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Innovation Intermediary Services for Customs Administrations and Firms: The case of the Pan-European Network of Customs Practitioners¹

I. Introduction

Customs administrations are on the frontline to protect societies against criminal acts in cross-border trade and logistics. These agencies benefit from technologies and solutions developed by firms in the security sector, assisting them in their daily tasks of detecting illicit trade and illegal cargo, including narcotics, weapons, and counterfeit goods. Due to the vast amount of cross-border transactions – just alone in the European Union there are over 500 declarations submitted per minute (European Commission, n.d.-b) – only a small percentage of all shipments can be physically inspected. Customs relies on modern technologies including container scanners, radiation detection devices, and risk management software, among many others. Unfortunately, many gaps exist today in technical performances of such solutions, particularly when it comes to “too many false-positives and too many false-negatives”. False-positive means that many shipments pointed by technologies as high risk are actually fully licit; while false-negative means that shipments supposed to be licit are actually illicit, after all. Further on failing to identify illegal shipments: a study performed by Oxford Economics (2018) indicated that “only 11% of illicit trade is seized, on average, across Europe [...] even the most effective border enforcement authorities cannot seize more than a small share, perhaps a quarter at most, of the illicit goods crossing their borders”. All in all, one can well state that customs administrations are increasingly needing more innovative products, services and processes in order to tackle the fast-changing pace of national and transnational criminal activities.

Traditionally, organizations have innovated by following the “close innovation” paradigm – which means to perform all innovation processes within the organization’s frontiers and without help from external parties. However, this paradigm has been replaced progressively by the “open innovation paradigm” (Chesbrough, 2003b; Kankanhalli, Zuidervijk, & Tayi, 2017). H. Chesbrough, Vanhaverbeke, & West (2006) define open innovation (OI) as “the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. [This paradigm] assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance their technology”. The father of OI, Henry Chesbrough (2003), originally considered only two types of open innovation: inbound OI (when firms bring external ideas or knowledge into their internal innovation process) and outbound OI (when firms share un-utilised or sub-utilised innovations, knowledge or ideas with external parties). As a third mode of OI, Gassmann & Enkel (2004) introduced an additional type of OI called “coupled open innovation”. They defined this last concept as the combination of inbound and outbound OI process.

Open innovation, including coupled OI, is no panacea for the innovation process of organisations; however, it has proven to be a successful approach in a large number of firms while tackling complex problems when internal and individualised approaches have not worked. Most of the recorded success of the overall OI paradigm is in the private sector; still, there is also a growing interest in open innovation in the pub-

lic sector. One driver for this could be that the close innovation schemes have not adequately addressed the emerging policy challenges that governmental organisation have to deal with (Bomert, 2010). There is already evidence of public institutions around the world where the concept of OI has been introduced. An example of this approach is the “Challenge.gov” crowdsourcing initiative of the US Government, where any US governmental department can post diverse challenges to be solved by anyone in the world – while having a chance to win a prize when doing so. Other countries including the Netherlands and Singapore have also introduced similar approaches (Yang & Kankanhalli, 2013).

Although customs administrations have realized the importance of approaching security threats in a coordinated matter and following the logic of coupled OI, it is not an easy task. In fact, according to the European Horizon 2020 work programme, “in Europe, practitioners [including customs administrations] interested in the uptake of security research and innovation [...] are dedicated to performing their duty and to focusing on their operation. In general, practitioners’ organisations have little means to free workforces from daily operations, and to dedicate time and resources to monitor innovation and research that could be useful to them. They have little opportunities to interact with academia or with industry on such issues. All stakeholders – public services, industry, academia – including those who participate in the Security Advisory Group, recognize it as an issue” (European Commission, 2016). For such reasons, the use of a third-party organization, or an innomediary, can facilitate the creation of an open

innovation ecosystem for these governmental agencies.

