securing a military advantage over partners and allies (i.e. sought in order to ensure a degree of specialisation and therefore a niche added value in the context of an alliance or military coalition) and adversaries and rivals (i.e. using technology to serve as a deterrence and/or to overcome military-technological symmetry or parity). Finally, some **military planners resist a high degree of standardisation for fear that it will diminish security of supply** by increasing in some cases the military's dependence on a single supplier (or a small supplier group). As Sandler and Hartley point out, in some cases a 'diversity of weapons and forces is needed as an insurance against the failure of standardized weapons and to meet the variety of future unknown and unknowable threats' (1999: pp. 207-208).

3 EU and NATO approaches to standardisation

The objective of this chapter is to provide a clearer understanding of EU and NATO approaches to armaments standardisation. As will be made clear, both organisations employ a voluntary and non-binding approach to the adoption of hybrid standards. As has been made clear by Molas-Gallart and Hawkins, while standardisation can occur through legal fiat or protracted common use, international organisations have tended to employ a negotiated and voluntary method of enhancing standardisation (1999: p. 5). Of course, any discussion of how the EU and NATO respectively approach armaments standardisation has to take into consideration the different memberships and structures of each organisation. In NATO, for example, it has been shown that the quest for a common benchmark for armaments standardisation based on military requirements such as lethality is greatly influenced by the US (Ford, 2017: p. 139). By contrast, standardisation efforts in the EU are not affected by a single military hegemon such as the US and supranational institutions such as the European Commission and standardisation bodies play an important role. Finally, despite the differences embodied by each organisation it should be stressed that there are no 'Chinese walls' between the EU and NATO and each organisation is able to learn from and influence the other in policy areas such as armaments standardisation (Fiott, 2017b: p. 410).

3.1 EU

Armament standardisation in Europe is not a new phenomenon. From 1993 to 2004, the Western European Armament Group (WEAG) dedicated its time and resources to increasing the harmonisation of requirements for equipment. Relatedly, armaments standardisation has also long been on the agenda of the European Commission. For example, in 1997 the Commission published a Communication on 'Implementing European Union Strategy on Defence-Related Industries', which stated that '[s]etting up a European defence equipment market and consolidating Europe's defence industrial base will call for an effort to rationalise the sets of standards currently being used by the defence ministries of the Member States' (European Commission, 1997: p. 19). Interestingly, even in the late 1990s the European Commission recognised that '[w]ith increasing use being made of dual-use technologies in the military systems, the current trend is to make as much use as possible of civil standards' (*Ibid.*). On this basis, the Commission proposed three lines of action: i) inviting industrial circles to draw up a work programme for identifying standards; ii) a regular exchange system on standards between the EU and NATO; and iii) providing Commission support to standardisation organisations while incorporating the specificities of the defence sector (*Ibid.*: p. 20).

Following a study commissioned in 1999 (the so-called 'Sussex Study'), the European Commission pushed for greater standardisation efforts within the EU. One of the major conclusions and recommendations from the Sussex Study (see Recommendation 16) was that the EU should work with ESOs to develop a 'European Defence Standardisation Handbook' (Molas-Gallart and Hawkins, 1999: p. 308). The Commission took on board this suggestion and developed a Handbook on defence procurement that identified and compiled more than 10,000 relevant standards in specific technical domains. However, despite the creation of the Handbook the Commission soon turned towards ways in which standards could be taken up by Member

States. Indeed, in its 2007 Strategy for a Stronger and More Competitive European Defence Industry, the Commission stated that in order to overcome fragmentation of the European defence market by reduced barriers to cooperation and avoiding wasteful R&D, it is necessary to 'promote the use of common standards to facilitate the opening up of defence markets' (European Commission, 2007: p. 6). This focus, and the maturation of the Handbook, saw the Commission transfer the initiative over to the EDA in June 2011. The Agency further developed the Handbook as an online database called the European Defence Standards Reference System.

The EDSTAR database sat alongside another EDA initiative that had been developed in 2007 called the European Defence Standards Information System. As web-based platforms, the idea behind both EDSIS and EDSTAR is to exchange information on defence standards, to allow stakeholders to advertise relevant standards, to promote networking among these stakeholders and to effectively utilise published standards. The key difference between EDSIS and EDSTAR is that EDSIS lists existing standards and it gives stakeholders the opportunity to amend existing or volunteer new standards, whereas EDSTAR is a platform that assists stakeholders implement and use existing standards. Since 2007, **EDSIS has recorded 147 published defence-relevant standards and 89 standards are still active** – of these 89 active standards, 20 are brand new whereas the remaining 69 are revisions of existing standards. The standards registered in EDSIS range from a basic standard for cables and insulated wires to packaging for ammunition and explosives to standards for methanol fuel cell systems (European Defence Agency, 2018a).

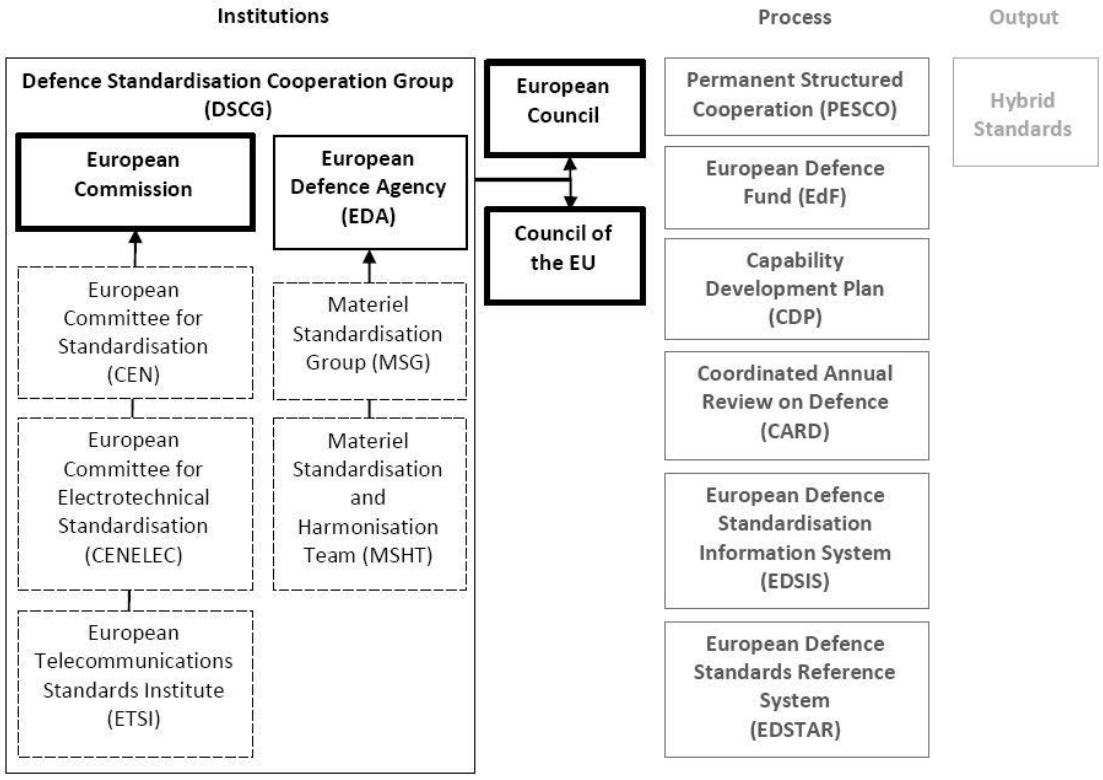
While the EDA does not develop defence standards itself, the **EDSTAR platform currently lists more than 2 400 defence-relevant standards** ranging from high-resistant paints and varnishes to electrotechnical vocabulary (European Defence Agency, 2018b). As part of the EDSTAR initiative, the EDA's participating Member States sit in the Materiel Standardisation Group (MSG) format and the group is chaired by the EDA's Armaments Director. The MSG oversees the state of play of defence standardisation in an EU context and it has the opportunity to make new standardisation requests and proposals (European Defence Agency, 2012). EDSTAR is organised according to various technical domains including ammunition; armoured land vehicle technology; camouflage; electrical interfaces; electromagnetic environments; life-cycle project management; military airworthiness; and many more (European Defence Agency, 2018c). Finally, to aid the Agency's work and to assist with the efforts of the MSG, there is an in-house body within the EDA called the Materiel Standardisation Harmonisation Team (MSHT), which provides advice and expertise to ESOs on defence standardisation.

After the commissioning of the 'Sussex Study' and the development of the defence standardisation handbook, the European Commission continued to develop a number of policy and legal instruments designed to enhance armaments standardisation. For example, following the adoption of the directive on defence procurement (see 2009/81/EC) in 2009, the European Commission made clear in recital 38 of the directive that the **use of standards and technical specifications are to be considered a precondition for defence procurement tenders**. According to the Commission, the use of standards is a way of overcoming 'incompatibility or disproportionate technical difficulties in operation and maintenance' (see Recital 51) (European Commission, 2009: p. 82). In particular, the Commission makes clear that '[t]echnical specifications shall afford equal access for tenderers and shall not have the effect of creating unjustified obstacles to the opening up of procurement to competition' (see Article 18.2) (European Commission, 2009: p. 95). In this respect, the Commission sees the defence procurement directive as a way to enhance armaments standardisation by challenging the principle of national discrimination during defence contract tendering. Furthermore, the purpose of Directive 2009/43/EC on **defence equipment transfers is designed to provide the market conditions for greater standardisation while maintaining a level playing field in the European defence market**. The European Commission has long been an advocate for the use of civil standards in defence because it believes the use of civil standards creates economic

efficiencies. Indeed, the EDA has concluded that the 'product cost savings following a more intensive use of civil standards by the military sector range from 10 % up to 50 %' (European Defence Agency, 2015a).

