

# Artificial Intelligence and Autonomy in the Military: An Overview of NATO Member States' Strategies and Deployment

## APPENDIX A – COUNTRY PROFILES

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# Table of Contents

Abbreviations .....	4
1. Albania .....	5
2. Belgium .....	6
3. Bulgaria .....	8
4. Canada .....	9
5. Croatia .....	11
6. Czech Republic .....	12
7. Denmark .....	14
8. Estonia .....	15
9. France .....	16
10. Germany .....	19
11. Greece .....	22
12. Hungary .....	23
13. Iceland .....	24
14. Italy .....	25
15. Latvia .....	26
16. Lithuania .....	27
17. Luxembourg .....	28
18. Montenegro .....	29
19. The Netherlands .....	30
20. North Macedonia .....	32
21. Norway .....	33
22. Poland .....	34
23. Portugal .....	36
24. Romania .....	37
25. Slovakia .....	38
26. Slovenia .....	39
27. Spain .....	40
28. Turkey .....	42
29. United Kingdom .....	44
30. United States .....	47
References .....	51

# Abbreviations

<b>2ACI</b>	Automatic Imaging Target Acquisition
<b>AI</b>	Artificial Intelligence
<b>AMD</b>	Air and Missile Defence
<b>AMRAAM</b>	Advanced Medium-Range Air-to-Air Missile
<b>AUV</b>	Autonomous Underwater Vehicle
<b>CCDCOE</b>	Cooperative Cyber Defence Centre of Excellence
<b>DARPA</b>	Defence Advanced Research Projects Agency
<b>DoD</b>	Department of Defense
<b>DASA</b>	Defence and Security Accelerator
<b>DSTL</b>	Defence, Science, and Technology Laboratory
<b>FCAS</b>	Future Combat Air System
<b>ISR</b>	Intelligence, Surveillance, and Reconnaissance
<b>IT</b>	Information Technology
<b>JAIC</b>	Joint Artificial Intelligence Centre
<b>LAWS</b>	Lethal Autonomous Weapons Systems
<b>LIMS IV</b>	Integrated Logistics, Installations, and Mission Support Decision Analysis
<b>MCM</b>	Mine Countermeasures
<b>MoD</b>	Ministry of Defence
<b>NATO</b>	North Atlantic Treaty Organisation
<b>NSM/JSM</b>	Naval Strike Missile/Joint Strike Missile
<b>PfD</b>	Partnership for Defence
<b>RAF</b>	Royal Air Force
<b>RAS</b>	Robotic Autonomous System
<b>RCN</b>	Royal Canadian Navy
<b>RNLA</b>	Royal Netherlands Army
<b>RNLN</b>	Royal Netherlands Navy
<b>SME</b>	Subject Matter Expert

<b>SWIM</b>	System Wide Information Management
<b>TAI</b>	Turkish Aerospace Industries
<b>TALIOS</b>	Targeting Long-range Identification Optronic System
<b>UAS</b>	Unmanned Aerial System
<b>UAV</b>	Unmanned Aerial Vehicle
<b>UGV</b>	Unmanned Ground Vehicle
<b>UK</b>	United Kingdom
<b>UN</b>	United Nations
<b>US</b>	United States
<b>UUV</b>	Unmanned Underwater Vehicle

# 1. Albania

## 1.1. AI Strategy

Albania does not have an AI strategy or a military AI strategy.

