

PREVENT PCP
White Paper

Venture Capital Engagement in Pre-Commercial Procurement: Boosting Innovation

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Written by



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In the context of



Abstract

Pre-commercial procurement is an important demand side policy measure to stimulate innovation in the economy. This article is written within the context of the PREVENT PCP project (GA 101020374). PREVENT PCP is an EU-funded Horizon 2020 research project aimed at developing *through pre-commercial procurement* new innovative technologies for early detection and tracking of unattended items in public spaces thus safeguarding public safety. Within the PREVENT PCP project it is explored how venture capital investment can support the innovative activities of technology vendors that participate in pre-commercial procurement, and possibly to enhance the outcomes of pre-commercial procurement. Our white paper describes the PREVENT PCP project, outlines the rationales for the bringing venture capital investment to Pre-Commercial Procurement (PCP) and reports on how Venture Capital (VC) involvement in pre-commercial procurement has operated in the US (which has a long-standing experience of Venture Capital involvement in pre-commercial procurement) and how Poland is currently operating its own scheme which links Venture Capital investors with the country's pre-commercial procurement activities.

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Abbreviations

CA	Contracting Authority
EC	European Commission
EU	European Union
FP7	Seventh Framework Programme
GA	Grant Agreement
GPA	Agreement on Government Procurement
IPR	Intellectual property rights
IWG	Informal Working Group
NCBR	National Centre for Research and Development
PCP	Pre-Commercial Procurement
PPI	Public Procurement of Innovative solutions
R&D	Research and Development
R&D&I	Research and Development and Innovation
SBIR	Small Business Innovation Research
SME	Small and Medium Enterprise—
TRL	Technology Readiness Level
UK	United Kingdom
US	United States
VC	Venture Capital
VOD	Valley of Death

Executive Summary

This white paper focuses on the role of venture capital in supporting the procurement of innovation, particularly in the context of Pre-Commercial Procurement (PCP). The insights presented in this paper are derived from existing literature and reflections on the PREVENT PCP project, a EU-funded Horizon 2020 research initiative aimed at exploring how venture capital can enhance Pre-Commercial Procurement (PCP) as an innovation policy.

Rationale for Innovation Procurement

The paper begins by examining the concept of innovation procurement and identifies potential gaps that can arise during this process. It underscores the pivotal role that venture capital can play in addressing these gaps and fostering innovation.

The PREVENT PCP Project

A description of the PREVENT PCP project is included, outlining its operational framework, and activities. This project serves as a key case study for understanding the practical implications of venture capital support in Pre-Commercial Procurement (PCP).

Engagement of Venture Capital

The paper reviews the current state of venture capital involvement in pre-commercial procurement, highlighting existing evidence of venture capitalists participating in this domain.

Gaps in the Innovation Pathway

This section focuses on showcasing the challenges of the development of new technology, particularly within the framework of Pre-Commercial Procurement (PCP) and the Technology Readiness Level (TRL) pathway. It highlights a critical juncture at TRL8, often referred to as the "Valley of Death" (VOD), where public funding ceases, posing challenges for technology vendors. Additionally, the said section acknowledges other risks, including intellectual property loss and visibility issues in the commercial market.

Benefits and Costs of Venture Capital Engagement

An analysis of the benefits and costs associated with venture capital engagement in pre-commercial procurement is provided. This evaluation offers valuable insights into the potential advantages and drawbacks of integrating venture capital into innovation procurement processes.

Venture Capital in Two Schemes

The paper delves into two distinct schemes operated in the United States and Poland, to explore how venture capital contribute to pre-commercial procurement activities. It discusses the well-established operation of venture capital in the U.S. and the current development of a similar scheme in Poland.

Observations and Conclusions

The document concludes with observations and key takeaways from the paper's findings. Additionally, it highlights the future work to be conducted under the PREVENT PCP project, with a specific focus on reporting more detailed lessons from the operation of venture capital support in Poland.

In summary, this CORVERS white paper sheds light on the pivotal role of venture capital in enhancing the effectiveness of pre-commercial procurement as an innovation policy. By addressing gaps in the innovation procurement process and considering various international contexts, it provides valuable insights for policymakers, researchers, and practitioners in the field of innovation procurement.

Preface

This white paper is the first one out of a series of two papers produced to support the procurement of innovation by disseminating knowledge of current projects and developments in the field of innovation procurement. In this context, the current document considers the involvement of venture capital in the process of supporting the procurement of innovation.

In this white paper we deal mainly with the involvement of venture capital in pre-commercial procurement. Our observations in the paper are based on research of relevant literature and upon reflection on PREVENT PCP (GA 101020374). PREVENT PCP is an EU-funded Horizon 2020 research project aimed at developing *through pre-commercial procurement* new innovative technologies for early detection and tracking of unattended items in public spaces thus safeguarding public safety. Within PREVENT PCP one of the activities is to explore the role that venture capital can play in the support of Pre-Commercial Procurement (PCP) and the enhancement of PCP as an innovation policy.

Our paper looks at the rationale for innovation procurement and more specifically Pre-Commercial Procurement and considers the gaps that may arise in the process of innovation procurement. It briefly outlines the contribution that venture capital may provide. We provide the evidence so far of the engagement of venture capitalists in pre-commercial procurement as well as the associated benefits and costs. The document then describes the PREVENT project itself and reviews how venture capital is currently involved in the pre-commercial procurement activities in two contexts. The first context examined is the one of the US where its operation is well established and the second is the context in Poland where a new scheme has been developed and its first round is being implemented. We conclude with a number of observations and finally draw conclusions indicating the aspects that can be produced with further work.