Building on this logic, on 24 July 2013 the Commission released a Communication spelling out how Europe could head towards a more competitive and efficient defence and security sector (see COM(2013) 542 final). In the Communication the Commission makes clear that it will develop a defence industrial policy based in part on developing hybrid standards to 'benefit security and defence markets' (European Commission, 2013a: p. 4). The Communication shows how most 'standards used in EU defence are civilian' but where '**specific defence standards are required they are developed nationally, hindering co-operation and increasing costs for the industry**' (European Commission, 2013a: p. 8). On this basis, the Commission stated that one of the action points derived from the Communication is to promote hybrid standards for Chemical, Biological, Radiological, Nuclear and Explosive materials (CBRNE), RPAS, airworthiness, data sharing, encryption and critical information communication technologies. Another relevant action point refers to certification and the Commission's pledge to build on the experience of EASA and its role in certifying the A400M aircraft (European Commission, 2013a: pp. 8-9).

Figure 6 – EU standardisation institutions, processes and outputs



The Commission's planned actions were further amplified following the 20 December 2013 European Council summit on defence. During the summit the EU heads of state and government endorsed the Commission's and the EDA's positions that '[d]eveloping standards and certification procedures for defence equipment reduces costs, harmonises demand and enhances interoperability' (European Council, 2013: p. 9). Following these conclusions, **the EDA and the European Commission were tasked to develop hybrid standards for defence** and the two institutions agreed to do this in cooperation with CEN, CENELEC and the ETSI. As a first step in developing these hybrid standards, each of these organisations decided to form what is called the Defence Standardisation Cooperation Group (DSCG) in order to give more structure and focus to the EU's efforts (see Figure 5). Formerly known as the CEN-CENELEC Stakeholder Forum for Defence Procurement Standardisation (SFDPS), the DSCG does not develop standards itself but it aims to be the single interface between industry, governments and militaries in Europe. The second step was deciding on

what areas the DSCG would focus on and a collective decision was taken to concentrate on four specific technical areas including defence shields, impulse noise from military weapons, explosives and pyrotechnics and hearing protection (European Defence Agency, 2015a).

A year later in 2014, the Commission published yet another Communication calling for 'A New Deal for European Defence' (see COM/2014/0387) in which it reaffirmed its commitment to armaments standardisation. Here, it set down a roadmap for a competitive defence industry based on greater standardisation and certification in the areas of MIS and RPAS (European Commission, 2014b). By announcing that it would launch these two pilot areas as case studies to display the added-value of hybrid standards, the Commission set in motion a process that would see the DSCG begin to focus on tangible results. To this end, the Commission's 2015 progress report on its defence roadmap highlighted how the **Commission had been carefully studying the role of the EASA in relation to civil aviation standards and their possible application to the defence sector**. EASA was established in 2002 as an EU agency to promote the use of aviation standards and to certify and approve products and organisations in areas such as airworthiness (see more below). In fact, the Commission used its progress report to state that 'recent submissions by the industry of applications for EASA certification of dual-use [RPAS] show that EASA in close cooperation with the Commission and the Member States has a significant contribution to make in this domain' (European Commission, 2015b: p. 11).

3.1.1 European Aviation Safety Agency

Given the importance the European Commission has placed on EASA in its role in certifying military aircraft such as the A400M, it is worth also considering in more detail the role played by the Agency. EASA deals with a broad range of standardisation and certification initiatives in the civil sector and it has a growing role in discussions about the certification of RPAS. Established in 2002, EASA has a specific mandate to ensure that EU citizens and the environment are protected in the domain of aviation. In particular, the Agency serves as the EU's central regulatory and certification body and it works with Member States and national authorities towards the efficient functioning of an internal single market for aviation. EASA also works with international organisations too and it has representation offices in Montreal, Canada, Washington DC, US, Beijing, China and Singapore. More specifically, **EASA is the EU Agency responsible for certifying and approving aircraft systems for safe use in European airspace**. The Agency also works with Member States and partners to support efforts on air operations and air traffic management, to draft aviation safety legislation, provide technical advice to the Commission and Member States, and, importantly, it has the task of promoting the adoption and use of European aviation standards within Europe and on a global basis (European Aviation Safety Agency, 2018). In this respect, it has been argued in the academic literature that EASA is a part rule-making, part enforcement agency that has substantial authority when it comes to setting safety and environmental standards (Schout, 2008: p. 262).

EASA has a specific approach to certification and standardisation. Primarily, EASA works with Member States to implement EU aviation legislation uniformly and effectively. In this regard, the Agency is responsible for certifying aircraft and it does this by issuing different types of certificates including a type-certification of aircraft and its main components (e.g. engines and propellers) and a restricted type-certification for the pre-certification phase. In order to certify an aircraft on the basis of design and performance, **EASA works with national authorities to oversee the testing of aircraft and it is responsible for approving aircraft maintenance and training organisations too**. The Agency is also responsible for registering technical amendments to aircraft and parts that have been altered after EASA certification (e.g. following a technical modernisation process). While some scholars have argued that the EASA finds it difficult to enforce EU legislation because of a high degree of dependence on the Commission and the Member States, it is has been acknowledged that EASA does play an important role in mutual learning processes among national regulatory authorities and in certifying aircraft types (Groenleer, Kaeding and Versluis, 2010; Schout, 2008).

In terms of its potential importance to armaments standardisation, EASA has gained valuable experience and expertise in certifying air systems for integration into European airspace. This can be observed in relation to EASA's certification of the Airbus A400M aircraft. The A400M is a quadruple turboprop plane that can conduct missions such as strategic airlift (i.e. the delivery of heavy cargo loads such as weapons systems and equipment), tactical airlift (i.e. the transportation of troops and goods) and air-to-air refuelling. According to Airbus, there is currently a total of 63 A400M aircraft in operation (Airbus, 2018). EASA's certification of the A400M's four TP400-D6 engines in accordance with safety and environmental protection standards is **the first time that a military engine has been fully civil certified** (Europrop International, 2018). EASA first certified the A400M in April 2012 with what is called a Restricted Type Certificate (RTC). In accordance with Regulation (EC) 748/2012, an RTC means that EASA grants design approval for aircraft following registration with competent national authorities. When an RTC is issued by EASA, it is confirmed that the aircraft complies with adequate safety and environmental protection standards. In the case of the A400M, the RTC phase included certification of the TP400-D6 engine and propellers (European Commission, 2012). Full certification was approved in March 2013 following over 300 hours of flight testing to demonstrate to EASA that the aircraft was compliant with civil airworthiness and environmental requirements and standards.

EASA's approach to certification is therefore based on rigorous flight testing to assess flight functioning and reliability. Civilian certification of the A400M by EASA now serves as a base line for the certification of the A400M for military aviation purposes, and it is for this reason that EASA's certification of the aircraft is of interest to other areas of aviation standardisation – including RPAS. EASA's military certification of the A400M is challenging given that the aircraft will need to be certified by various national authorities to ensure that the aircraft corresponds and adheres to their particular military certification and qualification requirements (European Aviation Safety Agency, 2013). In this respect, the steps taken towards **the full certification of the military A400M by EASA is seen as a litmus test of improving military airworthiness in the EU** and for relations between an EU Agency such as EASA and national aviation authorities. Finally, the EASA's role here is being viewed through the prism of cost effectiveness as without the Agency the need for multiple national certifications would increase the cost of airworthiness in Europe.

3.2 NATO

NATO has a long history of developing armaments standards among its allies. The alliance began working on standardisation in 1951 when it created the Military Standardisation Agency (Schmidt, 2014; see also DeVore, 2015: p. 176). It is for this reason that the alliance can claim more direct experience with developing armaments standards than the EU. Indeed, the alliance has developed and promulgated STANAGs since at least the late 1970s. The STANAGs are NATO standards related to technologies, components, procedures, doctrines and concepts. **More than 1,200 STANAGs have been promulgated throughout and by NATO** (NATO, 2017b). The STANAGs provide for operational and technical standards for some or all alliance members with the objective being to enhance NATO interoperability. Therefore, while NATO allies own and utilise different weapons systems the STANAGs are designed to provide for a minimum level of interoperability between systems and the interchangeability of replacement components. Overall, NATO develops armaments standards in three main ways:

- NATO Standardisation Agreements (STANAGs): as mentioned, STANAGs are documents whereby allied members agree to fully or partially implement a standard for the purposes of interoperability in any given operational, capability and/or industrial domain;
- NATO Standardisation Recommendations (STANRECs): STANRECs are documents which specify standards from NATO and/or non-NATO sources that could be used for a specific system or component by NATO allies; and

- Allied Publications (APs): APs are official standardisation documents that usually accompany STANAGs and/or STANRECs and which authorise the use of a standard based on the consent of several or all NATO allies. Occasionally, APs will serve as the basis for Multinational Publications (MPs) so that non-NATO states can make use of NATO standards too without a breach of confidential information.

Without having led to the complete standardisation of systems, the STANAGs are non-binding and flexible enough to allow for three sorts of standardisation including, *compatibility*, *interchangeability* and *commonality* (Dittmer, 2017: p. 85). Each of these forms of standardisation applies to operational and administrative procedures and armaments. Additionally, each of these objectives represents a different degree of standardisation with *compatibility* representing the lowest form and *commonality* the highest level. NATO's organisational procedures for adopting standards involve multiple stakeholders (e.g. governments, militaries, industry) in a process that begins with the identification of a standardisation at the higher level of political authority. The process then continues with the technical work on the standardisation through specialised NATO bodies.

