

Table D.2 Descriptions and examples of functional roles

Theme	Functional role	Name	Description of functional role	Example(s) of relevant innovation model(s) (Source: RAND Research for Frontex and EDA, 2017)
Coordinating requirement identification and setting	1.1	Performing horizon scanning to identify security threats and innovation opportunities	Systematically examining information in order to identify innovation opportunities and potential risks and threats relating to security, the environment and the political climate, which allows for better preparedness and decision making.	US: DHS S&T. S&T provides analysis and recommendations on viable technologies, products and services to advance homeland security capabilities. To do this, DHS draws on horizon-scanning activities and a 'technology scouting' ⁶⁶⁴ process to research and evaluate specific technology landscapes by sifting through global data on technology and market environments.
	1.2	Analysing the operational needs of end users	Engaging end users in research planning in order to help ensure that priorities are set and funds allocated in a way that takes operational requirements into consideration. This input can be captured through various mechanisms, including meetings and an analysis of capability gaps.	US: Science and Technology Resource Allocation Strategy (STRAS). This Strategy facilitates cooperation between S&T and end users through quarterly meetings focused on ensuring that R&D efforts remain focused on operational requirements. US: R&D Integrated Product Teams (IPTs). Within DHS, IPTs are tasked with identifying and coordinating DHS R&D efforts in priority mission areas, linking R&D activities with the work of the DHS Joint Requirements Council to close existing technology capability gaps. US: USCG Idea Submission Review (ISR). The ISR process allows for project ideas to be submitted by USCG member and is used to ensure that USCG research, development, test and evaluation programme (RDT&E) efforts are aligned with operational needs and existing technological gaps. Canada: annual meetings between Public Safety Canada and operational agencies (Canada Border Services Agency, Royal Canadian Mounted Police and Immigration, Refugees and Citizenship Canada)
Providing thought leadership	1.3	Other (please specify)	E.g. harmonising border guard and market requirements.	N/A
	2.1	Conducting research in-house	Participating in research and innovation, whether through actively leading research projects or contributing to research activities in a more secondary, supportive capacity.	US: DHS Science and Technology Directorate (S&T). S&T is the primary organisation for R&D within DHS, with responsibility for the RD&I programme that involves conducting basic and applied research (among other activities, e.g. testing and evaluation). 'Border security' is one of its areas of focus. EU: Frontex. Frontex is tasked to contribute to R&I activities relevant for border control. However, research projects are mainly outsourced and coordinated by its Research and Development Unit (RDU).
	2.2	Influencing policy developments	Providing independent advice and recommendations to key decision makers on innovative means to address future security challenges.	US Defense Innovation Board. Set up in 2016, the Board ⁶⁶⁵ is a 15-member panel introduced in order to 'inject a culture of innovation into the Pentagon'. The mission of the DIB ⁶⁶⁶ is to provide the Secretary of Defense with independent advice and recommendations on innovative means to address future challenges. Proposals put forward include the appointment of a Chief Innovation Officer to serve as a POC for innovation efforts across the DoD, and the creation of a COE for Artificial Intelligence and Machine Learning.
	2.3	Other (please specify)	N/A	N/A
Facilitating information provision and knowledge transfer	3.1	Centralising information on R&I opportunities	Presenting information regarding R&I funding in a consolidated and easily accessible way, e.g. on a single webpage or on an openly accessible database. This can help raise awareness regarding R&I opportunities among research stakeholders, industry representatives and end users, both at the EU and MS levels.	Gap identified by Frontex study interviewees. Study interviewees found that more could be done to facilitate information exchange across MS and organisations involved in border security research, particularly given that there is currently no centralised website or database with information about all border security research activities across the EU and its MS.
	3.2	Sharing information on operational impacts of research	Systematically communicating information on how research results have been integrated into operational practice after the end of each project, e.g. through press releases, briefings and other communications activities. This is aimed at increasing awareness among end users of the operational benefits of EU-funded research.	Gap identified by Frontex study interviewees. While MS participation in EU-funded research remains high, EU MS survey respondents reported that MS often lack access to information regarding project results that could help national border guards integrate these lessons into operational practice.