1. Rationale for Innovation Procurement [PCP and PPI]

1.1 Introduction

Innovation procurement or procurement of innovation is a government policy approach that aims to encourage the development of new technologies, products and services by means of public procurement. It can operate on a large scale through specific major procurements or as an approach that can be followed at the discretion of contracting authorities ['CAs'] which might, in certain circumstances choose to procure an innovation depending upon their specific needs at the time.

It is important firstly to make a number of distinctions. A first important distinction is between innovative procurement and innovation procurement. This white paper does not concern itself with innovative procurement methods but with the innovation procurement. Innovative procurement refers to the use of methods within the procurement process that may lead to more efficient procurement rather than a focus in any way upon what has been and what is being procured. For example, electronic auctions may be considered an 'innovative procurement' method.

A second distinction to make is between procurement of goods or services that do not yet exist and for which research and development (R&D) of some kind is required, and the procurement of goods or services that have no such, or no substantial research and development requirement. The former is referred to as Pre-Commercial Procurement (PCP). PCP involves developing a basic idea for a product and taking forward and developing it into a form which works in a field or real environment. Currently, within the EU, PCP operates as a process defined by a Communication from the European Commission and associated Staff Working document ^[1] and takes the form of an R&D competition in stages with risk benefit sharing between the CA and the suppliers. It does not involve the final purchase of a product or service but requires a further procurement activity under the procurement directives – the classic directive ^[2] or the sector directive ^[3].

It should be noted that an Innovation Partnership [Procedure] is available in the Classic and Sector Directives for a CA seeking the development of a new product or service. This is an integrated approach to innovation and includes an R&D stage which may be phased, and the product development. The Innovation Partnership may be competitive or with a single supplier.

Procurement of Innovation or Innovation Procurement has operated in western economies for some time with the US being the first to formalise an approach with the creation of its Small Business Innovation Research SBIR programme in 1982 under the US Small Business Administration, although a Pre-cursor to it had existed since 1977 within the National Science Foundation ^[4]. At this point in the development of the general approach to the procurement of innovation, it were the US R&D spending departments that were instrumental in operating innovation procurement, but since that time, the approach, particularly in Europe, has focused upon implementing the procurement of innovation by contracting authorities for their own use through contracts rather than grants.

Since then, the US has developed its approach to the procurement of innovation and the European Union and its member states [the UK and The Netherlands being leaders in the development of their own scheme] have adopted a range of measures to ensure that contracting authorities have a legal framework that allows them to facilitate innovation. Furthermore, it has become necessary to provide parallel schemes of support to develop the expertise of public procurement staff to operate what can be complex processes.

The development of approaches to support innovation procurement has come from a recognition ^[5] that public technology procurement could have significant innovation outcomes. However, since that time, the procurement of innovation approach using PCP has developed with policy makers adopting a range of forms. We will briefly examine the elaboration of the policy and then outline the policy rationales.

Initial definition of PCP provided a framework for individual CAs to procure for their own needs on where there was a public policy goal that could be most effectively attained by PCP. This distinction – between policy ‘challenges’ and operational goals for PCP - has been made by a number of reviews ^[6] and ^[7] and is also made by policy makers themselves. PCP is also operated within the context of a support programme by organisations such as the UK SBIR where costs of paying suppliers to conduct research and development can be met by the support programme itself. The EU also uses PCP approaches within its R&D programmes to support key priority areas. More recently, the report by Steer ^[8] documented a range of approaches in the way in which PCP could be used beyond the existing policy operational dichotomy: as form of support to existing commercial activities; on very broad mission levels across a wide range of policy areas [which we term ‘mission level challenges’]; and of support to very specific technology vendors.

1.2 The rationales

PCP can be used to support innovation and as has been noted above, it is a flexible tool that can meet a wide range of research & development needs. However, there are other rationales for its use.

Firstly, the relatively large size of the contracts offered to PCP participant companies with the payment of 100% of the costs of incurred is a significant incentive to encourage participation. However, the amounts allocated to PCP [at each phase] and even if large are matters of judgement that involve matching the funds allocated to an estimate of the amount of research and development time and effort required to address the challenge. It should be noted however that unlike in the US participation in the schemes that operate Europe there is no size limit as such and large companies could compete if they wished.

Secondly, PCPs provide the option to test product or service development ideas and if they prove not to be likely to lead to success competitions, it can be stopped and unnecessary work can be avoided. This is often described as risk mitigation for the CAs, and it can be extremely useful in the context of innovation where there are high levels of uncertainty.

Thirdly, PCP operates within a competitive framework. While the primary requirement is to deliver R&D services, the nature of competition inherent in PCP drives participating suppliers to surpass expectations. This dynamic incentivizes them to offer added value, enhancing the overall quality of service provision. This can be considered a benefit for the CA, and could be considered as a desirable outcome for the technology vendor. The public and open character of the PCP process is also useful in that it provides information to participant companies, especially insights to the most pressing needs of the Contracting Authorities across EU. In addition, the effect of winning in such a process may be an incentive to participant companies, as it provides them the possibility of creating added value to their products developed and compared to the competition. As there are multiple participants in the procurement process, public buyers can purchase R&D services from several competing suppliers in parallel to compare alternative solution approaches and to identify the best value-for-money solutions that the market can deliver to address their needs. This strategy minimises the risk of not obtaining a suitable solution, ensures interoperability and fosters competition among the contractors until the end of the procurement process. It also enables the selection of the best solution progressively. Due to the competitive nature of the procedure, it puts pressure on economic operators to develop better and more affordable solutions, within the time and budgetary limits prescribed in the tender documents.