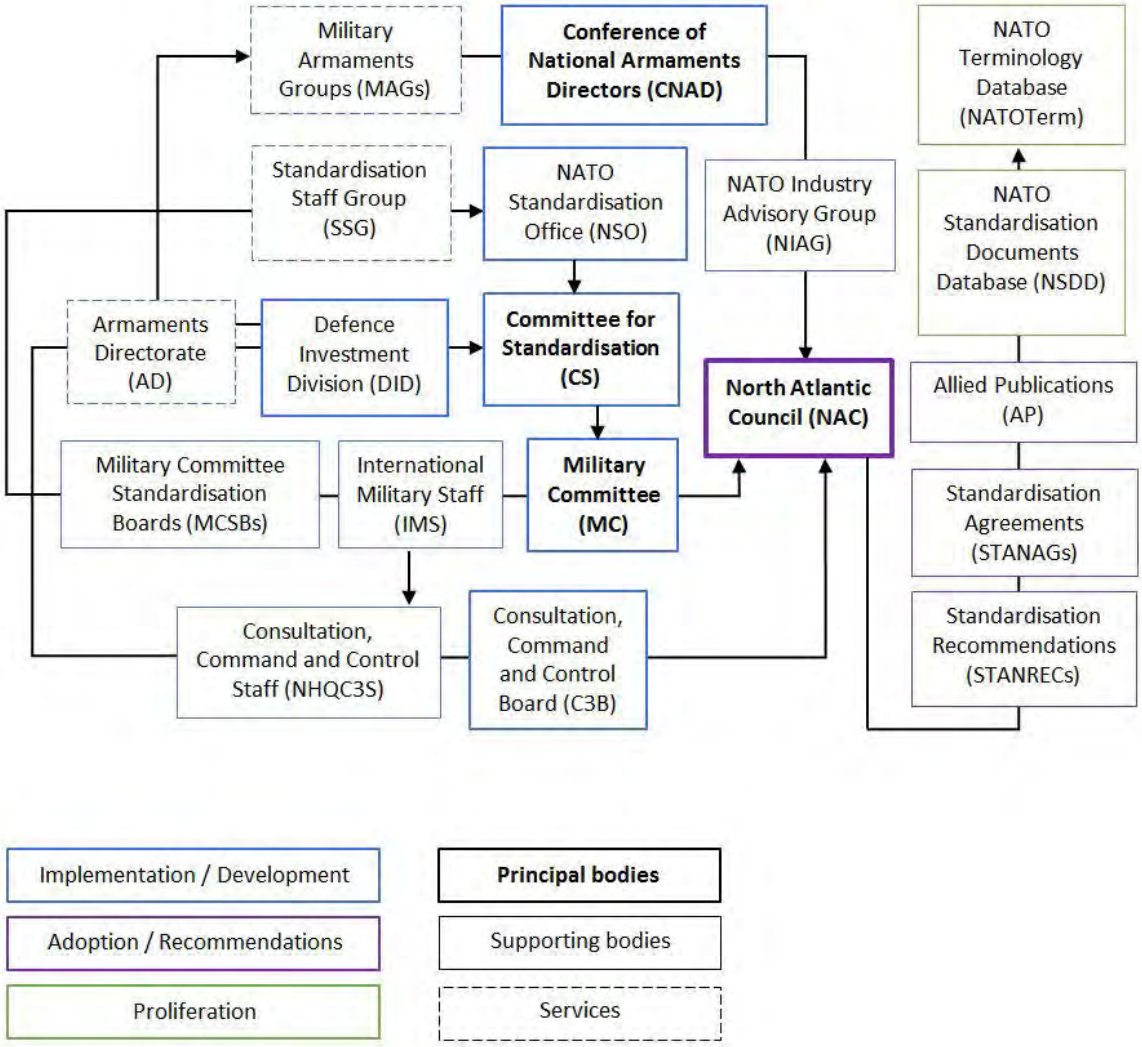
The NATO definition of a standard is 'a document, established by consensus and approved by a recognised body, which provides for common and repeated use, rules, guidelines or characteristics for activities or their results aimed at the achievement of the optimum degree of order in a given context' (NATO, 2017a). Such a definition has guided NATO efforts to enhance allied interoperability. In this regard, NATO standardises in three main areas or ways: *management*, *operations* and *materiel*. 'Management standardisation' centres on the development of rules, policies and regulations through the adoption of common terminology. 'Operational standardisation' focuses on doctrine, training and logistics. 'Material standardisation' involves the development of standards for research, testing, development, production, procurement and life cycle management (Schmidt, 2014: p. 5). It is important to note that **NATO has no sanctioning mechanism for allies who choose not to adopt and use the STANAGs**. The alliance's work in encouraging the proliferation and use of NATO standards is focused on networking, the sharing of best practices from operations and armaments production and consistent awareness raising at the highest political level.

The alliance has a proven set of institutions and bodies that deal with the question of armaments standardisation (see Figure 6). Located at the higher political echelons of NATO, the Committee for Standardisation (CS) plays a lead role in developing and adopting NATO standards and for working with civil standards. In essence, the Committee guides all of the alliance's work on standardisation and it provides guidance to all relevant NATO bodies and agencies. Created in 2001, the CS is composed of 29 senior representatives (and more than 30 partner countries through NATO's 'Interoperability Platform') from all NATO allied member countries and it answers directly to the North Atlantic Council (NAC). The Committee meets at least twice a year and it produces annual reports for the NAC. The CS is chaired by the NATO Secretary General and two permanent co-chairs deal with the day-to-day administration of the Committee: the co-chairs are the Deputy Chairman of NATO's Military Committee (MC) and the Assistant Secretary General for Defence Investment (NATO, 2015).

In addition, to these bodies the alliance draws on the expertise of the NATO Standardisation Office, which, since 2014, has pursued day-to-day work and progress on standards within the alliance. Formerly known as the NATO Standardisation Agency, and operating under the direct authority of the CS and the supervision of the MC, the NSO presides over the alliance's standardisation databases (known as the NATO Standardisation Documents Database (NSDD) and the Terminology Database (NATOTerm)) and it serves as a networking mechanism between stakeholders from allied governments, militaries and industry on all aspects of defence-relevant standards. A core task of the NSO is to provide the MC with support in developing operational standards, and the Office also serves as a liaison for the MC's Standardisation Boards (MCSBs), as well as playing a consultative role during the NATO Defence Planning Process (NDPP). The NSO is directly supported in its work by a Standardisation Staff Group (SSG), which is comprised of staff-level

experts and administrators that are tasked with facilitating and promoting standardisation activities and processes across the NATO institutional framework (NATO, 2017a). The NSO is also responsible for communicating and partnering with civil standardisation bodies.

Figure 7 – NATO standardisation institutions, processes and outputs



With specific regard to standardisation of weapons systems, the Conference of National Armaments Directors (CNAD) plays a vital role in NATO because it is the body tasked with enhancing military interoperability between allies (US Congress, 1990: pp. 49-50). It does this by identifying areas of potential collaboration in the areas of research, development, production and procurement of weapons systems and military equipment. Created in 1966 and directly reporting to the NAC, the Conference meets biannually under the chairmanship of the Assistant Secretary General for Defence Investment. The work of the CNAD is supported by a number of Main Armaments Groups (MAGs) focusing respectively on land, air and naval armaments issues (Maharani, 2009: p. 334; NATO, 2016). Additionally, the CNAD is supported on industrial issues by the NATO Industrial Advisory Group (NIAG). Composed of senior industrialists and established in 1968, the NIAG is responsible for providing the CNAD and NAC with technical advice on a range of industrial issues and it proposes potential areas of armaments collaboration between allies by bringing together industrial, governmental and military stakeholders (Matthews, 1992; Lazar, 2016; Fiott, 2017b).

Additionally, the CNAD is supported by NATO's Defence Investment Division (DID) within the International Staff. The DID works on developing alliance capabilities and interoperability and the Armaments Directorate (AD) supports the DID and the CNAD with expertise and administration. The DID is supported

by NATO Headquarters, Consultation, Command and Control Staff (NHQC3S) too, which also has a responsibility for developing and influencing standards within the alliance. The NHQC3S is a joint body shared by the DID and the International Military Staff (IMS) and it supports the development of standards in relation to C2 and cyber matters. In this regard, the NHQC3S advises the NAC, the MC and the Consultation, Command and Control Board (C3B). The C3B meets biannually and it reports to the NAC, and, as well as advising the CNAD, it helps to recommend standards in relation to communication and informatics, navigation, cyber and dual-use capabilities. It oversees the work on NATO's Interoperability Standards and Profiles (NISP) catalogue of command, control and communication (C3) standards too (NATO, 2017c).

Although the STANAGs are non-binding, NATO has nonetheless developed some notable standards including STANAG 4586 which defines a C3 architecture to enhance RPAS interoperability (Webber, Sperling and Smith, 2012: p. 183). NATO has long been involved in standardisation efforts for weapons systems such as RPAS. In fact, as early as 1984 the relevant working group under the CNAD sought to study the costs of duplication in various allies that were beginning to develop RPAS programmes (Kreienbaum, 2000). In 1988, an *ad hoc* working group on RPAS in the alliance worked to standardise requirements for these programmes and in 1999, a more coordinated approach to RPAS standardisation was endorsed by the CNAD. This resulted in greater exchange of RPAS development programmes in allied countries. NATO has also addressed the dual-use nature of RPAS through the NATO Air Traffic Management Committee (NATMC) (Kreienbaum, 2000: pp. 26-27).

The issue of armaments standardisation has consistently appeared at the highest political level in NATO. Despite mixed success, the issue of standards has historically appeared in NATO through the 1999 Defence Capabilities Initiative (DCI), the Prague Capability Commitment of 2002 and the 2010 Lisbon Critical Capabilities Package (Giegerich, 2012: p. 70; see also Kapstein, 2002: p. 152). Furthermore, the NATO Summit in Chicago in 2012 gave birth to the 'smart defence' initiative with its focus on capability prioritisation, cooperation and specialisation (*Ibid.*: pp. 69-70). Overall, it has been challenging for NATO to enforce standards with alliance members given the sensitivities surrounding the development and adoption of armaments standards. Political considerations about security of supply, national industries and military requirements can conspire to challenge the rational logic underlying armaments standardisation (Sandler and Hartley, 1999; see also Hurley, 1988).