This paper analyses the services provided by an innomediary called Pan-European Network of Customs Practitioners (PEN-CP) and how these services can improve the open innovation process of a Network of 13 European Customs Administrations (N13EC)². This innomediary was created as part of the EU Horizon 2020 program that intends to foster the bridging between firms and the N13EC for a smoother coupled-open innovation process – which will ultimately facilitate creation and adoption of more accurate, faster performing, and/or cheaper customs security technologies.

The paper starts with a brief literature review about innomediaries as well as an explanation of the methodology used. Then, the paper continues with the case study analysis, which is divided into three parts: first, a description of PEN-CP background and context in which it was established; second, a description main roles and functions for PEN-CP; and third, a description of the services provided. Lastly, the discussions and conclusions are presented.

II. Literature review on innomediaries

Multiple authors have shown that among the key success factors for new product development is the capability to obtain customer insights – especially in an early stage of the process – along with strong market orientation (Füller & Matzler, 2007). However, firms might commonly encounter challenges and limitations when it comes to engaging a direct communication with users (in this paper we use the words user, customer and consumer interchangeably).

Challenges and limitations are diverse, depending among others on the context, the type of involved actors, and the product or service in question. For example, Füller & Matzler (2007) recorded that “continuously monitoring the communication of thousands of community members for innovative ideas represents high efforts in terms of time and cost”. Furthermore, Sawhney, Prandelli, & Verona (2003) mentioned that “companies might not be able to reach to the right customers, because

their interactions and perspectives tend to be limited to the markets that they already serve” or in some cases “companies might not be able to find the consumers at the right time, because these people tend to interact with companies at a relatively late stages of the decision-making process”. Additionally, even when firms are able to reach broader range of consumers outside their market in the right moment, customers might have problems in articulating such needs. According to Füller & Matzler (2007) “the problem when asking customers what they desire is that they only refer to those which come to mind. They simply cannot imagine what they have not experienced and what they do not know about, for example new technologies, materials, etc.”

Effective and efficient interaction with user communities requires certain knowledge and skills which not every organization possesses, especially when it comes to reaching the right consumers. Under such conditions, one way to overcome these difficulties of connecting with the right source of external and internal knowledge is to engage with third party organizations. This third party acts as a broker to help firms to overcome the gaps in knowledge about customers or users that impede innovation (Sawhney et al., 2003). This service, where a third party mediates the process of innovation, is called “innomediation” and the actors who facilitate such action are called “innovation intermediaries” or “innomediaries”.

“Innovation intermediaries are organizations that facilitate innovation by providing the bridging, brokering, and knowledge transfer necessary to bring together the range of different organizations and knowledge needed to create successful innovation” (Lin & Wei, 2018). Innomediaries are relevant for the innovation process because they allow to tap into new and previously disconnected sources of knowledge (Chesbrough, Vanhaverbeke, & West, 2006; Howells, 2006; Randhawa, Wilden, & Gudergan, 2018), eventually allowing to connect those seeking solutions with a rather large number of potential knowledge suppliers (Thomas, 2018).

In practice, there is a wide range of “innovation intermediary” terms used in different contexts and research field, for example: knowledge intermediaries, intermediary firms, knowledge brokers, technology brokers, third parties, superstructure organizations, technology brokers, infomediaries, innomediaries, cross-sourcing initiatives, among many others (Abbate, Coppolino, & Schiavone, 2013; Aquilani, Abbate, & Dominici, 2016; Howells, 2006). Despite the differences in the terminology, the common denominator is that they all try to bring together previously disconnected knowledge with the aim of decreasing innovation cost and time (Aquilani et al., 2016). In this paper, we use the term “innomediaries” and “innovation intermediaries” interchangeably

Furthermore, many authors have also studied – from different perspectives – the roles and functions of innomediaries (Abbate et al., 2013; Aquilani et al., 2016; C. Yang & J. Z. Shyu, 2009; Gami-dullaeva Leyla, 2018; Howells, 2006; Lin & Wei, 2018; Mele & Russo-Spena, 2015) as well as activities carried out by them (Bakici, Almirall, & Wareham, 2010; Colombo, Dell’Era, & Frattini, 2014). For instance, a frequently cited author, described ten main functions of intermediaries in the field of innovation, namely: foresight and diagnostics; scanning and information processing; knowledge processing and combination/recombination; gatekeeping and brokering; testing and validation; accreditation; validation and regulation; protecting the results; commercialisation; and evaluation of outcomes (Howells, 2006).