664 DHS (2016e).

665 Mehta (2016).

666 United States Federal Register (2017).

Theme	Functional role	Name	Description of functional role	Example(s) of relevant innovation model(s) (Source: RAND Research for Frontex and EDA, 2017)
Facilitating information provision and knowledge transfer (cont.)	3.3	Facilitating knowledge transfer	Systematically capturing lessons learned during project implementation and after project completion to build a repository of good practices, as well as inefficiencies, with a view to supporting MS and other relevant authorities in the setup and management of future research and innovation.	Frontex. Through projects, workshops and conferences, the RDU aims to facilitate engagement and exchange of information between border management authorities and providers of research, including research institutes, universities and industry. NATO. NATO has set up a Joint Analysis and Lessons Learned Centre aimed at capturing lessons in a systematic way and, among other activities, manages the NATO Lessons Learnt Portal (NLLP).
	3.4	Delivering training and education for end users	Delivering training for end users on the use of newly developed technologies to support the uptake and operationalisation of tools, technologies and other solutions developed through R&I.	US: DHS COE. COEs are a network of universities conducting research to address homeland security challenges. Among other functions, COEs deliver training, knowledge products and expertise for the homeland security enterprise. ESA. In the EU, the ESA provides education and training for astronauts through its European Astronaut Centre (EAC).
	3.5	Other (please specify)	N/A	N/A
Providing an 'honest broker' function	4.1	Facilitating coordination and cooperation between industry, academia, policy officials and practitioners	Cultivating relationships between research, industry, policy officials and end users in order to help develop greater cross-sector partnerships. This involves moving away from more contractual customer/supplier relationships to an increased focus on innovation in partnership towards a shared endeavour. These relationships would be encouraged by an 'honest broker' organisation, which would also identify opportunities for these partnerships.	EU: Frontex. Through projects, workshops and conferences, the RDU aims to facilitate engagement and exchange of information between border management authorities and providers of research, including research institutes, universities and industry. US: DHS COEs. Funding opportunities for COEs are open to US universities and colleges (encouraged to partner with industry) and are designed to support DHS-specified homeland security requirements.
	4.2	Supporting coordination and cooperation between industry, academia, nations and investors (e.g. venture capitalists)	Supporting innovation by coordinating the actions of third parties, rather than by directly funding or performing the work. For example, facilitating regular interactions among the members of the private venture capital community, small innovative companies and end users.	US: Defense Venture Catalyst Initiative (DeVenCI). DeVenCI supports R&D by coordinating the actions of third parties, rather than by directly funding or performing the work. DeVenCI facilitates regular interactions among the members of the private venture capital community, small innovative companies. DeVenCI has focused on facilitating the purchase of field-ready products and services by DoD, rather than on the discovery and development of new capabilities.
	4.3	Other (please specify)	E.g. delivering support to industry to assist them in taking their innovations to market.	N/A
Hosting innovation	5.1	Running technology demonstrations	Presenting a prototype or incomplete version of a future system, put together as proof of concept with the purpose of showcasing the possible applications, feasibility, performance and method of a new technology. Demonstrations can be run for potential investors, researchers or end users in order to test the technology and convince these stakeholders of the viability of the chosen approach. It also presents an opportunity to gather end user feedback and make adjustments to the prototype or concept to better deliver value to end users and increase the probability of successful commercialisation.	EU: H2020. The <i>Treaty on the Functioning of the European Union</i> (TFEU) states that implementing research and technological demonstrations should be conducted in order 'to achieve a European research area'. Demonstration of research products often takes place at the end of H2020 (and FP7) projects. Canada: Technology Demonstration Program (TDP). ⁶⁶⁷ Launched in 2013 and managed by Innovation, Science and Economic Development, the TDP funds 1+ large-scale R&D projects per year, with a focus on conducting industrial research and technology demonstration.
	5.2	Running prize competitions or 'grand challenges'	Running innovation competitions to encourage industry experts to attempt to solve innovation challenges. By offering financial or other incentives ('prizes'), these initiatives can help entrepreneurs grow their business ideas, connect them to investors and global markets, and strengthen their innovative capabilities for the benefit of industry, end users and wider society.	US: DARPA Grand Challenges: a cash prize competition for US autonomous vehicles, funded in 2004 and 2005 by the Defense Advanced Research Projects Agency – the most prominent research organisation of the US DoD. Other DARPA prize challenges include: Urban Challenge (2007), Network Challenge (2009), Chikungunya Challenge (2014–15) and Robotics Challenge (2012–15).

