties about its operation and net impacts upon innovation, in terms of growth, sales, patenting, and scientific publication. The US SBIR scheme has a pattern of returns on investment (the government) typical of early stage performance, with many small returns, many cases of no return i.e. no commercialization of technology development funded, and a few cases of very significant returns.

Evaluation of pre-commercial procurement programmes other than the US SBIR is limited to programme descriptions, and accounts of impacts on firms that are participating, their subsequent performance in terms of employment, commercialization, their performance of other research, their collaboration with other firms. But there are no comparisons of pre-commercial procurement against other measures that might achieve similar objectives. In due course we might expect innovation agencies to develop their understanding of when to operate PCP and not, and when to choose a competitive form (such as that outlined in the EU Commission's Communication) or single source procurement (such as are allowed under Article 16f).

A small number of evaluations examine net impact using control groups. These are confined to the US. Their conclusions are not clear as to whether the pre-commercial procurement approach in the form of the US SBIR is effective in dealing with market failures.

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## Annex 1 Table of Evaluations

Country/ Region	Measure	Study	Period	Evaluation Method	Outcome Variables	Impacts
Australia (Victoria)	Victoria's Smart SMEs Market Validation Programme	( <a href="#">Berman and Squire 2011</a> )	Began in 2008, to last four years	Descriptive review of early phase of programme	Participation	High level of collaboration for intended participants; suggests target agencies believe this satisfies an unmet need; overall aims to improve export performance
BE - Flanders	Action Plan on Procurement of Innovation (Pol).	( <a href="#">Vermeulen 2011</a> )	From 2008	Descriptive review of early phase of programme		Not impact study
Finland	The Tekes funding instrument for public procurement of innovation	( <a href="#">Ikävalko 2010</a> )	From 2008	Brief descriptive review	NA	Observational study, introduces new Finnish programme; suggests activities of programme difficult to characterize
Multi- country	PCP and other innovative procurements	( <a href="#">Stern et al. 2011</a> )		Descriptive	NA	No observations other than very general on legal issues and general targeting for the measure
EU Review	Review of Procurement of Innovation Options	( <a href="#">Inno Partnering Forum 2010</a> )	NA	Policy Review	Review of EU and other schemes to support creation of EU SBIR	NA
EU Review	Review of Procurement of Innovation Options Policy Design	( <a href="#">Rigby et al. 2012</a> )	NA	Policy Review	Review of evidence, practicability and legality of SBIR scheme for DG Enterprise	Not concerned with impact as such but with legality, implementation, responsibility
NL	SBIR	( <a href="#">Holland 2010</a> )	Up to 2010	Peer review observations of performance	No comparisons or controls	New cooperations that don't occur with other methods of funding; new entrants to funding

US	SBIR	<a href="#">(Archibald and Finifter 2003)</a>	Post 1992	Questionnaire and review of participants: NASA Langley projects and firms post 1992 compared with GAO and SBA survey; authors state care required in interpretation	Commercial success, technical  No comparison outside SBIR	Effect of changing the rules for funding led to greater commercial success of projects but with less technical sophistication and lower levels of basic research (within the program only)
US	SBIR	<a href="#">(Audretsch, Weigand et al. 2002)</a>		Article not available to read on the Library subscription	Career patterns	Effect on entrepreneurship
US	SBIR	<a href="#">(Bears and Link 2010)</a>	1992-2001	Survey and quantitative methods 3055 firms surveyed	Project failure	Thresholds on the funding limits of Phase II if raised will lead to some marginal improvement in
UK	SBRI	<a href="#">(Bound and Puttick 2010)</a>	NA	Review study	Descriptive and reporting study	Review of the UK
US	SBIR	<a href="#">(Link and Scott 2012)</a>	2005	Quantitative study	Employment growth but other aspects of commercialisation noted and found to related	Employment growth negligible
US	SBIR	<a href="#">(Lerner 1999)</a>	1986-1995	Matched firms to non-participants	Sales, growth, VC investment	Long run impacts noted giving rise to – certification hypothesis established - but limited to certain areas and industries only and no effect of size of grant on success