3.3 Comparing the approaches

Based on these initiatives up to the Commission's 2015 progress report, it is possible to highlight some key differences between EU and NATO approaches to armaments standardisation (see Figure 8). Institutionally speaking, NATO has an established set of bodies and a dedicated agency focusing on armaments standardisation but in the case of the EU at two least institutions – the Commission and the EDA – are responsible for standardisation. NATO has a longer track record of developing standards (in the form of STANAGs) than the EU, even though the EU has growing experience. For example, the EDA presides over the Military Airworthiness Authorities (MAWA) Forum which has developed and adopted five defence-related standards (more on MAWA in the next chapter). In the EU, the bulk of hybrid standards have been developed by the three EU-recognised ESOs: CEN, CENELEC and ETSI.

It should be noted that **the European Commission has stakeholder buy-in in the civil and security sectors**, whereas NATO has a dedicated defence-industrial advisory forum on armaments standardisation in the form of the NIAG. For example, as part of its efforts on security research and innovation the Commission established a European Security Research and Innovation Forum (ESRIF) in 2007 to serve as a bridge between the EU institutions and industry. The ESRIF played an important role in developing a public-private dialogue over the use of civil standards and it opened the door for further thinking about how civil standards could be applied to the security and defence sectors.

One area that highlights the difference between EU and NATO approaches to armaments standardisation is legislation. Directive 2009/81/EC has opened the door to setting legal parameters for defence procurement and part of this legal norm sees standardisation as a key part of opening up the European defence market. Directive 2009/43/EC is designed to facilitate cross-border transfers of defence equipment and to create a European internal market for defence. The alliance has no such mandate to develop and apply these forms of legal instruments. While NATO does not have any equivalent to the EU's defence directives, however, this should not necessarily imply that the EU can enhance armaments standardisation via legal fiat. In fact, directives are a form of EU soft law that do not have direct effect in Member States. According to a recent evaluation by the Commission, in the case of Directive 2009/81/EC its **application has been uneven across the Union and it has been under-utilised for high-value defence contracts** (European Commission, 2016b). While the directive is principally aimed at removing market distorting behaviour such as the use of defence offsets, it is nonetheless arguable whether this legal instrument has led to any substantial improvement in armaments standardisation in the EU.

Figure 8 – Comparing EU and NATO approaches to standardisation

	European Union	NATO
Civil sector buy-in	✓	
Database management	✓	✓
Defence sector buy-in	✓	✓
Legislative tools	✓	
Relevant institutions	✓	✓
Standards adopted	✓	✓
Voluntary approach to standardisation	✓	✓
Sanctioning mechanism for standardisation	✓	
Budgetary tools to support standardisation	✓	

Despite these nuanced differences, however, the EU and NATO do share a number of approaches to armaments standardisation. Both organisations rely on the voluntary adoption of standards and stakeholder consultation in order to push for the use of these standards. With the exception of the EU's defence package of directives, **neither organisation has an effective sanctioning mechanism to enforce the use of defence-related standards**. Therefore, greater effort is needed to raise awareness with governments, militaries and other stakeholders in relation to available standards and to provide advice on their application, if so required. NATO bodies such as the NAC, CS, CNAD, MC and NSO propose STANAGs to allied members and the Commission and EDA advertise hybrid standards through EDSIS and EDSTAR. In this respect, while NATO largely develops STANAGs based on the advice of the NIAG and the MC (i.e. industrial and military feedback and proposals), the EU is largely but not exclusively geared to identifying defence-relevant civil standards that are developed by CEN, CENELEC and ETSI. Either way, neither NATO nor the EU can force any stakeholder to adopt and use existing defence-relevant standards.

3.4 New EU defence initiatives

Despite the aforementioned initiatives and dynamics, however, **the EU has recently adopted a number of new initiatives that may alter the EU's approach to armaments standardisation,** and lead to greater uptake of defence-relevant standards. These initiatives principally include Permanent Structured Cooperation and the European Defence Fund. A new impetus towards armaments standardisation in the EU began with the 2016 publication of the EUGS, which explicitly called for the rationalisation and standardisation of defence capabilities. Furthermore, Council Conclusions from 14 November 2016 (see

14149/16) set out the EU's level of ambition on security and defence with a view to implementing the EUGS. In these Conclusions, the Council called on the EDA and Member States to find ways to improve 'critical enablers for co-operation such as standardisation, certification, test and evaluation, as well as training and military education, while ensuring coherence and avoiding unnecessary duplication with national and multinational structures' (Council of the EU, 2016a: p. 10). In the same month, on 30 November 2016, the European Commission published the EDAP. In this Plan, the Commission yet again outlined the importance of standardisation and certification for defence, and it highlighted its achievements in developing hybrid standards for dual-use products, in areas such as security research and cybersecurity (European Commission, 2016a: p. 16).

3.4.1 European Defence Fund

The Commission has formulated a different approach to promoting armaments standards through the use of financial incentives, in the form of the EdF. Here, the overriding logic is that EU funds can only be invested in defence research (the 'research window') and capability development ('capability window') programmes, if a minimum of 2-3 Member States participate and if it leads to common research and capabilities, and therefore interoperability and standardisation. For example, in its 2017 Communication on 'Launching the European Defence Fund' the Commission is clear that the **financial incentives provided under the EdF should 'contribute to greater efficiency in national defence spending, maximise innovation by achieving greater scale, reduce the risk of duplication, foster interoperability between armed forces and encourage greater standardisation of equipment**' (European Commission, 2017a: p. 3). The use of financial incentives represents a new and interesting approach if applied consistently and properly.

Furthermore, following the publication of its proposal for a Regulation on the EDIDP on 7 June 2017, the Commission states that one of the promising aspects of the EdF is that '**common technical specifications that will be legally required by the regulation, will drive the Member States and their defence industry towards common standards**' (European Commission, 2017b: p. 20). Breaking with past initiatives, it is clear that the Commission sees financial incentives such as the EDIDP as a way to further encourage EU Member States to standardise equipment and systems. In its position adopted after the first reading of the proposed Regulation on 3 July 2018, the European Parliament concurred that 'an agreement on common technical specifications should be a primary condition to be eligible for funding under the [EDIDP]' (European Parliament, 2018a).

Work to enhance armaments standardisation through the EdF has already begun. For example, an EU-funded pilot project on defence research worth EUR 1.4 million was used over the 2016-2018 period to fund three research programmes: 1) EuroSWARM for the development of situational awareness for military unmanned swarm systems; 2) SPIDER for the development of situational awareness in urban combat environments; and 3) TRAWA for DAA systems on RPAS. Each of these pilot projects was designed to enhance armaments standardisation in communications, sensoring, data fusion, networking, mapping and detection technologies. This work has been taken further in the context of the Preparatory Action on Defence Research (PADR) – which follows on from the pilot projects and is the preparatory initiative for a possible longer-term European Defence Research Programme (EDRP) after 2020. For example, one project financed under the PADR is the Generic Open Soldier Systems Reference Architecture (GOSSRA), which aims to **use approximately EUR 1.5 million to develop an architecture for soldiers that will improve and standardise communications and situational awareness technologies** (i.e. data collection and sensors). GOSSRA aims to use hybrid standards, and the consortium partners on the project hope that the project may serve as the basis for the development of a STANAG (European Defence Agency, 2018).

In this respect, the **PADR is not only a tool that can be used to develop NATO standards, but it may also be a tool to unlock defence-relevant civil standards**. These benefits are relevant in the context of

EU-NATO defence cooperation. Accordingly, one of the specific objectives listed in the 8 July 2016 EU-NATO Joint Declaration is to '[d]evelop coherent, complementary and interoperable defence capabilities of EU Member States and NATO Allies'. This declaration was endorsed and followed up Council Conclusions on 6 December 2016, that focused on the implementation of the declaration through 42 specific action points. The NAC endorsed the same action points in parallel. Included in these action points was the need to '[e]nhance interoperability through increased interaction on standardisation with the aim to avoid duplication in the development of standards, identify projects where standardisation-related activities could be harmonised […]' (Council of the EU, 2016b: p. 9). The Joint Declaration on EU-NATO Cooperation signed on 10 July 2018 reiterated the need for European forces to improve their interoperability.

3.4.2 Permanent Structured Cooperation

Following the 13 November 2017 notification to the Council to establish PESCO, Member States made clear that Permanent Structured Cooperation on defence 'provides a crucial political framework for all Member States to improve their respective military assets and defence capabilities through well-coordinated initiatives and concrete projects based on more binding commitments' (Council of the EU, 2017a: p. 1). This form of cooperation is comprised of 20 binding commitments and waves of capability and operational projects. More specifically, PESCO binding commitment 9 calls for a '**[c]ommitment to drawing up harmonised requirements for all capability projects agreed by participating Member States**'. Of the six elements contained under PESCO binding commitment 12, the sixth one calls for 'simplifying and standardising cross border military transport in Europe for enabling rapid deployment of military materiel and personnel'. More specifically, however, binding commitment 13 recognises the need to interoperable forces and here the PESCO notification calls for a commitment to agree on common evaluation and validation criteria and technical and operational standards for EU force packages, in alignment with NATO standards. Binding commitments 19 and 20 also reiterate the need to ensure that PESCO capability projects lead to a more competitive European defence industry and European Defence Technological and Industrial Base (EDTIB) (Council of the EU, 2017a: pp. 3-5).

All of the PESCO binding commitments are subject to an annual review (conducted at least once per year) and a strategic review (conducted at different phases e.g. 2021, 2025, etc.). Thus, in principle PESCO should combine with the financial incentives provided under the EdF to **ensure that standardisation is placed on a higher political level, and streamlined in all of the EU's current and future defence research and capability development endeavours**. In essence, both PESCO and the EdF can serve as a market pressures that can induce cooperation between industrial and governmental stakeholders. For the first time, the EU has developed an annual process that should give heads of state and government and Member States greater political oversight over the progress on armaments standardisation. Accordingly, the combination of regular political oversight and financial incentives may create a particular EU dynamic for armaments standardisation. It should be recalled that while NATO has an institutional framework that provides for political oversight for armaments standardisation, the alliance has yet to introduce financial incentives and conditionality as a way to boost the use of its STANAGs.