## 1.2. Autonomous Vehicles

N/A

## 1.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

N/A

## 1.4. Data Analytics

N/A

## 1.5. Logistics and Personnel Management

N/A

# 2. Belgium

## 2.1. AI Strategy

In March 2019, Belgium released a national AI strategy titled 'AI 4 Belgium', which does not mention military applications of AI.<sup>1</sup> While Belgium has not published a military AI strategy, the Belgian Royal Military Academy has a robotics and autonomous systems lab that conducts research for the Belgian defence sector.<sup>2</sup>

## 2.2. Autonomous Vehicles

Belgium's military uses a number of unmanned aerial and underwater vehicles with autonomous capabilities. Currently, Belgium is working with the Netherlands to modernise its MCM capabilities by replacing old systems with autonomous underwater vehicles. At least 100 new autonomous platforms will be deployed in the Belgian Navy for MCM.<sup>3</sup>

### UAV

- The Belgian Army used Israeli Aerospace Industries' B-HUNTER UAV, which can operate autonomously,<sup>4</sup> for more than two decades before retiring the UAV in mid-2020.<sup>5</sup>
- Saab's Skeldar V-200 UAV, which the Belgian Navy uses for mine countermeasures (MCM), can autonomously conduct mine clearance missions at sea.<sup>6</sup>

### UUV

- Kongsberg's REMUS 100 AUV operates autonomously.<sup>7</sup>

- ECA Group's A-18M, which the Belgian Navy uses for MCM, can operate autonomously.<sup>9</sup>

## 2.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

Belgium uses Boeing's Harpoon Block II anti-ship missile,<sup>10</sup> which has some autonomous capabilities.<sup>11</sup>

In 2024 Belgium is expected to receive Lockheed Martin's F-35 Lightning II fighter aircraft,<sup>12</sup> which has several artificial intelligence components, including decision support and data analytics systems.<sup>13</sup> In the future, the F-35 will likely also use artificial intelligence to control unmanned drone 'wingmen', which could carry weapons, conduct ISR, or test enemy air defences.<sup>14</sup>

## 2.4. Data Analytics

N/A

## 2.5. Logistics and Personnel Management

N/A

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## 2.6. Other

The Belgian Army uses the MASA Group's AI-enabled SWORD simulation software for training purposes. SWORD is designed to 'improve training, analysis, and decision support' for commanding officers in the military by simulating highly realistic scenarios.<sup>15</sup>

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## 3. Bulgaria

### 3.1. AI Strategy

In December 2020 Bulgaria released a national AI strategy titled 'Concept for the Development of AI in Bulgaria until 2030', which does not mention military applications of AI.<sup>16</sup> Bulgaria has not released a military AI strategy.<sup>17</sup>

### 3.2. Autonomous Vehicles

The Bulgarian military uses AeroVironment's RQ-11 Raven UAV, which can navigate autonomously.<sup>18</sup>

### 3.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

For air defence, Bulgaria uses Raytheon's Advanced Medium-Range Air-to-Air Missile (AMRAAM),<sup>19</sup> which has autonomous 'launch and leave' capabilities.<sup>20</sup>

### 3.4. Data Analytics

N/A

### 3.5. Logistics and Personnel Management

N/A

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## 4. Canada

### 4.1. AI Strategy

In March 2017, Canada became the first country to release a national AI strategy,<sup>21</sup> titled 'Pan-Canadian Artificial Intelligence Strategy'.<sup>22</sup> However, the strategy does not mention military applications of AI.

While Canada does not have a military AI strategy, a number of senior Canadian defence officials have stated that military AI will be important in the future.<sup>23</sup> Additionally, the Department of National Defence is clearly developing autonomous systems, as they have made several calls for proposals for autonomous national defence systems and have entered into some small contracts with AI companies.<sup>24</sup>

### 4.2. Autonomous Vehicles

Canada's military uses several unmanned aerial and underwater vehicles with autonomous capabilities.