US	SBIR	( <a href="#">Wallsten 2000</a> )	1990-1992	369 successful firms and comparison set of 90 no award winners, controls for	Commercialisation, innovation,	No effect of SBIR grant winning on employment of winning firms; grants may crowd out private investments (substitution); can't easily generalize beyond agencies from which sample came
US	SBIR	( <a href="#">Wallsten 2001</a> )	1993-1996	Some control variables,	Compares firms with and without awards	Established using GIS that SBIR participants cluster with other SBIR competition winners
US	SBIR (DOD)	( <a href="#">Audretsch, et al. 2002</a> )	1992-1999	No control variables for innovation	Various impact measures	Impacts including support of research not otherwise undertaken (true comparison); but assessment of innovation impacts does not use a control group, authors argue findings should not be generalized to other SBIRs; demonstrates a method for assessing social returns to the SBIR but is not meant to apply outside the DOD
US	SBIR	( <a href="#">Audretsch 2003</a> )	Retrospective	Descriptive	NA	General observational review of features of SBIR, suggests prog. Creates small firms and increases competitiveness
US	SBIR	( <a href="#">Audretsch, Weigand et al. 2000</a> )	Indiana based survey of 20 firms and 12 short cases	Case studies survey	Descriptive, inferential statistics of limited generalizability	Impact on entrepreneurial culture
US	SBIR	( <a href="#">Toole and Czarnitzki 2007</a> )	CRISP Database 1972-1996 and panel database of participating firms in SBIR 1983-1996	Does not include comparisons with non-SBIR-participants	Link to science as predictor of follow-on funding (Phase II) and VC – some confirmation of Lerner certification hypothesis	Stimulation of entrepreneurship amongst biomedical scientists; SBIR academics not on average star scientists

US	SBIR	( <a href="#">Link and Scott 2010</a> )	1992-2001 survey conducted in 2005	NRC data used: disputes the view that control variables and true matches can be found as SBIR research is unique in form and output	Establishes the nature of the risk of failure of projects and commercialization of SBIR investment by government	Government as risk taker: should grant size change; should phases be as defined; should VCs be involved??
US	SBIR	( <a href="#">Link and Scott 2009</a> )	1992-2001 survey conducted in 2005	Uses NRC data	Concerns re-design of the SBIR to deal with low commercialization rate of projects; controls including for response bias	Prediction markets – private investors have information; private finance at Phase III leads to commercialization of inventions
US	SBIR	( <a href="#">Committee for Capitalizing on Science Technology and Innovation 2009</a> ) ( <a href="#">Committee for Capitalizing on Science Technology and Innovation 2007</a> ) ( <a href="#">Committee for Capitalizing on Science Technology and Innovation 2009</a> )	Phase I and Phase II Surveys 1992-2001	DOD no controls, observations based on survey additionally self-reported, case studies  NIH focused evaluation, no controls observations based on survey additionally self-reported, case studies	Projects reach market place, employment, firm creation mortality, Sales, licensing, employees, firm creation, co-funding, post program investment “Halo effect”; buyout i.e. purchase of SBIR firm; technology probing, usefulness, perceived level of innovation, capability development in house for DOD	Definitions of commercial success sales, licensing, patents; view from interview that commercial success should be set at 100M dollars; the larger of the smaller firms report higher rates of commercialization measured as cumulative sales; also commercialization often by licensee company but perhaps under reported  40% of projects reach the market so more than half fail, there is licensing revenue, attracts investment including outright sale of firms; company creation 25%; concerns expressed over the capacity of the office to manage the programme; commercial review specially resourced aspect of the programme management separate from scientific review

Table 4 Table of Evaluations and Measures





## Annex 3 The Literature

### The Web of Knowledge

The use of publicly supported pre-commercial procurement programmes has increased significantly over the five years and over the last 20 years there has been a growing interest in this form of policy which has been reflected in the number of publications in the academic literature that look at the policy, its development, rationales, impact. The Web of Knowledge currently contains 592 papers which are connected in some way with the issue of pre-commercial procurement (in October 2012) although the terms “pre-commercial” and “precommercial” return no papers on the subject of pre-commercial procurement. By far the commonest subject category within these papers which are returned with a search of the Web of Knowledge with the terms SBIR or “Small Business Innovation Research\*” is engineering as many of the papers contained in the citation index are not concerned with the policy effectiveness of pre-commercial procurement but with reporting the scientific findings that result from pre-commercial procurement grants.

Of the papers which are concerned with evaluation however there are around fifty, the subject category distinction reflects the strong interest of business school and finance researchers in the issues raised. It is surprising that such a topic, with its considerable scope for legal uncertainty, has not generated more papers in the legal literature although this is beginning to change. The author is aware however of a number of forthcoming articles and a number of books on the subject which are not covered by these reviews which deal with legal aspects of the pre-commercial procurement process. These items are not included here as they do not constitute evaluations of programmes but examine legal issues which pre-commercial procurement raises although they are of course likely to be important for programme impact.

Subject Category	Count of Instances
Business & Economics	33
Science & Technology - Other Topics	11
Public Administration	8
Information Science & Library Science	3
Urban Studies	3
Government & Law	1
Physical Geography	1
Sociology	1

**Table 5 Distribution of the Literature by Subject Category: WOK Publications**

The next figure indicates the clear rise in interest and in particular the strong rise in the middle of the 1990s in the annual count of publication connected with the SBIR.