667 Government of Canada (2017).

Theme	Functional role	Name	Description of functional role	Example(s) of relevant innovation model(s) <i>(Source: RAND Research for Frontex and EDA, 2017)</i>
Hosting innovation (cont.)	5.3	Launching an innovation incubator	Hosting an innovation 'incubator' or 'hub' on an organisation's premises, which can strengthen innovative capacity by bringing together key stakeholders from academia, industry and end users and by offering skills training and key infrastructure (e.g. labs, IT tools). An incubator can also be virtual (i.e. run online).	NATO Cyber Incubator. Launched in 2015, this 'incubator' is a pilot project to test ways of strengthening pre-competition cooperation between industry (including SME), academia and NATO's technical community into defining challenges and investigating innovative solutions for cyber defence. Activities include demonstration projects, discussion forums and interactive workshops.
	5.4	Other (please specify)	E.g. a science park (also called a 'university research park' or 'science and technology park'), which is located in close physical proximity to universities, government and private research bodies in order to share knowledge and promote innovation.	N/A
Facilitating access to funding	6.1	Providing direct R&I funding	Providing grants, subsidies, subsidised loans and equity financing for R&D, often (although not always) offered on a competitive basis. Non-competitive funding can also be offered through, for example, sole source mechanisms where the funding is intended for a unique technology or where it has to be allocated within a short timeframe.	EU: Horizon 2020 (H2020): the largest EU R&I programme, with around €80bn of funding available over seven years (2014–2020), with €73m available for border security research projects in 2014–2015 under 'Secure Societies'. EU: Frontex-funded research. Frontex has funded research projects since 2009, with annual funding increasing from 2009 to 2015. These projects are mainly outsourced and coordinated by Frontex's Research and Development Unit (RDU). US: Department of Homeland Security (DHS) Centers of Excellence (COE). COEs are a network of universities conducting research to address homeland security challenges. Among other functions, COEs award research funding (e.g. recent funding opportunity ⁶⁶⁸ announced by the Borders, Trade and Immigration Institute (BTI)). There are currently 12 centres, 10 of which are active, with each focused on a unique homeland security need.
	6.2	Facilitating access to available funding instruments	Raising awareness on how to access EU funding opportunities. For each funding programme, this involves providing details regarding its purpose, activities, timeframe, budget, eligibility, and application process.	European Defence Agency (EDA) ⁶⁶⁹ . The EDA aims at raising awareness across the European Defence Technological and Industrial Base on how to access EU funding opportunities, with a particular focus on European Structural and Investment Funds, the new EU COSME (Competitiveness of Enterprises and SMEs) Programme and H2020.
	6.3	Using procurements to 'pull' innovative solutions from the market	Providing funding for R&I projects designed to address short-term, high-priority end user requirements that need to be addressed quickly.	US: Rapid Innovation Fund (RIF). Provides a collaborative vehicle for small businesses to provide DoD with innovative technologies that can be rapidly inserted into acquisition programs that meet specific defence needs. Administered by the Office of the Secretary of Defense (OSD) Assistant Secretary of Defense for Research and Engineering (ASD R&E) and Office of Small Business Programs (OSBP).
	6.4	Other (please specify)	E.g. debt-sharing schemes (which encourage innovation by reducing the risk to lenders and investors, e.g. through partial cover of losses).	N/A

Table D.3 Qualitative assessment criteria

Criterion	Definition
Feasibility	The ease with which Frontex can implement each option ⁶⁷⁰ in practice
Impact	How far each option will increase the likelihood of research and innovation improving operational practices
Stakeholder appeal	The attractiveness of each option to key stakeholders with decision-making power and access to resources

668 DHS (2017).

669 EDA (2017).

670 At the external stakeholder workshop, 'functional roles' were referred to as 'options'. In Appendices D and E, the use of the term 'option' refers to the functional roles described throughout the main report and elsewhere in this Technical Annex.

Table D.4 Quantitative scoring metrics

	1	2	3	4
General definition	Very low	Quite low	Quite high	Very high
Feasibility	Very low feasibility, i.e. it would be almost impossible to implement the option.	Quite low feasibility, i.e. the option would require major changes for it to be implemented.	Quite high feasibility, i.e. the option would require minor changes for it to be implemented.	Very high feasibility, i.e. the option is readily implementable.
Impact	Very low impact, i.e. the option will not increase the likelihood of research and innovation improving operational practices.	Quite low impact, i.e. the option is fairly unlikely to increase the likelihood of research and innovation improving operational practices.	Quite high impact, i.e. the option is likely to increase the likelihood of research and innovation bringing minor improvements in operational practices.	Very high impact, i.e. the option is likely to increase the likelihood of research and innovation bringing major improvements in operational practices.
Stakeholder appeal	Very low stakeholder appeal, i.e. the option is highly unlikely to attract the support of key stakeholders.	Quite low stakeholder appeal, i.e. the option is quite unlikely to attract the support of key stakeholders.	Quite high stakeholder appeal, i.e. the option is quite likely to attract the support of key stakeholders.	Very high stakeholder appeal, i.e. the option is very likely to attract the support of key stakeholders.