Fourthly, the winning of a PCP may be considered a signal to prospective investors and may encourage capital investment in the technology vendor from venture capitalists or other investors, which might include banks. For investors, as PCPs have 100% recovery of costs, the opportunity to invest in PCP participants offers a low financial commitment, a restricted timeframe, and a phased approach – which tend to reduce the risk of investing in such projects.

Fifthly, innovative activities have shown in various economic assessments of impact to provide a return to the taxpayer through increased revenues from technology vendors although such investment in PCPs may vary between generalized schemes such as those operating in The Netherlands or the UK and specific PCPs that are conducted directly by CAs.

Sixthly, under the EU's PCP framework, CAs retain user rights to technologies developed under the PCPs. This is an incentive for CAs to use PCP in contrast to other forms of procurement.

We should also note that under the current EU framework, as PCP is outside of the scope of the procurement directives and the Agreement on Government Procurement (GPA), it can require that the performance of the R&D has to take place within the EU.

2. Prevent PCP

2.1 Operation

The main goal of the PREVENT PCP (GA 1 01020374) project¹ is to improve safety and security in both public transportation and public areas. To reach this goal the project focusses on the procurement of innovative technological solutions, through a pre-commercial procurement (PCP) approach, that will allow timely automatic detection of potentially dangerous unattended items, identification and tracking of perpetrators, and an advanced crisis management system.

The first stage of the project consisted of defining the needs and common challenge within the scope of the project. Then the project was engaged on getting a clear insight into the current market situation, through a check of the state-of-the-art and the launch of an Open Market Consultation.

In the context of the Open Market Consultation activities, and in order to explore the VC involvement from the supply side perspective, the participants were specifically asked about a potential need or desire for an external support by Venture Capital (VC) funds. It needs to be noted that 30% of the companies responding to the Open Market Consultation questionnaire were SMEs and about 10% were Start-ups/spin-offs.

In this regard, a total of 35% of the responders answered that they would be interested in receiving external support for the development and the commercialization of their PCP solution. The follow up input received was related to the areas that support would be needed from an external investor, where the majority of the companies' interest was regarding the funding and the expertise knowledge on the development phase as well as networking support during the commercialisation phase of their solution. In addition, 60% of the companies which responded positively on receiving external support, stated that an external investor would incentivize their participation to the PREVENT PCP.

Based upon the pre tendering preparatory actions, the procurement specifications were drafted leading to the development of the tender documentation. Following the tendering process, the public buyers selected six (6) contractors which delivered their solution designs at the end of Phase 1.

Following a comprehensive evaluation process, the project selected four (4) contractors to enter Phase 2 aimed at further developing their solution to deliver their first working prototype. A follow-up evaluation process was then initiated under which the public buyers selected the two solutions that are currently evaluated under Phase 3 on real life conditions leading to two TRL8 solutions at the end of the process.

¹ <https://prevent-pcp.eu/>

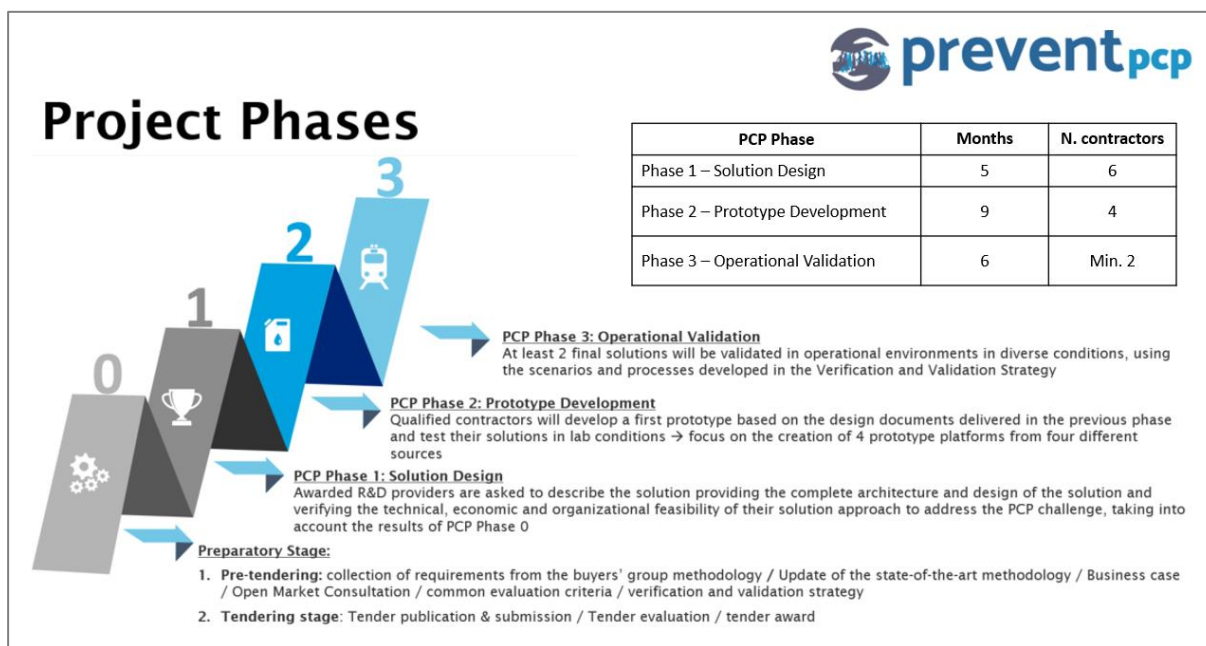


Figure 1 - Project phases PREVENT PCP

2.2 Backers

In the present time, where innovation procurement has a paramount role, PREVENT PCP has been launched to develop novel technologies with the purpose of pre-empting attacks on public transport. This project also aims to tackle the fragmentation of the security market in Europe by addressing the needs and common challenge defined by its 23 partners, among which are 11 public buyers coming from 6 different EU countries. In addition to the project main objectives, PREVENT PCP acts as a pilot to understand the benefits and the challenges of engaging VC funds in innovation procurement.