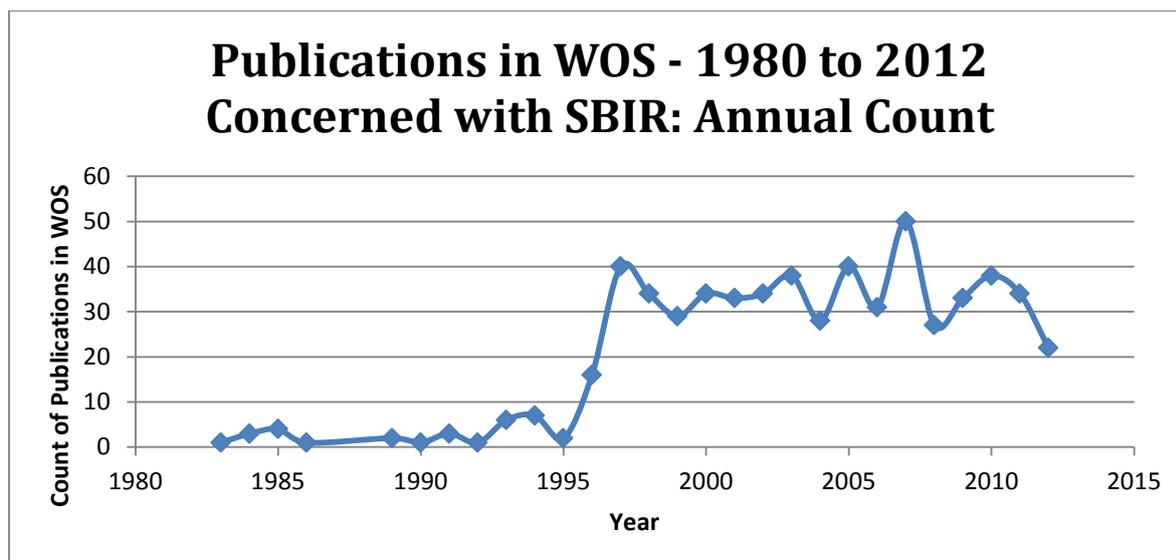


Figure 7 Publications in the Web of Knowledge 1980 to 2012 Annual Count

Below we show the annual count of articles in the research and management journals which deal with one or other aspect of the SBIR in the period 1990-2012. Note that in these leading journals of the field there are number of years in the period when there are no publications.

Journal	Year and Count of Articles														Grand Total
	1990	1994	2000	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	
Journal of evolutionary economics													1		1
Journal of policy modelling								1							1
Journal of technology transfer											1		1	3	5
Management of technology ii: the key to global competitiveness	1														1
Management science											1	1			2
Politics & society											1				1
Rand journal of economics			1	1			1								3
Research evaluation													2	1	3
Research policy		1		3	2	1	1	1		4	1	3		3	20
Review of economics and statistics										1					1
Review of industrial organization												1			1
Science and public policy												2			2
Scottish journal of political economy							1								1
Service industries journal												1			1
Small business economics					4	1	1		1				1	4	12
<b>Grand Total</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>4</b>	<b>6</b>	<b>2</b>	<b>4</b>	<b>2</b>	<b>1</b>	<b>5</b>	<b>4</b>	<b>8</b>	<b>5</b>	<b>11</b>	<b>55</b>