Despite all the research in this topic, the understanding of innomediaries’ role, function and activities in different context is limited (Abbate et al., 2013), and to the best of the knowledge of the authors, there is no literature analysing innomediaries in the context of coupled-open innovation process between customs administrations and the security industry firms for the development of better performing and/or more tailored security products and services.

Innomediaries have been classified in many ways by different authors. For example, Sawhney et al. (2003) identi-

fied three types of innomediaries: each type has a way to acquire customer knowledge that will help companies create more tailored technology (customer network operator, customer community operator, and innovation marketplace operator). Lopez & Vanhaverbeke (2009), have classified the ten innomediary functions of Howells into three groups: connection group, collaboration and support group, and, technological services group. Other authors such as Hargadon (1998) classify the innomediaries according to the strategic roles they perform: access, learning, linking and implementation activities. The father of OI also classified the innomediaries into three types: agent, broker and market maker (Chesbrough, 2006).

Other authors have identified the different phases in which innomediaries can intervene. For example, Roijakers et al. (2014) recognised four main phases: orientation, exploration, selection and engagement; each phase represents a different level of innovation maturity and therefore the innomediary offers a different supporting role to its customers in each phase. The authors Mele & Russo-Spena (2015) considered four practices – engaging, exploring, exploiting, and orchestrating – in which resource exchange takes place among connected actors by innomediaries.

To summarize, academic contributions on innomediaries have mainly focused on the roles, functions and activities of innomediaries when supporting any aspect of the innovation process; the classification of the intermediaries; the modes of interaction between the different actors; the benefits of using innomediaries; and the use of web-platforms to connect users with companies. However, little has been written about the services provided by the innomediaries and how these innomediaries support the open innovation process of their customers (Randhawa et al., 2018), especially in the context of public and private sector collaboration in the security industry. Here, services refer to the practical way that the innomediaries operate and support their customers (Aquilani et al., 2016)

Within this setting, this paper investigates the following research question:

“Which are the services that an innomediary can offer in order to support its customers’ open innovation process?”

III. Research method

This research constitutes a descriptive analysis using the single case study methodology. According to Yin (2003), a case study research is „an empirical enquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident”. The object of research in this paper is the PEN-CP, which is a contemporary phenomenon related to the utilisation of an innomediary to foster coupled open innovation between firms and N13EC (Network of 13 European Customs Administrations). This real-world case is developed in the context where Customs Administrations are increasingly needing faster, cheaper and more tailored instruments to fight against illicit trade while maintaining societal security

This research aims to be descriptive by nature as “it will provide a description of all the fundamental elements which characterise certain phenomenon and the relationships that develop among them” (Chiucchi, 2009). In this paper, the researchers describe the services provided by an innomediary, explaining how the services support customs administrations’ open innovation process.

The researchers follow a critical realism approach for the case study development. According to Easton (2010), critical realism is particularly well suited for a case study, mainly when the case to be studied is clearly bounded, but also it is a complex phenomenon. In this particular study, the case refers to a complex innovation system that involves multiple services provided to the N13EC and the security industry firms.

Data is gathered using the participant observation technique by DeWalt & DeWalt (2011). Both authors of this paper are part of the PEN-CP project, therefore, the collected information is „naturally occurring data” – in other words, the data is obtained in the natural environment of the actual events. The researchers have already conducted

several interviews with involved actors. An interview is a conversation with the purpose of gathering insightful information about events, facts, ideas and other data that the actors do not necessarily express during formal meetings or sessions (Webb & Webb, 1975). Lastly, the researchers have also collected evidence from a variety of documentation including emails, notes, minutes of meetings, proposals, news clippings, articles appearing in the mass media, alongside with other public and internal records.