Based on data collected by the European Commission, inferences could be drawn that participation in a PCP has helped several companies to attract VC financing. Indeed, 30% of all SMEs that participated in FP7 funded PCPs are today VC backed. Some of these companies were already VC backed before starting the PCP and it is expected that the number of companies receiving VC after participating in a PCP grows. Moreover, being a PCP contractor can serve as an incentive for Venture Capitalists (VCs) to invest. Some evidence from FP7 funding programme also shows that VC investments lead to the commercialization of the solution developed during a PCP.

In this line, PREVENT PCP aims to ensure the engagement of VCs in the PCP in order to increase the chances of commercialization of the developed solutions. To this end, the PREVENT PCP Consortium is engaging with carefully selected external experts who have relevant experience and background and created the Informal Working Group (IWG) 'Fostering Venture Capital involvement in pre-commercial procurement'.

The said IWG has as a primary objective of facilitating the interactions between the Venture Capital organisations and the selected PCP contractors. Considering the different roles (supporting, investing, or disseminate) that VC can play for the PREVENT PCP contractors in exploiting the outcomes of the R&D, the members will be engaged in discussions on the different approaches that could enhance the

collaboration among the abovementioned stakeholders. Thus, the outcome will be composed of a set of lessons learned and policy recommendations for the pathway that can lead to the commercialisation of the developed solutions, avoiding the so-called “Valley of Death”.

The PREVENT PCP project will serve as an excellent platform to access different entities from various Member States and several public buyers, who have already described their unmet need and have also expressed their commitment to develop and test a TRL 8 prototype. The overall aim is to commercialise the final solution in the public and private sectors, which would in turn increase the chances of receiving a profitable return on investment.

2.3. Evidence VC Engagement Benefits

The analysis of the ways of operation of the VC and the PCP approach led to a number of observations. Firstly, according to its relative maturity, a VC-backed technology vendor receives a specific round of financing sufficient to reach some natural milestone, such as the development of a prototype product or the acquisition of a major customer. At each milestone, the parties can return to the negotiating table with some new information. The pre-commercial procurement shares the same staged, or rather phased approach, as it is set-up in three consecutive phases whose access is contingent to the achieving of certain milestones set in the framework agreement and phase contracts by the Contracting Authorities. Moreover, the final milestone – in a new award procedure - is the commercialization of the product developed during the PCP. In this regard, a VC fund may also utilise the innovation procurement’s phases to calibrate its investment in a given company. In this case, it can commit further rounds of financing to a company, conditioned on the success of a specific PCP’s phase. Conversely, funding can stop if the company fails to do so.

Lastly, further information on the links between the Venture Funding and the pre-commercial procurement have been examined and presented by the EC on a relevant survey². Based on this study, there are first indicators that suggest a higher growth rate of the VC-backed companies compared to the non-VC-backed companies that participated in the PCP. In addition to that, the analysis revealed that participation in the PCP helps several companies attract VC financing, in some cases on more than one round_and there is also evidence of potentially higher commercialization rate of VC-funded companies.

² Update on results from completed and ongoing FP7 and Horizon 2020 funded Pre-Commercial Procurements (PCPs) Lieve Bos DG CONNECT F3 unit (“Digital Innovation and Blockchain”)

3 Gaps in the Innovation pathway

3.1 Barriers in the commercialisation of Innovative Solutions

The development of new technology through PCP, or through any other mechanism such as R&D&I that a technology provider autonomously undertakes, has the goal of moving an initial idea [a ‘basic principle’ forward to become, eventually, an operational product or service] to TRL8 [at TRL 9, a technology is considered commercial and on the market]. At TRL 8, which is the status achieved at the end of the PCP Phase 3 in the European approach, technology is considered a system proven in an operational environment (competitive manufacturing in the case of key enabling technologies, or in space)’. This pathway of development is often known as the as the technology readiness level pathway and has nine steps [9].