Box D.1 Frontex's mission statement

What role should Frontex be playing in the field of research, development and innovation for border security? What do you see as being the added value of Frontex in this field?

In answering the first part of the question, please consider what Frontex should (1) continue to do, (2) stop doing, (3) start doing, or (4) do differently in the context of research, development and innovation.

Appendix E: Frontex workshop summary

This appendix provides an overview of the stakeholder workshop held on 5 September 2017, before summarising the discussions that took place. Relevant reference materials, including the tables of functional roles and a description of the scoring approach applied at the workshop, are presented in Appendix D.

Workshop overview

On Tuesday 5 September 2017, RAND Europe organised a workshop at Frontex to assess various options⁶⁷¹ for the establishment of a Frontex-led R&I platform. There were approximately 28 participants in attendance throughout the day. The majority of the participants were MS representatives from border guard agencies. Other participants included representatives from Frontex and the European Commission.

The workshop opened with a brief overview of the study and workshop objectives. Participants were then divided into three groups for sessions one and two. Session one, 'Functional options for a Frontex-led R&I platform' involved participants developing a mission statement for a Frontex-led R&I platform and assessing a set of functional roles through qualitative discussion.⁶⁷² In session two, 'Ranking of functional options', participants were asked to rank the functional roles according to their 'feasibility'⁶⁷³ and 'impact'.⁶⁷⁴ Session three, 'Challenges, opportunities and practical considerations', summarised the main discussion points and the preferred functional roles of each group.

⁶⁷¹ Functional roles are also referred to as 'options' in Appendices D and E (see previous footnote).

⁶⁷² Functional roles are outlined in Table 1.

⁶⁷³ 'Feasibility' was defined as 'the ease with which Frontex can implement each option in practice'.

⁶⁷⁴ 'Impact' was defined as 'how far each option will increase the likelihood of research and innovation improving operational practices'.

Summary of discussion

While functional roles scored highly across the board, some roles scored more favourably than others. However, it should be noted that participants tended to conflate 'familiarity' with 'feasibility', in that they often gave high feasibility scores to those roles that they were particularly familiar with.⁶⁷⁵

The first theme, requirements and identification setting, and its two functional roles, 'perform horizon scanning to identify security threats and innovation opportunities' (1.1) and 'analyse the operational needs of border guards' (1.2), were highly rated. Regarding thought leadership, there was divergence in opinion between participants. Role 2.1, 'conducting research in-house', was poorly received by participants. They agreed that Frontex should not develop tools or technologies, but instead it should leverage its existing knowledge from external research outputs. Based on this, participants said that Frontex could create knowledge, risk analyses and overviews of past and current work. However, participants found the 'influencing policy developments' role (2.2) feasible and impactful, stating that by having an influence on policy developments, Frontex could better help connect operational needs with the European Commission policy context. Participants also said that having Frontex in that role would help Frontex spend money more effectively as they have an in-depth understanding of border security research.

Under information sharing, participants stated that convening expertise and disseminating findings is very important for Frontex and can help avoid duplication of project work. They also said that it was good for Frontex to know

⁶⁷⁵ It should be noted that the numbers in this appendix correspond to the updated numbering of functional roles, as presented in Appendix D.

experts in MS conducting these projects, and to continue to build relationships with them. Participants also felt that Frontex could offer help with procurement procedures, for example by providing a checklist. Role 3.1, 'centralise information on R&I opportunities', was highly rated – particularly on feasibility – as participants felt that if this entailed the creation of a database it would not be too difficult to implement. Regarding role 3.2, 'share information on the operational impacts of research', opinion was divided. While impact was highly rated, feasibility scores ranged between 2 and 4.