IV. Case Study: Pan-European Network of Customs Practitioners (PEN-CP)

a. PEN-CP Background and Context

Security of cross-border trade and supply chains has become a key priority for the European customs administrations. According to the European Agenda on Security, „threats are becoming more varied and more international, as well as increasingly cross-border and cross-sectoral in nature”, therefore, „these threats require an effective and coordinated response at European level” (European Commission, n.d.-a). Examples of criminal acts in cross-border trade and logistics include trafficking in counterfeits, narcotics, explosives, arms, weapons of mass effect, protected wildlife, protected cultural goods, hazardous waste and so forth. Next, to the direct security issues like prospering organised crime groups, terrorist financing, and even human casualties, the negative impacts from trafficking and smuggling to consumers, businesses and societies as a whole include health and safety issues, environmental damages, tax evasion and unfair competition.

In the context of the new Union Customs Code (UCC) of the European Union (EU), customs administrations have a significant responsibility in mitigating these risks across external European borders. Unfortunately, due to the growing trade volumes, the tightening resource constraints, the louder demands for trade facilitation as well as the changing security landscapes – threat and crime areas and topics, criminal modi operandi etc. – the customs administrations are finding

it increasingly difficult to resolve the classic challenge of customs security: how to maintain adequate control over cross-border cargo flows, to protect citizens and societies against criminal and terrorist activities, while still facilitating legitimate commerce? (Grainger & Hints, 2017).

In a context where threats need to be approached in a coordinated manner and at a European level (European Commission, n.d.-a), a consortium of 17 partners (including the 13 customs administrations, N13EC), coordinated by Cross-border Research Association (CBRA), has successfully submitted (in August 2017) a proposal called „Pan-European Network of Customs Practitioners (PEN-CP)”, as part of the EU Horizon 2020 program. As of September 2018, the PEN-CP acts as an innomediary with the aim of building a network, based on the coupled-open innovation concept, between distinct customs administrations, and firms to create an ecosystem for interoperability, knowledge sharing and open innovation.

The vision of the PEN-CP is to facilitate the translation of customs security research and innovation ideas and requirements into scalable, viable solutions, technologies and process improvements that will help European customs administrations to overcome the challenges of the contemporary customs security

b. PEN-CP as an innomediary

Innomediaries are organisations that aim to facilitate the adoption of the OI paradigm by mediating the relationship between two or more parties. In this particular case study, PEN-CP is an innomediary that aims to foster the bridging between firms and customs administrations for a smoother and more successful coupled-open innovation process. As shown in Figure 1, PEN-CP will support the inside-out OI process of N13EC and the outside-in OI process of firms of the security industry sector (including start-ups and scale-ups). Again, such combination of inside-out and outside-in OI is called coupled-open innovation.

The inside-out OI process of the N13EC consists of revealing each customs administrations' internal ideas,

needs and customer value assessment of innovative security products and services, and sharing them among N13EC members. As mentioned earlier, these inputs provided by users (in this case the customs administrations) are valuable for firms; as many literature has evidenced that innovative ideas for new products came from users instead of manufacturers (von Hippel, 2013).

The outside-in open innovation process of the firms consist of accessing the valuable information provided by external parties (in this case the customs administrations acting as users) in order to further develop user's idea on new product and service development.

In other words, as illustrated in Figure 1 below, PEN-CP acting as an innomediary will bridge together the previously disconnected knowledge of the N13EC with the knowledge and expertise of firms located in same and in other geographies. The end goal of this scheme is to facilitate co-development of more accurate, faster performing, and/or cheaper customs security technologies.