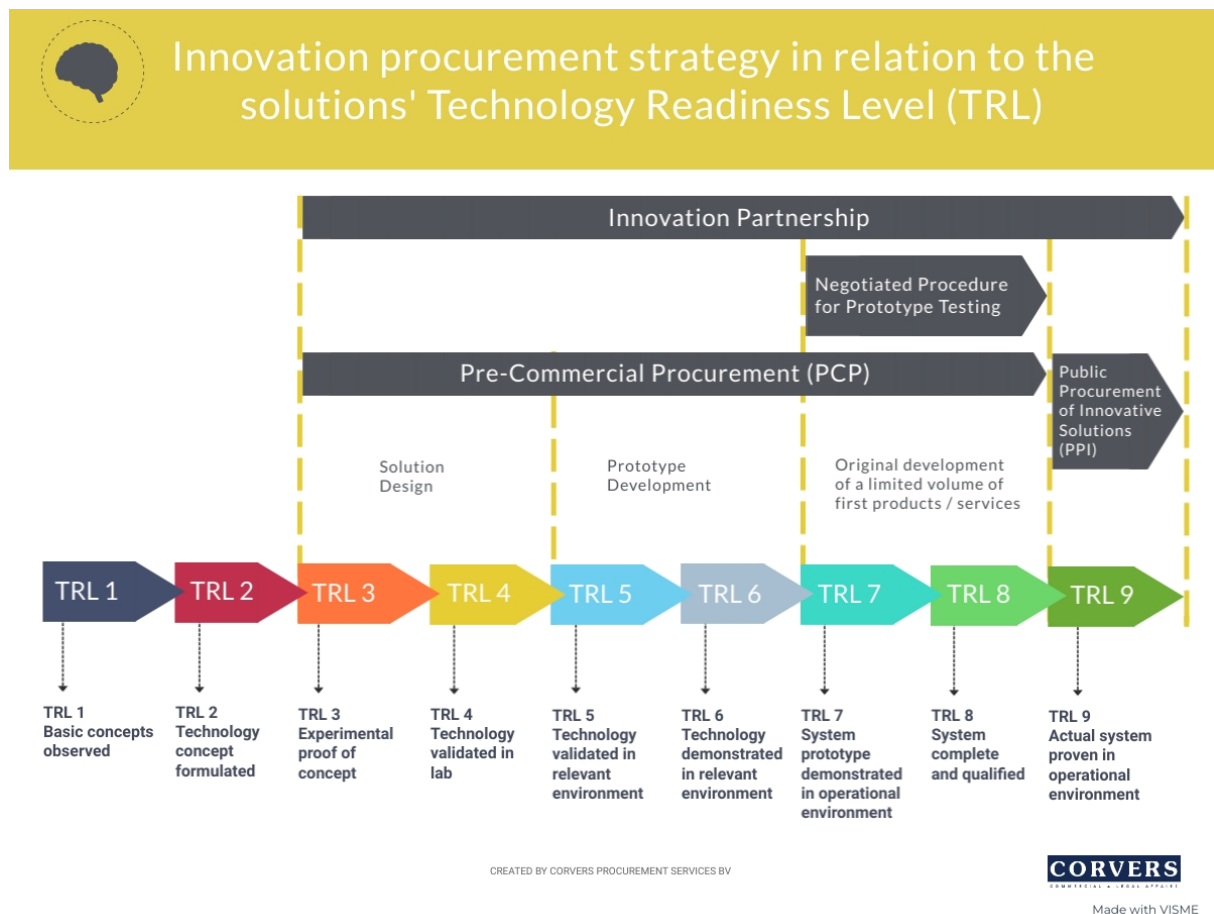


Figure 2 - Innovation procurement strategy in relation to Technology Readiness Levels (TRL)

While it is well-understood that as technologies move along the pathway there are feedback loops [10], the linear, step by step approach of the TRL pathway is used for regulatory purposes³. Also important within the regulation of PCP is the use of Phases, the first two of which are rounds of competitive R&D,

³ As is the related Frascati categorization of development stages.

followed by a further Phase 3. In the EU, public funding for development along the TRL pathway through PCP cannot be continuous from idea to operational product, but must halt at TRL8, which is at the end of Phase 3. At that point, public buyer(s) intend(s) to purchase the solution, a tender for the purchase/procurement of the solution will be published through a PPI (Public Procurement of Innovative Solutions). This tender will be open to all solution providers on the market that meet the requirements and criteria of the tender.

While this competitive approach is a stimulus to innovation and ensures competition between products or services [and necessarily between suppliers], *it creates risk* for technology vendors that have invested in development to TRL 8 but have no guarantee that their product or service will then be purchased at Phase 3, a situation noted in the early review of the US approach ^[11]. It is also at that point in the technology development process that far greater resources are usually needed to develop a product or service to the next stage where it can be offered on the market, i.e., to TRL9. There are therefore two forms of risk that technology vendors experience at this point: the risk that their product *will not be purchased* at the next stage, and that they will not be able to *acquire the capital to commercialize* their product or service even if they are successful in developing the solution to TRL9 (market product).

While other regulatory and customary rules lead to other gaps along the TRL pathway that might slow the development of technology along the TRL pathway, the gap at this point at TRL 8 is the most significant and has been long recognized as a barrier to the development of technologies in the case of the US SBIR. This gap is known colloquially as the ‘Valley of Death’ [or the ‘VOD’ for short].

A number of other risks are also present at the point that technologies move beyond the development stage and enter the commercial market which are noted in ^[11], notably the loss of IPR relating to the invention as small companies are often unable to secure effective IPRs. Another risk is the lack of visibility of the innovation. This lack of visibility has two possible consequences, the first of which is that the innovation does not secure investment, which is related to the lack of capital to fund commercialization noted above; the other and equally important one is that the potential purchasers may not be aware of the innovation, which may affect sales and thus market uptake of the solution. It is therefore essential that these both risks relating to the VOD, are recognized, addressed and mitigated at an early stage in the PCP. Below in the next section we examine the financing of innovation that seeks to address the VOD.

3.2 The VC Gap

The importance of financing within this context of pre-commercial procurement in the US model has been extensively discussed. Key work in this area has been the work of Lerner ^[12] who early on drew attention to the importance of VC at the stage of expansion of technology providers that had participated in the US version of pre-commercial procurement [the SBIR]. However what Lerner concluded from his research was a link between SBIR participation and the attraction of VC that followed participation, rather than the other way around. His finding was considered to be a ‘quality certification’ effect ^[13] [a form of signalling to the market, in this case the market for finance]. Lerner’s

findings were qualified in a number of important ways; one of which was that funding by VC was only likely to occur in areas with significant VC company presence.

The US and the EU both operate public procurement of R&D approaches, and both systems have given rise to the risk that vendors that are successful in earlier stages of the development of a technology [product or process] may then fail to acquire the resources required to develop their product or service for sale. However, within the US approach there has been the emergence of measures that permit contractors who are successful at the development phase to continue to the commercialisation phase without competition and continue to draw up on funds from the procuring authority. Within the EU, the use of VC funding is allowed but there is a break at the Phase 3 point – as explained above - [with the exception of a procurement within the Innovation Partnership Procedure] and a new procurement procedure open for competition (PPI) must be applied.