What is unclear at present, however, is how armaments standardisation will feature in the PESCO review processes. Here, questions are likely to emerge with regard to whether (or not) the PESCO secretariat (jointly composed of the EDA and the EU Military Staff (EUMS)) should have a specific mechanism for ascertaining whether existing defence-relevant hybrid standards are being used by national procurement agencies and armed forces. This is particularly the case with regard to the PESCO projects that have standardisation as a core feature of their work. For example, there are already PESCO projects that seek to standardise national medical sanitary principles, medical command concepts, radio-defined software, logistics concepts and procedures, cross-border transport procedures and more (Council of the EU, 2017b). In combination with EdF projects, PESCO projects that experience a high degree of standardisation could

be used as case studies, to be presented to the European Council as evidence of the benefits of armaments standardisation.

4 EU experiences with hybrid standards

The aim of this chapter is to look into more detail at the EU's approach to armaments standardisation. It does so through an analysis of two case studies that derive from the European Commission's 2014 Communication that elaborates a roadmap for more enhanced European defence cooperation. The two case studies include standardisation and certification for MIS and RPAS. The analysis in this chapter is therefore divided between these two studies and each dedicated section aims to provide information on the importance of each capability domain to the EU, the specificities of developing and certifying standards in these areas and how various actors at the EU level act in relation to the development of hybrid standards. Based on the analysis of these case studies, the chapter also proposes other capability and technology areas that could be exploited by the EU in the future in relation to the development of hybrid standards. This section of the chapter is particularly pertinent given initiatives such as the EdF and PESCO, and the need to define projects for the PADR and the EDIDP up to 2020 and beyond.

4.1 Maritime information sharing

In the context of technological developments and increased digitalisation, MIS is an increasingly important element of the EU's overall maritime strategy. The maritime domain is home to technologies such as cloud services, big data, the Internet of Things (IoT), autonomous vessels and blockchain (e.g. for supply chain digitalisation and real time cargo tracking). Digitalisation in the maritime domain is a key commercial and security driver and enabler. For example, in its 2018 Crew Connectivity Survey of 5,889 respondents, Futurenautics showed that between 2015 and 2018 there was a **45 % increase in internet usage on board bulk carriers, a 40 % increase for container ships, 33 % for general cargo and 41 % for tankers** (Futurenautics, 2018: p. 23). Crew members and masters carry a range of technologies on board maritime vessels including laptops, tablets, smart phones, wearables, etc. Furthermore, the maritime domain has seen the introduction of autonomous systems for the purposes of surveillance, safety and inspection. In this respect, the standardisation of models, sensors, semantics and codes and recorders is important with potential economic and security benefits.

MIS is vital to the proper functioning of the maritime domain because it can enhance security, ensure port integration, facilitate efficiency in global supply chains and protect the environment. MIS infrastructures include satellite sensing, communications, geographic information systems, visualisation systems, web services, sensor networks and autonomous systems. These technologies may improve navigation, fuel usage, meteorological awareness, maintenance, training, performance, procurement and supply. The use of such technologies and systems helps maintain the proper functioning of vessels and it ensures control integration between ports and the land. **The mining, analysis and use of data are vital elements of MIS as diverse and numerous maritime factors can be used to improve security and enhance competitiveness**. Yet data collection is only half of the story as it is more costly and more technologically challenging to fuse maritime information for a defined purpose. Given the diverse actors involved in the maritime domain, standardisation is seen as a way to create consistency and reliability when sharing maritime information.

However, the maritime domain is characterised by its own specific economic and security factors. First, it is marked by potential choke points, pollution, environmental degradation, natural disasters, territorial disputes, terrorism, piracy and human and narcotics trafficking. Second, **the maritime domain is affected by sizeable communications distances and there is a high degree of traffic**. A number of stakeholders and economic actors use the maritime space with government agencies (coastguards, border guards, navies) operating alongside economic operators (shipping companies, insurance firms, natural resource

exploiters (oil, gas, wind)) and others (oceanographic agencies, marine scientists). Each of these actors has different MIS needs (e.g. defence actors may require higher resolution imagery and positioning than other actors) and so standardisation becomes even more challenging.

Standardisation of MIS is further complicated by the risks posed by cybersecurity. A lack of resilience to cyber risks and threats can have far-reaching implications for information security and privacy, and it can lead to a loss of financial investments and insurance-related liabilities. In this respect, the standardisation of technologies and procedures of cybersecurity in the maritime domain is a critical pillar of the EU's steps towards a single cybersecurity market (European Commission, 2017d). Cyber resilience is an increasingly important element of MIS. As the same 2018 Futurenautics crew survey shows, **while more than 65 % of 5,889 crew members surveyed said they felt confident using new technologies, 47 % of respondents stated that they had sailed on a vessel that was the target of a cyber-attack** (Futurenautics, 2018: p. 28). In this respect, it is clear that steps towards MIS standardisation have both economic and security dimensions in a context where a multitude of maritime actors have different business and public policy needs and requirements.

4.1.1 EU engagement with MIS standardisation

In the 2014 EU Maritime Security Strategy (EUMSS), information sharing was made a priority and it called for an 'enhanced common situational awareness and better sharing of information, operational concepts, *modi operandi* and experience' (Council of the EU, 2014a: p. 6). As the Strategy goes on to state, '[i]ntegration of different data sources in the maritime domain on the basis of existing national and international law is a key task […] the more information is aggregated and integrated, the more complete is the maritime picture created and more value is delivered to the operational end-users, in a cost efficient way' (*Ibid*.: p. 11). In this respect, **the EU places importance on being able to collect and share information between civilian and military authorities**, but it also stresses that standardisation and certification are key enablers for civil-military interoperability and competitiveness (*Ibid*.: p. 12).

Building on the EUMSS, the 2014 action plan seeking to implement the strategy highlighted a number of priority areas for standardisation and certification including for port and maritime transport security, harmonising requirements for the next generation patrol vessels and systems, training of maintenance personnel, energy efficiency and cybersecurity (Council of the EU, 2014b). The revised EUMSS action plan of 2018 stresses the importance of maritime surveillance and it proposes the development and consolidation of initiatives such as the Common Information Sharing Environment (CISE) and the Maritime Surveillance Network (MARSUR), plus it aims to better link together relevant Agencies such as the European Fisheries Control Agency (EFCA), the European Maritime Safety Agency (EMSA), the European Border and Coast Guard Agency (Frontex) (European Commission, 2018a: p. 1) and instruments such as the Copernicus Security Service for maritime surveillance. One policy challenge is **to enhance coordination between the multitudes of EU bodies that are involved in MIS**. Nevertheless, the EU has taken a number of steps to enhance MIS, including:

Union Maritime Information and Exchange System (SafeSeaNet)

Since 2002, the EU has maintained a data sharing platform for vessel traffic monitoring called Safe SeaNet (SSN). The monitoring and information system is hosted by EMSA and it brings together national authorities to share information on maritime safety, environmental protection and maritime traffic. Established under Directive 2002/59/EC and using established industry standards, SSN makes it easier for maritime actors such as masters, owners, agents, operators, etc. to exchange maritime information. **Standardisation has played an important role in the establishment and functioning of SSN** and there may be lessons-learned for recent initiatives such as CISE. Maritime operators need to provide information to SSN and this includes information such as the technical names for dangerous and polluting goods and ship identification

information, all of which rely on international standards. The SSN system has developed valuable experience in awareness-raising for relevant standards (GMVIS Skysoft, 2014).

Maritime Surveillance Network - MARSUR

MARSUR is an EDA *ad hoc* Category B project that was initiated in 2006 by 18 EU Member States and Norway. MARSUR is designed to facilitate MIS through exchange of maritime information such as ship locations and movements, identification data and visualisation. As part of the project, the EDA serves as a hub of exchange between national naval and maritime authorities and it has a key task the avoidance of duplication of technologies and approaches. In terms of the project's deliverables, a live demonstration was held on 30 June 2011 between project members to prove the system-of-systems concept developed under MARSUR. A month later on 27 October 2011, 15 EU Member States signed a technical agreement to move towards a fully interoperable and standardised demonstrator architecture for MIS. Three years later on 28 October 2014, the **MARSUR Exchange System was deployed as part of the demonstration phase** and following on from this the EDA has promoted the use of MARSUR for CSDP operations and missions. To this end, the EDA sponsored MARSUR training in January 2017 and a capability demonstration at the EUNAVFORMED Operation Headquarters in May 2017. In this respect, there is potential to enhance connectivity with national information systems and to promote greater use of MARSUR capabilities across the EU (European Defence Agency, 2017a).

Common Information Sharing Environment - CISE

The EU is currently developing a CISE for the maritime domain and it is designed to facilitate the exchange of information and integration of surveillance systems and networks across the EU's more than 400 maritime authorities (European Commission, 2016c). With a planned operational timeline of 2020, project members are currently working on the development of standards for IT solutions where a harmonised approach to data modelling, terms, conventions, meanings and data formatting can be achieved (European Commission, 2014c). Such efforts are taking place under a Framework Programme 7 project called EUCISE2020, which includes 15 Member States and 50 public authorities (European Commission, 2018b). Interestingly, standards are being developed between the project stakeholders through ETSI which is not only assisting with the creation of standards but will also officially adopt the standards on behalf of the CISE project. However, while a range of existing civil standards will be scanned under CISE it should be noted **that a key challenge for MIS standardisation more generally is that standards may not exist**, and when they do, they may not always match the needs of all customers or stakeholders. This problem is particularly acute with regard to defence actors because of specific naval needs and requirements.

Ocean 2020 - PADR

Under the EdF/PADR a project called Ocean 2020 has been initiated worth some EUR 35 million with the aim of boosting maritime surveillance and interdiction missions at sea (this is the largest single grant awarded under the PADR so far). The project, which started in April 2018, **aims to integrate RPAS and unmanned subsurface vehicles into the EU's fleet operations by providing naval commanders with an enhanced situational awareness**. Ocean 2020 will see cooperation among 42 partners from industry and research institutes across 15 Member States and the objective is to stage live demonstrations of the project in the Mediterranean Sea in 2019 and the Baltic Sea in 2020. While it is too early to ascertain whether the project will be successful in terms of standardisation, it should be noted that Ocean 2020 is a 'system-of-systems' programme and that many of the enablers of the overall system (and their constituent components and technologies) such as unmanned helicopters may already conform to hybrid standards. Ocean 2020 offers a **good opportunity to develop and utilise standards at an early stage of capability development**.