Table 6 Count of Papers on SBIR in 15 Leading Journals

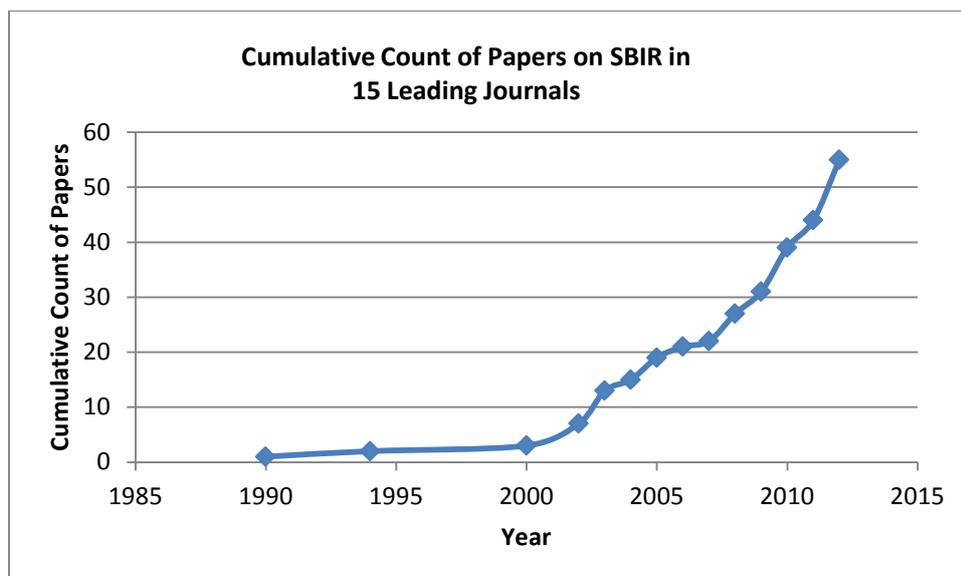


Figure 8 Cumulative Count of Papers on SBIR with 15 Leading Journals

The cumulative count of papers on the SBIR rises steadily. It should be noted the publications that are evaluations of the SBIR are few in number.

### Other Literature

A bibliography of evaluations on the SBIR including papers (with some overlap with the WOK) but including reviews, books and evaluations is provided by the US government at the National Centre for Biotechnology information. This covers reviews of the SBIR and numbers 304 references.

### Focusing on the Evaluations of Measures

The approach adopted here has been to scan this very large literature of papers and reports studies and grey literature, which have accumulated over a long period of time, and to identify for closer scrutiny those items where the SBIR has been reviewed or where other programmes have been examined. SBIR is however the only programme to have had significant evaluation work carried out on it although there are recent studies that suggest that in the medium term there will be a much wider literature.

## Annex 4 Decision Making within the Procurement of PCP Slide

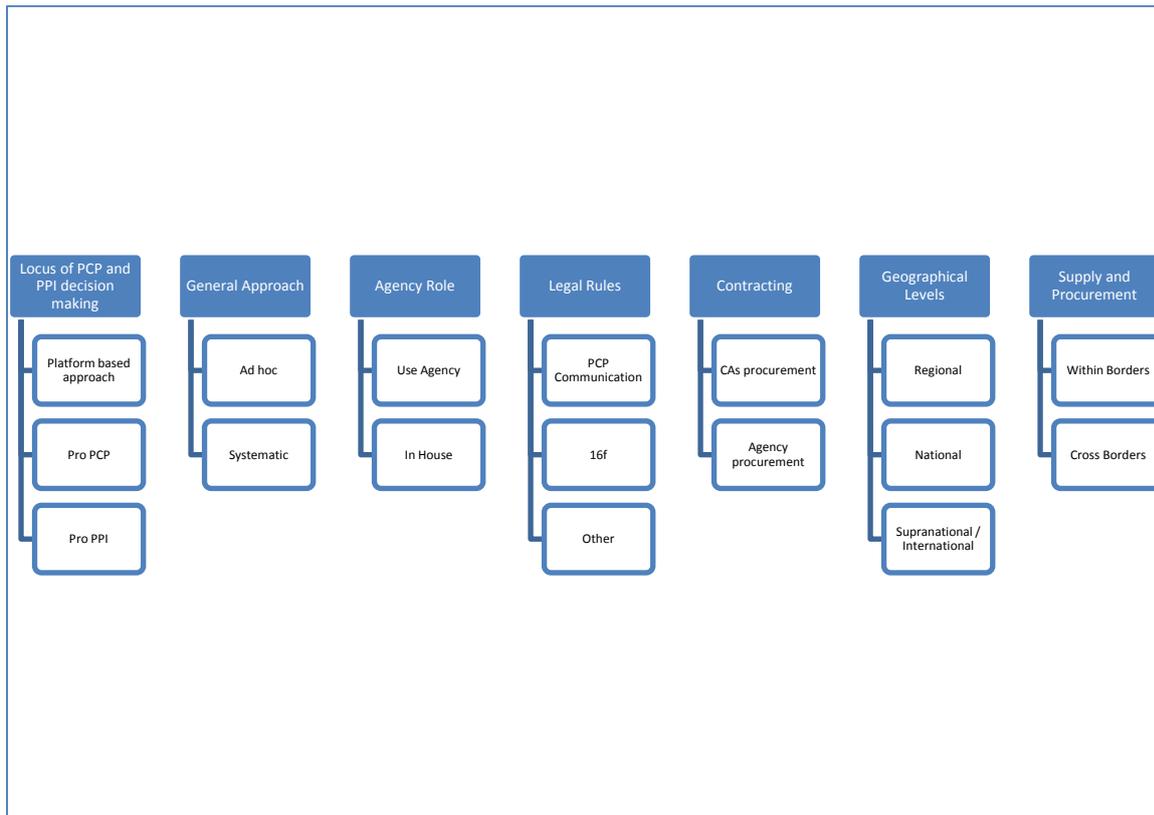


Table 7 Decision Making in Procurement of Innovation, Considerations