The EU is now urgently considering how to address the gap in the further development [the notional Phase 3] of technology through the engagement of VC. The EU European Investment Fund is a key actor in this area and provides extensive data on the investment sector. Its working papers report on the recent state of small business financing^[14] and also upon the views of SMEs about access to finance which across the countries of the 27, show considerable variety^[15]. On the basis of evidence, it is shown that VC is not only attracted to companies that have participated in pre-commercial procurement, which was Lerner’s conclusion, but that VC assisted and supported suppliers are more successful at pre-commercial procurement than companies without such support. In the following section we review the evidence in detail that the Commission has gathered to support the engagement of VC firms with suppliers that are participating in pre-commercial procurement.

4 Benefits and Challenges of VC involvement

4.1 Benefits

VC involvement within the context of pre-commercial procurement should be seen to have a variety of benefits at different levels and for a range of actors and not just one simple impact in enhancing the development of a new technology.

Firstly, those benefits that occur that are internal to their transaction, and which arise for the contracting authority / public buyer who is performing the PCP. More specifically, upon a successful PCP they benefit from the use of an improved solution that can tackle their need or problem. This usually translates to better quality of services, more efficiency, a reduction of the operation costs or a combination of one or more. PCP additionally provides contracting authorities with enhanced control of the innovation process giving them the opportunity to stop a R&D process if it fails to promise a return. Risk benefit sharing which is inherent to the PCP process currently operating in the European Union ensures that the IPR will go to the supplier, but it leaves a licence with the contracting authority. PCPs can be held as a joint procurement process reducing the cost of larger scale activities and articulating demand for innovative services with PCP contracting authorities can more effectively engage with larger scale problems or so-called wicked problems which are only addressable at a larger scale and when demand is defragmented. The prospect of VC involvement in a PCP is likely to generate increased interest from the market, potentially attracting higher-quality market participants and enhancing both the development process and the resulting solution. The specialized market knowledge and experience offered by VC firms can positively impact not only the efficiency and quality of the development process but also the final solution. Leveraging the testing and validation expertise of VC firms could lead to a better-managed, controlled, and expedited process if the public buyer were to integrate VC expertise in these areas.

Among the benefits are those that come to suppliers from participating in PCP, such as sales increases, business expansion opportunities by accessing new customer base, employment creation, and the creation of new companies, the generation of intellectual property, and skill acquisition from participating in innovative activity. Participation in R&D is historically associated with an enhancement to companies networking and further embedding in an innovative ecology. Contractors may also publish the results of their innovative activities in trade and professional journals. Suppliers which participate in pre-commercial procurement and in the procurement of innovation identify themselves as likely candidates for investment by VC firms, as already presented in section 2.3. Specifically, arising from the VC involvement in innovation procurement, suppliers stand to gain valuable insights and expertise in their specific market sector, as well as in prototype development and testing, which are typically abundant within reputable VC firms. Furthermore, VCs can augment commercialization prospects by providing networking opportunities and specialized market insights at the conclusion of Phase 2 and onwards.

For the VC firms that are involved in pre-commercial procurement and the procurement of innovation there are a number of benefits that arise from taking a financial stake in a business. These are that when capital is put forward and invested in a business, it may give a degree of control over the company in which the investment has taken place. VC companies will also acquire expertise in the procurement of innovation which has a growing field and may provide further profit opportunities. In addition, VC firms that invest in PCP contractors or even simply become aware of PCP as an investment choice are gaining access to innovating suppliers that provides them with investing opportunities and awareness of new markets and solutions. To the extent that a PCP may develop a technology along the TRL spectrum without necessarily direct investment at this early stage, VCs may consider that they are avoiding the risks of early-stage investment in R&D.

Benefits that arise external to the transaction are where contracting authorities conduct what might be known as catalytic innovation where they support innovative activity that leads to technology or service that they themselves do not directly use, but has public good aspects. Venture capitalists can also use PCP to acquire interests in a range of technology providers that constitute for them a portfolio in a particular industry sector which may have more value as a range of holdings than as a single investment.

4.2 Challenges

While there can be significant benefits for all actors (contracting authorities, suppliers, and venture capitalists if venture capital actors are engaged in the procurement of innovation), there are also challenges that will arise. For the technology vendor, when VC is engaged in the support of innovation procurement there is a new actor with new incentives involved and there may be a loss of control of the company [dilution of equity] regarding the developed end-solution and a pressure of rapid growth which may not align with the Contracting Authority's strategic needs as well as the operational and managerial capacity of the technology vendor. The procurement itself may be overtaken and fail because the aims of the VC company may not be aligned with the aims of the pre-commercial procurement, therefore an undefined balance might exist between these two objectives: the objective of the public buyer, who is trying to have its unmet need fulfilled or problem solved, and the objective of the VC fund, which is seeking a suitable return on investment in a set timeframe^[16]. There are therefore also larger risks arising from VC ownership of technologies that may have a significance beyond the procurement. We note two forms of risk may arise for the contracting authority when VC is involved in their PCP: a) VC control of the innovation process may challenge the aims of the Contracting Authority about the specific technology which is being developed in the pre-commercial procurement, including such issues as timing, we term this a *business risk*; b) a second risk, which we term *the policy risk*, is where the subject of the procurement is broader and at a more systemic level where any loss of control of the project [through the involvement of a VC with contradictory interests] would create risk for larger scale policy priorities such as European autonomy.

There are also risks for VC investors when getting involved in a PCP. A level of uncertainty will always arise at any stage in a competitive R&D process or a commercial competition / tendering. But when technologies are new, and potentially the contracting authorities have a low level of capabilities in

innovation procurement, or the innovation is in a complex area that is highly regulated, there are risks of failure. Introducing more parties into a transaction also increases the risk of hold-up.