c. Main roles and functions of PEN-CP

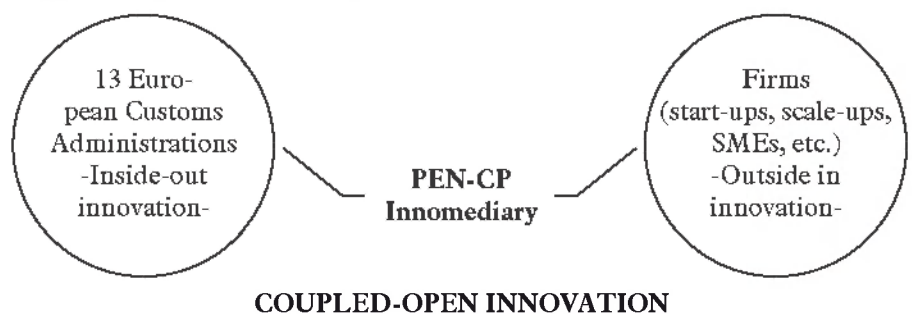
As explained previously, many authors have studied the roles and functions of innomediaries, from various perspectives. Particularly the ten main functions of intermediaries in the field of innovation described by Howells (2006) have been frequently cited (see literature review for the complete list of functions). PEN-CP performs six out of these ten functions:

- *Foresight and diagnostics.* PEN-CP monitors technological innovation

inside and outside the realm of customs security. The objective is to foresee potential use of new technology to fight against illicit trade as well as technology trends that might change the way of doing things in cross-border trade and logistics. Also, PEN-CP provides help in the articulation of needs and requirements for new product development by making a diagnostic of current needs and gaps.

- *Scanning and information processing.* PEN-CP is constantly scanning for information that might be helpful for customs administrations in their tasks. In the next section, the specific services used to scan and record the information will be explained. Such information comes from multiple sources: from social media post to scientific publications. All the raw information is presented as is, also going through a process of selection, filtration and analysis.
- *Knowledge processing and combination/recombination.* The information that is scanned and processed in the previous function is turned into specialized knowledge. In some cases, this knowledge can be obtained by combining different pieces of information from two or more sources. This knowledge can be useful for the interesting parties, namely customs administrations and firms (start-ups, scale-ups, etc.).
- *Gatekeeping and brokering.* PEN-CP helps customs administrations to coordinate their demand. For example, it helps to generate more detailed information about the needs and the requirements of users. With such infor-

Figure 1. Coupled-Open Innovation Between Firms and Customs Administration Supported by an Innomediary



Source: Own elaboration

mation, PEN-CP engages in a process of searching potential solution suppliers. Once one or more suppliers match the corresponding criteria, PEN-CP provides means for interaction between specific user(s) and firm(s). There are some innomediaries that provide further functions of brokering such as negotiation, deal making and even contractual advice for the finalization of the purchasing agreements; however, PEN-CP is limited to bridging solution seekers (N13EC) and solution providers (firms).

- *Testing, validation and training.* PEN-CP plans to implement six “prototype grants” which will field test innovative products or services with potential in customs security (more details about these grants are explained in

the next section). Furthermore, PEN-CP also provides training in different areas, one of them could be training for the use of new technologies that the N13EC deems necessary.

- *Accreditation and standards.* As a piece of technology evolves, standards should be set (Vincent, Niezen, O’Kane, & Starwarz, 2015). In this scenario, PEN-CP develops a standardization roadmap that paves the way for future standardisation ambitions and activities within the customs security domain. Further practical details are provided in the description of the PEN-CP services.

d. PEN-CP services

In this section, we provide a description of the PEN-CP’s innomediary services. However, before continuing with

the description, it is worth explaining the PEN-CP Online Platform based on a Community Management Tool (CMT) provided by ARTTIC company (part of the PEN-CP consortium). The CMT is the online tool used in PEN-CP for most of the services provided by it. Its goal is to generate a user-friendly infrastructure for efficient knowledge management and storage of the data needed for the innovation process. More details about the specific functionalities of the CMT will be described later in this section, according to the services provided by PEN-CP

In total, the authors of this paper have identified ten services. As a reference, Table 1 below matches each PEN-CP innomediary service to one or more roles and functions described in the previous section, which is again based on the taxonomy by Howells (2006). Next, we describe the practical way in which PEN-CP operates and supports the innovation process of customs administrations.