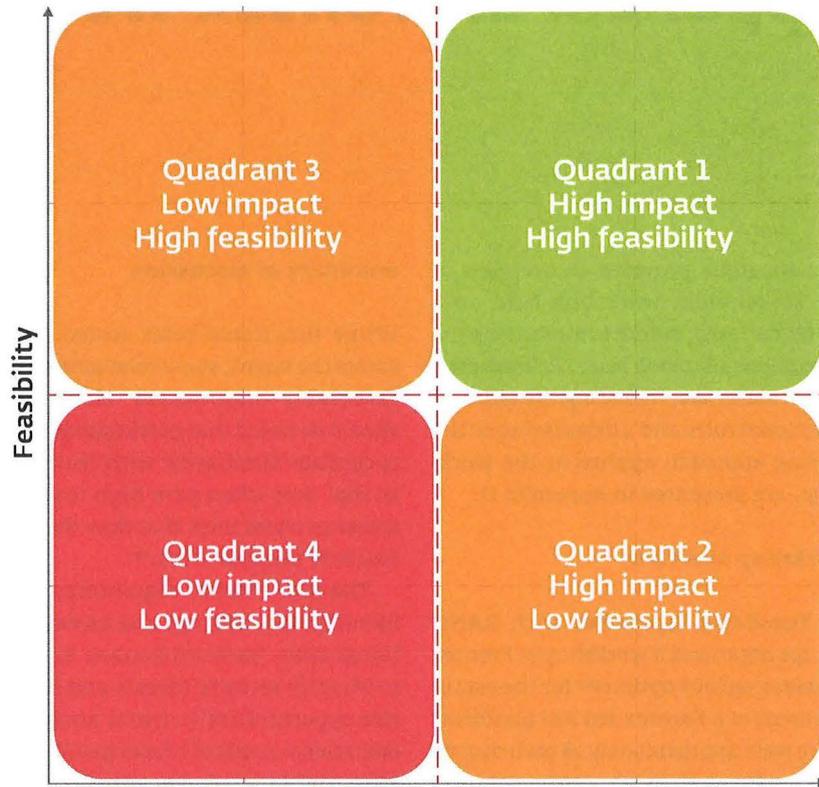
'Deliver training and education for MS border guards' (role 3.4) was highly rated overall. While some participants stated that industry should be undertaking product training and education as they develop the technology, the participants suggested that Frontex should also provide baseline training. Other participants said that Frontex could help MS with the testing of border security technologies and also help ensure that the output meets end user needs. Participants said training is already being delivered and its impact is high. Role 3.3, 'facilitate knowledge transfer', received mixed scores: while feasibility was high, views on impact varied, as participants stated that this depended on MS knowledge and priorities.

Under the honest broker theme, participants gave high ratings to the two functional roles, 'support coordination and cooperation between industry, academia, nations and investors (e.g. venture capitalists)' (4.2), and 'facilitate coordination and cooperation between industry, researchers, policy officials and practitioners' (4.1). Participants agreed that Frontex needs to play the role of a convenor and communicator. The groups said that while Frontex fulfils this requirement already, there is a risk of Frontex being solicited directly by industry and becoming disconnected from the needs of MS.

Participants noted that hosting innovation should be focused on the specific needs of MS and end users. While role 5.1, ‘run technology demonstrations’, scored highly on feasibility and impact, roles 5.2 and 5.3, ‘host prize competitions’ and ‘launch an innovation incubator’, scored poorly in comparison. One reason given by participants was that ‘prize competitions’ and ‘innovation incubators’ are not Frontex’s core business. Another reason related to logistical issues, for example the possibility that a jury would need to be set up to assess the competition, and that MS may not want to share new developments more widely.

Regarding funding, participants broadly saw Frontex as a coordinator and facilitator to help MS find new funding. Participants rated role 6.1, ‘provide direct R&D funding’, quite highly. Role 6.2, ‘facilitate access to available funding instruments’ was also seen as important, with suggested ways of improving this including the creation of a website and more proactive dissemination of information to MS (e.g. through newsletters). Participants noted that to deliver these tasks, Frontex would need to invest in human resources to identify and disseminate information, and also to work closely with the European Commission to obtain information early on. They also pointed out that not all MS would be eager to share the results of their projects. Regarding role 6.3, ‘use Frontex procurements to ‘pull’ innovative solutions from the market’, some participants felt that this overlooked the fact that MS need tailor-made solutions to respond to their unique context and border challenges.

Figure E.1 Matrix of functional roles



Overall, the matrix (see Figure E.1) showed that participants saw most functional roles as having high impact and high feasibility for a Frontex-led R&I platform. In particular, information sharing, influencing policy developments, being an honest broker, providing training and education, and requirements identification and setting all were ranked highly by participants. Participants appeared to place less importance on Frontex being directly involved in conducting in-house research; rather, they felt that Frontex should focus its efforts in this area on leveraging research conducted externally.

Questions and comments

According to one participant, the reason why grand challenges scored more poorly than other functional roles could be due to a lack of familiarity. This participant observed that grand challenges can be very impactful, can incentivise the involvement of small- and medium-sized enterprises, and can be an indirect way of stimulating the market and creating new ideas. According to the participant, grand challenges can also help to develop certain products and technologies faster and with lower budgets, as well as setting a baseline for future research.

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