The abovementioned risks and challenges should be duly taken into account during the pre-tendering phase and especially the tender documentation development process, having as an end goal to safeguard the interests of the parties involved.

5 Schemes in place

5.1 A note on Comparing Schemes

While competitive R&D in phases is an approach that is being used widely, there are notable differences between the implementation of the general idea between economic areas in the world. It is also the case that pre-commercial procurement is considered in relation to a further activity, procurement of innovative solutions (PPI), which in several cases is considered as a next and linked step. Indeed, this next step is considered to be part of the general approach as the activities of each step are designed to connect technology development activities together.

It is possible to state some general overall features and note some key differences between the major implementations of pre-commercial procurement; the US and European versions. Both schemes fund research and technological development in stages. These stages are referred to in both approaches as phases.

In the US version known as the Small Business Innovation Research programme [the 'SBIR' for short], there are two phases that are related to the R&D process, Phase I and Phase II. A third phase ['Phase III'] is sometimes referred to although this does not have SBIR programme funding as such. In the European implementation, pre-commercial procurement has 3 phases with an additional Phase 4, which is the commercial procurement stage (PPI). The US scheme the numbering is Roman, the European uses Arabic numbering.

It may be helpful to consider how the different schemes or programmes and their phases relate to the development of technology as measured by technology readiness levels (TRLs). In the US scheme, Phase I supports prototype development and covers concept development over TRLs 1-3. The Phase II of the US programme funds activity at TRLs 4-6. In the US process, commercialization is considered to take place in a Phase III, which is external to the SBIR and this takes place at TRLs 7 to 9.

In the European scheme, usually Phase 1 is a solution exploration stage and concludes at the end of TRLs 3 to 5 depending on the targeted technology. Phase 2 is the delivery of a prototype which covers TRLs 4 to 6. The European Phase 3 is the validation/testing of a limited set of first products and can cover technologies maturing from TRLs 6 to 8. In the European scheme the next stage could involve either proceeding to a PPI or directly advancing to commercialization endeavours. In PREVENT PCP, VC involvement takes place at the end of Phase 3 when technology development at TRL 8 is to be funded.

5.2 United States

In the United States it is common for technology vendors that are participating in SBIR competitions to have some form of VC funding, hedge fund or private equity funding, although VC funding is the most likely. It is useful to draw the distinction as we have done above between technology vendors that are VC owned at the time of application to a pre-commercial procurement competition process [in this case the SBIR] and technology vendors that subsequently receive VC funds having won a SBIR

Program award and with this are selected to participate in the PCP [at any one of the three stages referred to in the US program].

It should be noted that the SBIR Program does not itself make awards at Phase III, but companies that are successful and move to the Phase III stage may well receive follow on contracts for products or services intended for use by the US government ^[17] ^[18] and at that point they may also receive funding from VC firms. It is always possible that technology vendors that are funded before they apply to the SBIR may receive further VC funding at a later stage, i.e., at any one of the Phases [I, II, III].

The SBIR has initially been reluctant to allow majority VC owned technology companies to receive awards, but there is a dispensation and the following departments now permit technology vendors that are majority owned by VC to apply: Department of Health and Human Services (Centers for Disease Control and Prevention, and the National Institutes of Health); Department of Energy (Advanced Research Projects Agency); Department of Defense (Defense Advanced Research Projects Agency); Department of Defense (Department of the Navy); Department of Defense (United States Air Force); Department of Defense (Army); Department of Education^[19].

The US rules concerning the ownership of technology vendors that participate in SBIR competitions envisage that more than one little VC company may be the owner of or have a share in a technology vendor.

It has been argued that SBIR funded companies might be more likely to be successful if they are given support to find help with investment at Phase I and Phase II ^[20], however, the study did not look at Phase III, and because the US SBIR is operated by a large number of government departments, and because Phase III awards are not SBIR awards but from individual departments, the data is dispersed and difficult to collect. A recent study by Howell ^[21], which looks at the Department of Energy, continues a trend of examining the effect of awards on the chances of a technology vendor then receiving VC investment, and then upon its subsequent performance across a range of measures: [revenues, profitability, patenting, survival].

This study demonstrates a link for Phase I awards. The study notes that 40% of the companies which do not apply for Phase II awards are far more likely to have received VC funding. Those technology vendors that apply for Phase II awards are doing so in order to progress patent applications, and are unlikely to be receiving VC funding.

5.2 Poland

In the European Perspective, a national initiative, the Green Deal Accelerator has been implemented in Poland by National Centre for Research and Development (NCBR) and the Polish Development Fund in order to assist the commercialisation of “green deal” technologies developed by innovative companies. In the context of the said program, companies that have participated as PCP contractors reaching a mature TRL for their solution, are being assisted to their commercialization plans and actions.

The structure of the program is characterized by an initial phase of interviews with the entrepreneurs to identify the obstacles and gaps for commercialization, followed by the support phase organized into 3 thematic modules, business tools, VC funding and foreign expansion.

The first module includes workshops on aspects that are important for each entrepreneur/company to be aware of and models that can be used to introduce their solutions to the market, like Public Private Partnerships, Horizon Europe funding program, loans, corporation funding, VC funding, etc). In the said workshops, the participants have the opportunity to learn from experienced trainers as well as to practically develop their business models, marketing strategy, IPR management approach etc. One of the important outcomes of this activity is the development of their pitch decks. During the second module, the program focuses on enhancing the participants knowledge of VC financing and how it works. The thematic areas provide knowledge and practical guidelines to the contractors in relation to the negotiations, the investment agreement preparation and the development of a comprehensive financial analysis (cash flows, etc). Lastly, module 3 is dedicated to the contractors that are keen on expanding their business to other markets. In this regard, trainings are offered connected with the evaluation of the expansion to new markets (like barriers to entry, etc), the financial support available and guidance on how to deliver a professional business plan provided by one-to-one consultations with experienced professionals.