Monitor information from different sources. The PEN-CP Information Observatory (PIO) is the main service used in PEN-CP to monitor continuously information sources in order to identify potentially relevant information items for further processing in the PEN-CP Innovation Funnel (PIF). The sources of information can come from customs administrations (inside and outside the N13EC); other governmental actors (political institutions, police, border guards, patent office etc.); universities and research institutions; technology and service providers (large companies, SMEs, start-ups etc.); and other relevant sources (media, NGOs, civil society etc.). The PIO carries out the first analysis on the observed information items, including news, events, projects, products, organizations, research papers, presentations, product sheets and so forth. Twitter and LinkedIn are examples of channels / platforms used in the monitoring process. Next to publishing a quick analysis on the observed information items, the PIO captures following elements within the information items (when available): PEN-CP User Need Ideas (PUNIs), and/or PEN-CP Security Innovation Monitoring Items (PSIM), and/or knowledge gaps to be

Table 1
PEN-CP services with its corresponding roles and functions

Services	Roles and functions
Monitor information from different sources.	<ul style="list-style-type: none"> • Foresight and diagnostics. • Scanning and information processing.
Collect user innovation ideas and needs from the N13EC.	<ul style="list-style-type: none"> • Scanning and information processing. • Knowledge processing and combination/recombination.
Keep track of promising innovations and developments in the market inside and outside the traditional customs domain.	<ul style="list-style-type: none"> • Foresight and diagnostics. • Scanning and information processing. • Knowledge processing and combination/recombination.
Create a repository of user experiences on products and services.	<ul style="list-style-type: none"> • Knowledge processing and combination/recombination • Testing, validation and training.
Organise expert reports and annual studies to fill knowledge gaps.	<ul style="list-style-type: none"> • Foresight and diagnostics. • Knowledge processing and combination/recombination.
Facilitate the matching and prioritization of needs.	<ul style="list-style-type: none"> • Scanning and information processing. • Knowledge processing and combination/recombination. • Gatekeeping and brokering.
Formulate user requirements.	<ul style="list-style-type: none"> • Foresight and diagnostics. • Knowledge processing and combination/recombination.
Coordinate prototype grants for promising technologies.	<ul style="list-style-type: none"> • Testing, validation and training.
Launch and administer crowdsourcing contests.	<ul style="list-style-type: none"> • Scanning and information processing. • Knowledge processing and combination/recombination.
Organise standardisation roadmap efforts.	<ul style="list-style-type: none"> • Accreditation and standards.

filled using Expert Reports or Annual Study Chapters. Each one of these elements is explained in this section.

Collect user innovation ideas and needs from the N13EC. Customs administrations, as the actual users of a broad range of security technologies and solutions, might have ideas on how to improve current products, or ideas for new products, services or processes that haven't been developed yet by any company. In this scenario, the innomediary collects "PEN-CP User Need Ideas" (PUNI) for improving customs security performance in the context of security technologies and solutions. Customs administrations are able to insert their PUNIs in the CMT platform using a pre-defined template. Once a PUNI has been introduced and stored into the CMT, it will go through a process of refinement and prioritization. This process is done in the PIF (this funnel process will be described also in this section). In practice, customs administration can insert at any time a PUNI; next to it, the identification and storing of PUNIs is promoted/boosted, for example, during annual PEN-CP events. This information is undoubtedly valuable for organisations interested in integrating users' ideas and needs into the planning and designing phase of products, services and processes. The plan is that selected firms could gain an electronic access to a rich set of PUNIs.

Keep track of promising innovations and developments in the market inside and outside traditional customs domain. PEN-CP provides an easy access to a comprehensive catalogue of customs security relevant technology companies, research institutes and their technical products. Such information is stored in the CMT platform as a "PEN-CP Security Innovation Monitoring Items" (PSIMs). Once the information is stored in the CMT tool, it will also go through the PEN-CP innovation funnel (PIF) for further treatment. Next to the obvious benefits for the N13EC, such monitoring can be useful also for firms because they can use PSIMs as a way to be aware of new innovations outside their common competitors as well as finding potential synergies and collaboration with complementary firms.