Harbour and Maritime Surveillance and Protection (HARMSPRO) - PESCO

One of the projects launched within PESCO in 2018 relates to harbour protection and maritime surveillance (HARMSPRO). As project participants Italy, Greece, Spain and Portugal hope to deliver a new maritime capability that will allow the EU to enhance security in its littoral waters and harbours by **improving surveillance and protection through the integrated use of sensors, software and surface, subsurface and air assets**. The project began in May 2018 and in a similar vein to Ocean 2020 the project should build on existing standards (Council of the EU, 2017b).

4.2 Remotely Piloted Aircraft Systems

RPAS have a recognised and demonstrable civil and military application and they can be used for a range of security and defence-related activities including surveillance, disaster relief, environmental and enforcement monitoring, border control, crisis management and much more. According to the European Commission the **RPAS sector is likely to employ more than 100,000 people and earn over EUR 10 billion per year by 2038** (European Commission, 2018c). Technologically speaking, while RPAS technology has improved development is still underway in many key technology areas especially with regard to C3, DAA and space/satellite links. In this respect, there is an opportunity to enhance standardisation in technical domains such as sensors for imagery and situational awareness, data links and self-protection devices especially given the uptake of RPAS for a range of commercial and public purposes. Nevertheless, despite technological advances in the RPAS technologies the fundamental concern is that the 'absence of a pilot on board […] brings the challenge of matching the ability of the pilot to "see and avoid" and "remain-well-clear" of other traffic and dangerous situations, such as potential collisions with other airspace users or obstacles and severe weather conditions' (International Civil Aviation Organisation, 2018: p. 2).

One of the key challenges facing the EU with regard to RPAS and standardisation relates to the integration of civil and military RPAS into European non-segregated airspace. A key aspect of the integration of RPAS into European airspace relates to the technological maturation of RPAS systems as there remain questions about a loss of C2 links between pilots and systems, a loss of data links between the RPAS system and ground control stations, a loss of geographical positioning system signals and a loss of engine control. As the Commission's EDAP makes clear, while initiatives such as the Single European Sky (SES) and the Single European Sky Air Traffic Management Research Joint Undertaking (SESAR JU) are principally focused on civil aviation there is **a growing need for military requirements to be taken into consideration when developing standards and for certification** (European Commission, 2017; see also Lavallée, 2017). This recognition is vital in a context where RPAS are used for security and defence purposes, which means that there could be potential cost efficiencies with regard to R&D. Given the technological specificities of RPAS, their usage in European airspace has been limited because the technology must subscribe to higher levels of safety than can perhaps currently be achieved (European Defence Agency, 2007: p. 21). Standardisation therefore could result in RPAS technological development and safe integration into European airspace.

4.2.1 EU engagement with RPAS standardisation

The EU's response to these challenges is noteworthy. Starting in 2012, the European Commission established a 'European RPAS Steering Group' (ERSG) to serve as a hub for key stakeholders involved in the integration of RPAS into the European airspace, including EASA, the European Organisation for the Safety of Air Navigation (EUROCONTROL), EUROCAE, SESAR JU, EDA, the European Space Agency (ESA) and many other areas (European Commission, 2013: p. 4). One of the first substantial activities of the ERSG was to produce a 'Roadmap for the Safe Integration of Civil RPAS into the European Aviation System' and the ERSG's final report **identified three key areas of focus including regulation, research and societal impacts**. One of the major conclusions from the final report was that there was a clear need for military requirements and needs to be considered when working towards the safe integration of civil RPAS. The

report also reiterated the importance of R&D and the role this can play in proposing new standards for C3, DAA and flight operations (i.e. taxi, take-off and landing) (*Ibid*.: p. 8).

Based on the findings of the ERSG roadmap and report, the SESAR JU started to integrate military RPAS requirements into the overall SES initiative and the inclusion of RPAS is now an important feature of the European ATM Master Plan. To this end, an expert group was established in 2016 to **develop a dual-use strategy for RPAS regulation**. Following the initiation of nine demonstration projects starting in 2013, the SESAR JU confirmed such developments by stating that following its demonstrations five key areas needed addressing before RPAS could be safely integrated into the European airspace: 1) the harmonisation of regulations and certification; 2) policies and procedures for interaction between air traffic control and RPAS; 3) DAA capabilities and compliance with established requirements; 4) reliable C3 capabilities and linkages; and 5) training and licencing for RPAS pilots (SESAR, 2016: p. 8).

EU agencies such as EASA and the EDA and European organisations such as EUROCAE are responsible for a range of RPAS-related activities. For example, **EUROCAE has a dedicated working group on RPAS** (labelled WG-105 / Unmanned Aircraft Systems) with the aim of developing standards and guidance documents for RPAS integration into non-segregated European airspace. WG-105 is sub-divided into six teams that work on issues such as traffic management, C3, DAA, airworthiness, risk assessments and ERA. Each of these focus areas relies on the expertise of industrial representatives from companies such as Airbus, Leonardo, Saab, Safran, Thales Group and a range of specialist firms. In developing standards for RPAS, EUROCAE works with international partners such as RTCA (an international public-private venture) that are developing minimum operational performance standards for RPAS. RTCA's special committee SC-228 was established in May 2013 and it brings together European firms and operators with counterparts from the US (e.g. Rockwell Collins and Boeing) (RTCA, 2018).

Beyond these initiatives, the EU's experiences in relation to RPAS standardisation takes many forms ranging from the standardisation of on board RPAS technologies and enablers (i.e. sensors and data networks) to the certification of RPAS for the purposes of military airworthiness and civil airspace integration. Past and recent initiatives include:

Military Airworthiness Authorities Forum (MAWA)

One notable success with regard to standardisation relates to the harmonisation of military airworthiness regulations. Initiated in 2008, the MAWA Forum has been tasked by European defence ministers to develop a common regulatory and certification framework for military airworthiness. As the chair of the MAWA Forum the EDA serves as a facilitator and networking hub for the MAWA participating Member States and the Forum partners and liaises with EASA, NATO and the Aerospace and Defence Industries Association of Europe (ASD Europe). These states retain their sovereign rights with regard to the adoption of airworthiness regulations but through the MAWA Forum they have pushed for mutual recognition. It is noteworthy that the MAWA Forum has led to tangible results with the adoption of five European Military Airworthiness Requirements (EMARs) including for aircraft certification (EMAR 21), aircraft maintenance (EMAR 145), training organisations (EMAR 147), personnel licencing (EMAR 66) and management of continued airworthiness (EMAR M). In partnership with EASA, these EMARs have already been applied in support of the service support for the A400M transport aircraft being (to be) used by Belgium, France, Germany, Luxembourg, Spain and the United Kingdom. **EMARs are the first military airworthiness requirements to be developed in the world, and even non-EU states such as Australia have started using them** (European Defence Agency, 2018e: p. 46). To build on this work, in 2013 the EDA and EASA signed an agreement to apply the EMAR experiences to airworthiness of systems such as RPAS and a working group was established in 2014 to harmonise airworthiness requirements for RPAS (European Defence Agency, 2017b).

Mid-air Collision Avoidance System (MIDCAS)

The MIDCAS project was initiated in 2009 as an EDA Category B project to move towards the integration of RPAS into non-segregated airspace. In April 2013, the first test flight was conducted to demonstrate the ability of RPAS to operate safely Beyond the Line of Sight (BLoS) and more test flights were conducted in 2015. These test flights were designed to develop image processing algorithm, sensor models, visible band cameras and an infrared camera. Interestingly, the MIDCAS project served as a platform for the Agency to work closely with EUROCONTROL, EUROCAE and the EASA on RPAS integration which was important given the vital linkages between these bodies for civilian aviation. For example, EUROCAE (under its Working Group WG73) was involved in the systems engineering phase of the project where any standardisation-related issues could be immediately communicated to EUROCONTROL, EASA and NATO. As a follow up to the project, **a standardisation support phase was initiated with the objective of demonstrating DAA functions in RPAS**. This phase resulted in technical feedback and analysis for collision avoidance standardisation. In short, many civilian based DAA technologies could be of use to the defence sector and the eventual integration of military RPAS into European airspace.

Demonstration of Satellites Enabling the Insertion of RPAS in Europe (DeSIRE II)

Following the DeSIRE I project from 2011-2013, in 2015 the EDA and the ESA launched a second DeSIRE project designed to support the development of government, institutional and commercial services provided by RPAS operating in non-segregated airspace (European Defence Agency, 2015). The project ran for 18 months and had a budget of EUR 2.6 million in order to demonstrate the safe operation of RPAS in civilian airspace. Much like DeSIRE I, this second **demonstration project sought to test fly RPAS using a satellite link for airspace traffic management**. It achieved this on 18 November 2016 and 5 April 2017 following demonstrations and simulations designed to test the performance of Satellite Communications links with RPAS units (European Space Agency, 2015). Additionally, the EDA has developed a number of other initiatives including a European Medium Altitude Endurance (MALE) RPAS user community in 2013 to serve as an interface for users in relation to exchange information on operational experiences and possible avenues for cooperation on training, logistics and MRO. Furthermore, the EDA has initiated a number of pertinent projects including the 'Enhanced RPAS Automation (ERA)' project in 2015 to enhance RPAS automation for take-off, landing and taxi. Additionally, it should be noted that in February 2018 the EDA launched a market survey calling on operators to provide information to the Agency on commercially available RPAS solutions for the purposes of improving the EU's situational awareness in crisis management – the deadline for responses was 31 March 2018 and the results are still pending (European Defence Agency, 2018). Again, here it is hoped that civilian technologies that already bear civil standards can be used for the purposes of defence.