Part of the program is also the matchmaking between industry and VC funds through the organisation of pitch days as well as reverse pitching days, where the VC funds get the opportunity to present themselves to the companies. To reinforce the matchmaking opportunities, demo days are also implemented where the companies have the opportunity to present their solution and elaborate on their innovation potential.

The said program provides a unique opportunity for the participating PCP contractors to enhance their capabilities and receive practical guidance on the tools and resources needed for the commercialization of their innovative solutions.

In addition to the said Green Deal Accelerator program, in order to support the commercialization process, NCBR is implementing an open call formula allowing investors, VCs, business angels and other interested parties to connect with PCP contractors and get to know their innovative technologies. In this formula, NCBR acts as a contact-point (connecting interested parties with PCP contractors/ interested suppliers and/or technology vendors), promoter and an advisor in scope of innovative technologies developed in PCPs.

6 Observations & Future work

The PREVENT PCP project, with its focus on enhancing safety and security in public transport and public areas, demonstrates a collaborative approach involving multiple partners across EU countries. This collective effort underscores the importance of addressing safety challenges in public spaces and transportation.

PCP initiatives, exemplified by the PREVENT PCP project, function as catalysts for innovation within specific domains, such as public transport and public areas. These initiatives identify pressing needs and challenges, creating opportunities for innovative companies to develop and validate their solutions.

The involvement of venture capital in innovation procurement initiatives such as PREVENT PCP can yield substantial benefits for participating suppliers. These benefits include increased sales, business expansion opportunities, employment creation, and the generation of intellectual property. Such support from VC entities aligns with the growth objectives of innovative companies. While VC engagement offers clear advantages, it also presents challenges, notably the potential loss of company control and pressures for rapid growth. These challenges necessitate a delicate balance between securing funding and maintaining a company's strategic and operational alignment.

Regulatory frameworks governing the connection between PCP and VC funding are dynamic and adaptable. In the United States, for instance, there has been a noticeable shift towards permitting majority VC-owned technology companies to participate in programs such as the Small Business Innovation Research (SBIR) initiative. This adaptability reflects a recognition of the ever-evolving landscape of innovation and the acknowledgment that venture capital can play a pivotal role in bridging the gap between development and successful commercialization.

In EU the Green Deal Accelerator program in Poland serves as a tangible example of how PCP and VC funding intersect. This program offers tailored support to PCP contractors, aiding them in advancing their technologies toward commercialization.

In conclusion, the connection between PCP schemes and VC funding is increasingly essential to innovation procurements. PCP serves as a precursor, providing structured validation and maturity to companies, rendering them more attractive to venture capitalists. VC funding, in turn, provides the resources, expertise, and networks necessary for successful commercialization. Nevertheless, a careful consideration of timing, goal alignment, and potential trade-offs remains essential for companies navigating this dynamic landscape, which will be part of the Informal Working Group's future work.

In this context, this is considered as the first publication that introduces the topic, outlines the framework of benefits as well as the drawbacks and challenges of connecting VC with innovation procurement. It will signal further reports on the topic under discussion in which we will consider the lessons learned (Green Deal Accelerator program in Poland), the possibilities of such schemes working with cross border aspects as well as address the implementation risks that arise under our study.

7. Conclusion

This white paper has explored the relationship between venture capital (VC) investment and pre-commercial procurement (PCP) in the context of innovation procurement. The material presented under this paper reflects a number of insights provided from the Informal Working Group members operated under the PREVENT PCP project. The authors would like to thank the members of their support and expertise knowledge provided.

In the pursuit of fostering innovation through procurement, it has become evident that PCP offers a flexible and competitive framework for the development of new technologies and solutions. The PCP process allows contracting authorities to engage with the private sector, encouraging the creation of cutting-edge products and services. However, as technology progresses along the Technology Readiness Level (TRL) pathway, several barriers emerge, prominently the "Valley of Death" (VOD) at TRL 8, where the risk of innovation not advancing further becomes a significant concern.

Venture capital investment emerges as a pivotal solution to bridge this VOD. VC firms bridge the gap between innovative ideas and market-ready products, offering capital and know how to drive progress and commercialize solutions. This not only aids technology vendors in getting their developed solution to the market, but also enhances service quality for contracting authorities through a more facilitated market uptake, ultimately serving the public interest.

Our examination encompassed VC participation in PCP in the United States and Poland. The United States' SBIR programs have facilitated connections between technology vendors and VC funding, resulting in positive impacts on suppliers; performance. In Poland, the Green Deal Accelerator program supports PCP contractors on their commercialization journey by providing guidance, networking, and access to VC funds.

VC engagement in PCP yields diverse benefits, from improved solutions and cost reductions for contracting authorities to increased sales and intellectual property generation for technology vendors. VC firms also gain financial stakes and procurement expertise. However, challenges include a possible loss of control for technology vendors, potential misalignment of goals, and the introduction of additional parties, risking project delays.

In conclusion, VC investment in PCP presents a compelling opportunity to overcome the barriers faced by technology vendors in advancing their innovations from TRL 8 to market-ready solutions. It enhances the success rates of PCP and promotes the commercialization of innovative products and services. As innovation procurement continues to evolve, the role of VC firms in supporting PCP is poised to become increasingly vital, contributing to the broader goals of fostering innovation and enhancing public services.

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