Create a repository of user experiences on products and services. PEN-CP stores and shares user experiences among the N13EC regarding specific products and technologies that some administrations are already using or in the process of evaluating to do so. In practice, any partner of the N13EC can log-in to the CMT platform and fill out a dedicated user-experience template. This information is posted into the platform and other members of the N13EC can expand with comments and discussions.

Organise expert reports and annual studies to fill knowledge gaps. It is likely that needs for further analysis and knowledge formulation – to complement the outcomes of the (basic) information monitoring – will arise among the N13EC members. The process to define and prioritize such topics is straight forward and fast; the innomediary taking care of all formalities, contracting, quality control and other aspects required to produce high quality expert reports in a fast cycle. Organizing annual studies (or, annual study chapters) – in the broad context of customs security thematic – is another service to meet the new knowledge needs of the N13EC members. Contrary to the expert reports, the annual studies commonly require an active participation in research by one or more of the customs administrations.

Facilitate the matching and prioritization of needs. All PUNIs, PSIMs and expert reports mentioned above will go through the PEN-CP Innovation Funnel (PIF). PIF is the process in which "PEN-CP generates matches and analyses gaps between the security innovations and innovators versus, security user need ideas" (Hintsä, Pontén, & Wong Chan, 2018). Once the matching and gap analysis are performed, the inputs will be prioritized for further development. In practice, the PIF-process has five steps, first one being the input of a PUNI or a PSIM. Each time a PUNI is inserted into the PIF, the innomediary will cross-check if such PUNI can be combined with another previously inserted PUNIs, and, if one or more mergers are possible, the innomediary will proceed with this process. After this cross-check is done, the innomediary will perform a matchmaking

between the inserted PUNI and the previously inserted PSIMs. The objective of this process is to determine if there is already a company that provides a product or service that could satisfy the requirements of the PUNI. If a match is identified, the innomediary will inform the N13EC, particularly the customs administration(s) behind the original PUNI. When a PUNI cannot be matched to any PSIM, the first round of PUNI prioritization kicks in. This prioritization is done inside the CMT by the N13EC. When PUNIs are ranked as high priority, the innomediary will carry out gap analyses. After these analyses are performed, a second round of voting is done, consisting of setting the next actions for those gaps such as developing prototype grants, or standardization roadmap, among others. Regarding PSIMs, when one PSIM is inserted into the funnel, or PIF, the innomediary will firstly enrich the information by further studying the subject. For example, if the name of a technology company is recorded as a PSIM, the innomediary will study the company itself as well as products and services they provide. Once the PSIM is enriched with additional information, it carries the same process as PUNI: the new PSIM is cross-checked with other PSIMs to determine the possibility to combine them. Then, the innomediary will attempt to match the new PSIM with one or more PUNIs, and if there is a successful match, the innomediary will inform the customs administrations (and possibly the involved company). When no matchmaking is possible, the PSIMs will be prioritized by the N13EC, and once the prioritization is made, the high ranked/ potentially promising PSIMs will go through a gap analysis and in some cases, this gap analysis can feed into additional work such as prototype grants.

Formulate user requirements. A user requirement document specifies what the user expects a product or service to be able to do – was it a software module, a technical device, a supporting process, or any other category of products or services. Drafting a high-quality user requirement document, which can be afterwards used for various purposes including for com-

mercial tenders, research and development funding programs, or standardization roadmaps – to name few examples – is time-consuming expert work. PEN-CP as an innomediary prioritizes and selects PUNIs – one or more at a time – in order to develop them into meaningful user requirement documents, typically based on requirements by multiple N13EC administrations. PEN-CP also considers experiences by other governmental agencies – when available – within the serviced of user requirement formulation. Finally, subject to agreements between N13EC administration, user requirement documents may be shared on case-by-case basis with (a subgroup of) the firms, in order to help them to better understand the needs emerging in the customs security markets.

Coordinate prototype grants for promising technologies. Technology grants – coordinated and administered by PEN-CP – is a core service for facilitating technology innovation uptake by the N13EC. Two grants are available per each of the following customs security themes: big data and risk management; detection technologies; and, laboratory equipment. Following an open call for tenders, the selected firms will customise and/or field-test their solutions to match the requirements of two or more partners of the N13EC, exercises financed by the innomediary possessed grants. Depending on the outcomes per grant engagement, further collaborative actions with (successful) firms and one or more N13EC members may follow.