Standardisation of RPAS Detect and Avoid (TRAWA) – Pilot Project

Launched as one of three projects under the pilot project on defence research, TRAWA was awarded a grant worth EUR 433,000 to standardise DAA sensors on board RPAS and to develop requirements for a remote pilot human-machine interface. The TRAWA project is also designed to lead to the successful integration of RPAS into civil airspace based on DAA technologies. The underlying logic of the project is that there is **a clear need for standards in relation to the exact separation distance between an RPAS pilot and the RPAS and the response times that need to be adhered to when the RPAS detects a nearby aircraft**. Such standards will be of use to civil and military RPAS pilots and for air traffic control management systems in Europe (NLR, 2017). To this end, the EDA has already begun its cooperation with EUROCAE and EASA and the project will follow EUROCAE's ED78A standardisation procedure (European Defence Agency, 2016). This standardisation procedure provides guidelines for the approval of the provision and use of Air Traffic Services (ATS) supported by data communications. In effect, ED78A sets the minimum operational

performance specification for ATS. A first public workshop on the TRAWA project was held in September 2017.

4.3 Enhancing the EU approach to standardisation

The examples of the EU's approach to and experiences with MIS and RPAS display growing EU action on armaments standardisation. Notwithstanding the inherent challenges associated with armaments standardisation, EU bodies such as the Commission, EASA and EDA, have not neglected the importance of standardising and certifying key technology and system domains. It is clear from the analysis above that the **EU's process of armaments standardisation is a decentralised one, with the Member States and European Commission relying on specialised agencies to take the work forward**. It is also clear that the EU has put energy into developing and promoting civil standards and their potential applicability to the defence sector. Much like NATO, the EU's process of armaments standardisation can be described **as an open network of consultation, awareness-raising and demonstrations** with the objective of adopting and promoting the use of standards. With regard to the rationalisation of the EU's armaments standardisation efforts, it is apparent that a multitude of bodies are currently working on MIS and RPAS standards, and a key question is whether there is a duplication of efforts. Based on the evidence provided so far, it can be observed that the EU does rely on a number of specialised agencies that serve as interfaces with industry and the Member States, and there is evidence that EU agencies and ESOs cooperate through fora such as the DSCG.

Despite the existing level of coordination between EU agencies and ESOs, however, the issue of armaments standardisation requires clearer guidance on the part of the European Commission and the EU Member States. Thus far in the EU's evolution on armaments standardisation, the Union has developed standardisation databases, legal instruments, consultative venues and processes, lessons learned mechanisms, technology demonstrations and many more initiatives. Despite these experiences, the EU now finds itself in a position where a range of financial incentives and legally binding commitments have been developed that have a significant bearing on the Union's armament standardisation efforts. In fact, financial conditionality under the EdF and the binding commitments under PESCO mandate the use of civil and defence standards during the EU's defence research and capability development efforts. What is more, initiatives such as the EdF and PESCO open up further domains of armaments standardisation that could form the basis for EU action in the short to medium term. In what follows, it can be observed that other standardisation domains may benefit from the EU's standardisation network and approach. Such domains include but are not restricted to:

4.3.1 Military mobility

Military mobility has emerged in recent years as a crucial part of the EU's response to the security and defence of the Union. The concept hinges on the idea that **Europe's militaries should be able to move freely in the EU for operational purposes** (i.e. reassurance measures, exercises and training). Currently, a range of physical, legal and regulatory barriers hinders this free movement. Physical barriers include not having the adequate transportation infrastructure in place to physically allow for European armed forces and equipment to cross borders (i.e. load bearing on trains, load bearing of infrastructure such as railways and bridges). Legal barriers refer to the protection of personnel and equipment when they do cross borders, and issues such as social and health care, criminal liability and prosecution, data protection and the transportation of dangerous goods. Regulatory barriers relate to non-tariff barriers such as customs checks and clearances and information exchange between national transportation authorities. Removing these barriers has become a focus of the EU's security and defence efforts in the context of the EUGS and PESCO. In fact, military mobility forms one of the 17 projects that are part of the first wave of PESCO projects.

The task of improving military mobility in Europe assumes close coordination between EU bodies such as the Council of the EU, the EDA, the European External Action Service (especially the EUMS), the EU Military Committee (EUMC) and the Commission's Directorate General (DG) for Transport, with NATO, in the context of the Joint Declarations. Thus far, the EDA has developed a roadmap on military mobility based on the recommendations of a working group it led (the so-called Ad Hoc Working Group on Cross-Border Military Transportation). On this basis, a Joint Communication was published on 10 November 2017 that recognised that a wide range of civil and NATO standards, and how the work already conducted by the EU in **developing hybrid standards could be applicable to enhancing military mobility** (European Commission/HRVP, 2017). Following this Communication, an Action Plan was released on 28 March 2018 showing the way forward for the EU in terms of marrying up transportation infrastructure and legal instruments with the military requirements of Europe's militaries (European Commission/HRVP, 2018). More concretely, in early 2018 the European Commission proposed to commit EUR 6.5 billion under the next Multi-annual Financial Framework (MFF) towards improving civil-military infrastructure for military mobility, over the period 2021-2027.

Yet a key challenge that needs further attention is how **to ensure that existing civil and hybrid standards can apply to military mobility, in the face of often diverse military requirements** in each Member State. While work is ongoing to scope out the potential of utilising trans-European Transport Network (TEN-T) infrastructure for military mobility, it is important to align military requirements and civil standards. In this respect, the work being conducted by the EDA and the EEAS in surveying existing civilian rules with regard to customs arrangements and military requirements (work due to be ready by spring 2019), is important. However, it appears as though there is still a need to specifically study the issue of hybrid standards in more detail. Here, a possible way forward could be to ensure that the DSCG has a greater focus on military mobility standardisation. This is important given the horizontal nature of military mobility and how it touches both MIS and RPAS standardisation, too. Consider, for example, how CEN has developed over 260 specific standards for tram and railway engineering in relation to track safety, noise emissions and more (European Committee for Standardisation, 2018b). Such standards have a potential benefit to the development of any new and/or modernised transport infrastructure under military mobility.

4.3.2 Cyber defence

A major element to the EU's defence and standardisation efforts relates to cyber defence. Cyber defence is of growing importance across all domains of the EU's activities on promoting cyber resilience and combating hybrid threats. In the specific context of the CSDP, cyber defence is particularly important because it may have implications with regard to the EU's Solidarity (Article 222 TFEU) and Mutual Assistance (Article 42.7 TEU) clauses. Cyber defence is vital for a number of reasons including: the protection of EU forces during EU-led operations and missions under the CSDP. This is especially true given the range of C3 technologies and processes used by EU forces during crisis management operations. As the European Parliament's Resolution on cyber defence of 13 June 2018 makes abundantly clear, there is a continued need at the EU level to ensure that '**cyber defence requirements and standards' are integrated 'into the planning and conduct of missions and operations**' (European Parliament, 2018b). To this end, the EU has thus far integrated cyber defence into its regular crisis management exercises (e.g. MULTILAYER 2016 and PACE17), and a first table top exercise on cyber defence (EU CYBRID17) was held on 7 September 2017. These exercises emerge as part of a broader EU approach to cybersecurity including the Cyber Security Strategy, the Protocol on Countering Hybrid Threats and the transposition of the Network and Information Security Directive (see 2016/1148). Furthermore, within PESCO, the 'EU Cyber Rapid Response Force' project also seeks to bolster the EU's cyber defences, and training on cyber defence is underway under the auspices of the European Security and Defence College (ESDC) and the EDA.

Cyber defence is an issue that branches into many other policy areas (transport, aviation, health, trade, etc.), and for this reason a 'whole-of-EU' approach is required to developing and promoting hybrid standards for

the purposes of cyber defence. In this respect, standards can be developed and/or adopted for technology development and usage, administrative procedures, resilience, etc. On this basis, it is incumbent **on EU institutions to study the application of hybrid standards for cyber defence**. For example, consultation with EASA, European Centre for Cybersecurity in Aviation (ECCSA) and the NATO Cooperative Cyber Defence Centre of Excellence (CCD COE) should be continued and enhanced on addressing aviation-relevant standards that could be applicable to cyber defence. With regard to space-based capabilities, there is a clear benefit to consulting the ESA with regard to improving the cyber resilience of satellites and space infrastructure through the development and use of hybrid standards. In this respect, greater attention to the EU's Cyber Defence Strategic Research Agenda (CSRA) is needed, and relations between the EDA, Commission, ESA and the European Cyber Security Organisation (ECSO) and relevant ESOs, should be advanced.

4.3.3 Energy management for defence

Energy management for defence is an increasingly essential issue for governments and militaries in Europe, and effective management of **energy generation, supply and storage has implications for security of supply and operational effectiveness**. Interestingly, energy management is being developed within PESCO under the 'Energy Operational Function' (EOF) project. EOF has as its main objective to develop new systems of energy supply for military camps in the field, and to integrate energy efficiency in the development of new combat systems. In a context where there is significant scientific and technological progress on energy storage systems, and where clean energy is increasingly playing a role in renewable energy strategies, the military plays an important role in practicing energy management and investing in energy management R&D (Nuttall, Samaras and Bazilian, 2017; see also Fiott, 2014b). In this respect, a range of existing environmental standards is applicable to the defence sector, including ISO 50001 on Energy Management Systems and Near Zero Energy Buildings (NZEBs) standards. Yet, transferring civil energy management standards to the defence sector is challenging for many reasons.

According to a study conducted by the EDA in 2017, the challenges associated with standardisation and energy management in defence include: 1) a lack of energy management reviews by defence organisations with a view to stocktaking existing environmental standards; 2) **the energy requirements of operational buildings and infrastructure do not necessarily adhere to existing standards,** because of different and defence specific needs such as great energy demand; 3) a lack of agreement between the Member States on a clear definition of NZEB standards; 4) not all defence infrastructures located on one site as a cluster of buildings have the same energy needs; 5) no common operational procedures for energy standards in EU-led military missions and operations under the CSDP (European Defence Agency, 2017c).

The EU has already initiated a number of projects and formed consultative bodies on energy management in defence, including the Consultation Forum for Sustainable Energy in the Defence and Security Sector (CF SEDSS) and the European Defence Energy Network (EDEN). Initiatives such as CF SEDSS and EDEN have led to work on photovoltaic power generation, the use of defence estates and alternative fuels. Nevertheless, there is still some way to go before civil standards related to energy management are fully accepted and adopted by militaries and ministries of defence in the EU. **The Member States still retain certain exemptions from the EU's energy efficiency legal framework**, including the Energy Efficiency Directive (see 2012/27/EU) and the Renewable Energy Directive (see 2009/28/EC). Therefore, building on these efforts within the context of the Commission's overhaul of the ESS and the introduction of PESCO and the EdF, could be a profitable work avenue to improve the EU's operational effectiveness and cost efficiency in defence.

5 Conclusion

The standardisation of armaments has been a long-standing focus of EU efforts to enhance the Union's military effectiveness, to improve capability development, and to support the competitiveness of the European defence industry. Armaments standardisation is a process that can lead to cost savings for defence spending, by injecting added-value in defence production processes and the avoidance of capability and equipment duplication. **Standardisation is a method of improving interoperability within and between European armed forces and a process that is can enhance the operational effectiveness of Europe's militaries**. Both the EU and NATO have taken measures over many years to enhance armaments standardisation in Europe. Yet the nature of the contemporary global defence market is that many more technologies and components integrated into military systems are sourced and/or produced in the civilian sector. The line drawn between defence equipment and capabilities and civilian products and technologies is increasingly blurred.

This study has highlighted the complex nature of standardisation, and it has explained how standardisation can broadly be defined as a process leading to the continuous, repeated and efficient use of technical guidelines, processes and rules. **Standardisation in a European context has tended to be of a voluntary nature, with the need for consensus between a range of stakeholders from industry, governments, international organisations and civil society**. A challenge in promoting the adoption and use of standards is that there is little in the way of an enforcement mechanism to mandate the use of standards by industry, governments and armed forces. This study has also stressed the challenges associated with armaments standardisation, especially with regard to the role that civil standards or hybrid standards may play in the defence sector. Furthermore, there is sometimes disagreement over whether standardisation can reduce costs while also maintaining competition in the market place. Finally, this study has shown how the use of open standards in the defence sector can be problematic, given the need to maintain security of supply.

This study has shown how **the EU and NATO broadly apply a voluntary and negotiated approach to the development and adoption of standards**. As highlighted in chapter three, the STANAGs are not binding standards. It has also indicated that the different membership composition of each organisation affects the style of the approach. The EU has no overarching hegemon such as the US in NATO, so supranational institutions such as the European Commission can play an influential role. Nevertheless, in the context of the EU-NATO Joint Declarations, it is clear that European members of both the EU and NATO expect the two organisations to work closely on armaments standardisation. In both organisations, there is an emphasis on maintaining databases and registers of applicable standards (i.e. NSDD, NATOTerm, ESTAR and EDSIS), networking among key stakeholders and awareness-raising within the military planning and defence procurement community. One key difference between the EU and NATO is the existence of EU soft law on defence procurement, with an effect on standardisation (e.g. the defence directives). Despite these efforts, however, this study has argued that new defence initiatives such as PESCO and the EdF may well lead to greater emphasis on and up-take of defence-relevant standards, in line with Council Conclusions since 2016 and the EUGS.

Nevertheless, the EU and NATO have already taken a great number of steps to enhance armaments standardisation in Europe. **Armaments standardisation has been on the policy agenda of the EU and NATO for many decades, and a range of measures has been developed,** including databases, working groups and – most crucially – standards themselves. To highlight the EU's approach to armaments standardisation, this study focused on the cases of MIS and RPAS standardisation. The study has shown how the EU adopts a network approach to developing standards, and how central authorities such as the European Commission rely on specialised Agencies such as EASA and the EDA to maintain relations with key stakeholders such as industry and governments. Agencies play a key role in armaments standardisation,

although there is a need to avoid duplication of efforts and to guarantee that the work packages, policy findings and work practices of each EU Agency feeds into the EU's overall standardisation efforts. This study has also speculated on other policy domains that could benefit from enhanced coordination and support with regard to the development and use of hybrid standards. These domains included military mobility, cyber defence and energy management as growing areas of the EU's security and defence.

5.1 Recommendations

Building on these broader observations about EU armaments standardisation, it is possible to note a number of areas, challenges, and issues, that could be addressed as part of the EU's standardisation efforts. These recommendations range from a reiteration of existing measures that should be supported, to potentially new avenues for further cooperation on hybrid standards. The recommendations based on this study include:

- **Enhance inter-institutional cooperation** – one of the approaches taken by the EU is to cluster bodies and agencies into for a, in order to discuss and develop approaches to armaments standardisation. Such fora include the DSCG, and bodies such as EDA, Commission and the ESOs are involved in regular discussions, including with NATO and other ESOs such as EUROCAE when necessary. These fora are indispensable not only because they facilitate networking and awareness-raising, which are vital to the development and adoption of standards, but because they allow specific expertise and interests to be channelled into standardisation processes. Here, defence firms should be actively brought into discussions and at the earliest stages of defining standards. For example, the EDA is able to provide input on the defence-specific interests and nature of standardisation and to share it with ESOs. Yet, as has been indicated with regard to initiatives such as military mobility, cyber defence and energy management, many more industrial stakeholders may need to be brought into the discussions taking place in the DSCG. This is not a specific call to replace the DSCG with another body, but rather to indicate the need to manage the proliferation of actors and stakeholders that have a role in armaments standardisation. It is recommended that each organisation involved in hybrid standards conduct a collective auditing of success stories and failures with regard to the use of hybrid standards.

- **Leverage the European Defence Fund** – the EdF represents an opportunity to advance the development and adoption of hybrid standards in defence research and capability development. In theory, the financial incentives offered under the EdF could significantly advance armaments standardisation. This study assumes that the conditionality attached to the PADR and the EDIDP will be maintained after 2020, with the further elaboration of the 'research window' (with a possible EDRP) and the 'capability window'. In order to seize the opportunity afforded by the EdF, careful consideration needs to be given to the optimal phases from basic defence R&D right up to the commercialisation of defence capabilities where the use of hybrid standards should be emphasised. In particular, it may be necessary to adopt a life-cycle approach to capability development under the EdF in order to potentially reduce costs at the R&D and MRO phases of EdF projects (especially by using the Financial Toolbox and drawing on existing STANAGs). The test phases of both the PADR and the EDIDP represent an opportunity to highlight lessons learned on standardisation for EdF support after 2020. EdF projects should serve as 'best business cases' for standardisation. Early experiences could lead to an eventual dedicated share of EdF funding to standardisation, but first there is a need to identify the most effective areas of standardisation as the EdF progresses.

- **Operationalise Permanent Structured Cooperation** – the PESCO annual and strategic reviews offer the EU an opportunity to take stock of armaments standardisation efforts, and to promote best practices among Member States. In line with the Council Conclusions from 14 November 2016 (see 14149/16), each of the review processes should be used to highlight how Member States have

progressed on standardisation in relation to PESCO binding commitments 12, 13, 19 and 20. In particular, each annual review could incorporate and call for standardisation practices before new waves of PESCO projects are agreed (especially if these PESCO projects will benefit from funding under the EdF). Indeed, even the National Implementation Plans (NIPs) could be used to ascertain how each relevant national authority is (or not as the case may be), integrating hybrid standards. For the longer-term PESCO strategic review, each phase (2021, 2025 and beyond) could be used as a stock-taking exercise to measure the degree of standardisation for each PESCO project, and whether standardisation is promoted as part of the management practices of each project. For such an exercise to be operationalised, it will be incumbent upon the PESCO Secretariat (working in close tandem within the DCSG and with ESOs and dependent on institutional resources) to design a benchmarking system, to measure the progress of each project and how they are managed. Such a system will rely on EDSIS and EDSTAR, but it should also work closely with NATO and capability development management bodies, such as OCCAR.

- **Promote EU defence-related legislation** – following the recent evaluation of the EU's defence directives, it is clear that the European Commission is working on ways to improve the consistent and even application of the directives across the EU. These efforts have a standardisation dimension that should not be lost when applying the defence directives. In this respect, the Commission should be specifically encouraged to support the Member States in fully applying the provisions of defence procurement directive Article 18(3a). Article 18(3a) provides for the need for technical specifications, based on national and international standards, to be drawn up in procurement contracts. Furthermore, with regard to the Commission's recent recommendation on supporting cross-border market access for defence and security SMEs (see EU 2018/624), there is scope for the Commission to provide further guidance to defence-relevant SMEs with regard to standardisation and certification, given that SMEs face particular challenges in this regard.
- **Optimise databases and registers** – this study does not counsel the creation of any new databases or registers, as this will serve as a distraction from the challenge of encouraging defence-relevant actors to use these databases and registers. It is already useful to have instruments such as the NSDD, EDSTAR and EDSIS. Nevertheless, this is not to say that these registers cannot be used for purposes other than the promotion of new standards. For example, there is evidence that such registers can also play a useful role in listing obsolescent standards. CEN-CENELEC have already called for EU level mechanisms that clearly identify and list obsolescent standards, and the EDA has begun scoping work on this issue (European Defence Agency, 2016c). Managing obsolescence is important because standards that are outdated or inapplicable pose a risk to life-cycle management and associated costs (European Committee for Standardisation, 2014: p. 17). A more integrated and urgent approach to obsolescence would be beneficial to actors and firms that may not always have the capacity to identify outdated or inapplicable hybrid standards. In this respect, existing databases and registers should be optimised.

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PE 603.872
EP/EXPO/B/SEDE/FWC/2017-01/01

Print ISBN 978-92-846-3932-8 | doi:10.2861/25041 | QA-06-18-178-EN-C
PDF ISBN 978-92-846-3933-5 | doi:10.2861/305765 | QA-06-18-178-EN-N