Launch crowdsourcing contests. Crowdsourcing is a way to “leverage the collective intelligence of online communities to serve business goals, improve public participation in governance, design products, and solve problems” (Brebham, 2013). In other words, companies do not have to rely solely on their employees, but actually, they can involve external parties in the generation of ideas, experimentation and problem-solving processes (Surowiecki, 2004). In this scenario, one of the services offered by PEN-CP is to coordinate crowdsourcing contests. In practice, a problem or a topic will be posted through different channels and a timeframe to complete the assignment will be allocated. PEN-CP will receive the propose solutions

and those who are capable of providing the most innovative resolutions will win a monetary prize.

Organise standardisation roadmap efforts. Standardisation roadmap paves the way for future standardisation ambitions and activities within the customs security domain. The underlying rationale for the standardisation roadmap is that it facilitates bridging the gap between the customers’ needs and the available technologies and services in the markets. It can also facilitate joint tendering procurement in the future, between two or more customs administrations. In practice, the content for the standardisation roadmap is triggered by PUNIs, PSIMs, and/or expert reports and annual studies chapters. The innomediary can launch the work for specific standardising items once it has been supported by minimum of three customs administration of the N13EC.

V. Discussion and Conclusions

This paper has described a series of services provided by an innomediary. The case study has revealed that the PEN-CP innomediary services can help customs administration to innovate – noting that not necessarily all services help these agencies to develop their Open innovation process. As shown in Table 1, each of the ten services provided by PEN-CP can be matched to one or more innomediary roles and functions created by Howells (2006). However, these roles and functions of an innomediary are related to any *innovation process* and not exclusively to an *Open Innovation process*.

There are three instances of open innovation, namely: inbound, outbound and coupled open innovation. PEN-CP focuses in supporting the coupled-open innovation process between the N13EC and firms. In a glimpse, it seems that the services provided by PEN-CP are likely to help in the overall coupled-open innovation process, but, further empirical analysis has to be conducted to support this statement. In particular, it is necessary to collect evidence from the firms’ perspective in order to prove that PEN-CP can support their open innovation process.

From the perspective of the N13EC, PEN-CP offers services that can help

to support customs’ inbound and outbound OI process. The services that help the outside-in OI of the N13EC include the following: monitor information from different sources; keep track of promising innovations and developments in the market inside and outside traditional customs domain; launch crowdsourcing contests; and, organise expert reports and annual studies to overcome knowledge gaps. These services support Outside-in OI as they collect and generate information from external sources – information which can later be converted into knowledge, eventually sparking new ideas for customs relevant products and services.

In the case of the Inside-out OI, the single PEN-CP service that promotes this type of OI is the Collection of user innovation ideas and needs from the N13EC. This is the function when the knowledge of the N13EC is collected and later shared with those interested in further developing the ideas or seeking to come up with solutions matching the customs’ needs. PEN-CP also offers services for coupled OI such as the matching between solution seekers and solution providers and the coordination of prototype award grant for promising technologies. These are considered as coupled-OI services as they require customs administration to spill out their knowledge and needs (inside-out OI), while calling for parallel collaboration and expertise of firms or solutions providers (Outside-in OI).

Finally, the PEN-CP innomediary provides also innovation services in general, which are not necessarily linked to the OI concept. For example, helping the N13EC to better articulate user requirements; to create a repository of user experiences on products and services; and to organise standardisation roadmap efforts. These are more in line with additional supportive services for innovation and not directly linked to Open Innovation.

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- 2 Customs administrations from the following 13 countries are beneficiaries of this H2020 networking project: Albania, Austria, Belgium, Estonia, Hungary, Ireland, Latvia, Lithuania, Macedonia, Netherlands, Norway, Slovak, and United Kingdom (note: UK opted to join the network via Home Office/ Border Force entity, which is responsible for goods controls)

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