#### UAVs

→ Boeing's ScanEagle<sup>25</sup> UAV operates fully autonomously.<sup>26</sup>

→ Saab's Skeldar V-200 UAV<sup>27</sup> can operate autonomously.<sup>28</sup>

#### UUVs

→ Kongsberg's REMUS 100 AUV, which the Royal Canadian Navy (RCN) uses for MCM and defence research,<sup>29</sup> operates autonomously.<sup>30</sup>

→ L3 OceanServer's Iver UUV, which the RCN uses for MCM and defence research,<sup>31</sup> operates autonomously.<sup>32</sup>

→ Saab's Double Eagle SAROV UUV,<sup>33</sup> which is used for naval MCM, operates autonomously.<sup>34</sup>

### 4.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

Canada uses Oerlikon's ADATS Short-Range Air Defence System, which operates autonomously.<sup>35</sup> Additionally, Canada uses Boeing's Harpoon Block II anti-ship missile,<sup>36</sup> which has some autonomous capabilities.<sup>37</sup>

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Canada is a partner in Lockheed Martin's F-35 Lightning II fighter aircraft programme,<sup>38</sup> which has several artificial intelligence components, including decision support and data analytics systems.<sup>39</sup> In the future, the F-35 will likely also use artificial intelligence to control unmanned drone 'wingmen', which could carry weapons, conduct ISR, or test enemy air defences.<sup>40</sup>

## 4.4. Data Analytics

Patriot One subsidiary Xtract Technologies has secured a contract with Canada's Department of National Defence to develop AI strategies for situational awareness. Xtract will design, develop, and deploy 'data sets, machine learning models, and visualisation software that will be used to increase situational awareness'.<sup>41</sup>

## 4.5. Logistics and Personnel Management

IBM Canada and Lockheed Martin Canada are currently developing an AI-enabled voice assistant for RCN warships called 'Boatswain's Mate', which would enable soldiers to speak commands to the ship and view ship data.

Currently the RCN is testing Kognitiv Spark's Mixed Reality Remote Assistant Support system, which uses AI-enabled augmented reality to make ship maintenance and repairs more efficient.<sup>42</sup>

## 4.6. Other

Patriot One subsidiary Xtract Technologies has secured a contract with the Canadian Armed Forces to develop ways to use deep learning and computer vision to camouflage army platforms and soldiers by modifying the visual and infrared signatures they emit.<sup>43</sup>

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# 5. Croatia

## 5.1. AI Strategy

Croatia is currently working on a national AI strategy, which was expected in May 2020 but had not yet been released at the time of writing.<sup>44</sup> Croatia does have a preliminary AI strategy document titled 'Artificial Intelligence Potential for Croatia',<sup>45</sup> which does not mention military applications of AI.<sup>46</sup>

## 5.2. Autonomous Vehicles

The United States donated two REMUS 100 AUVs to the Croatian Navy that can operate autonomously.<sup>47</sup> In addition, the Israeli and Croatian governments have agreed to work together to develop autonomous UGVs that could be used in high-risk areas, including those contaminated by chemical, biological, and radioactive agents.<sup>48</sup>

## 5.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

N/A

## 5.4. Data Analytics

N/A

## 5.5. Logistics and Personnel Management

N/A

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# 6. Czech Republic

## 6.1. AI Strategy

In June 2019, the Czech Republic published a national AI strategy titled 'National Artificial Intelligence Strategy of the Czech Republic'.<sup>49</sup> The Deputy Minister of Defence is on the Czech AI committee, and the strategy identifies security and defence as a key area for applications of AI and calls for a dialogue to commence 'between security forces about the possible AI application in the security area'.

While the Czech Republic has not published a military AI strategy, several army strategy documents mention AI. For instance, the document 'Long Term Perspective for Defense 2030' notes that the importance of autonomous weapons systems will grow and that the Czech military must continue to develop autonomous systems.<sup>50</sup> Similarly, the document 'Long Term Perspective for Defense 2035' calls for the army to 'make full use of the unmanned and autonomous systems, or employ artificial intelligence' and classifies autonomous systems and artificial intelligence as 'emerging and disruptive technologies' that are necessary for the army to keep its edge.<sup>51</sup> In addition, in January 2020, the Czech army created an unmanned systems unit that works with a number of UAVs with autonomous capabilities.<sup>52</sup>

## 6.2. Autonomous Vehicles

The Czech military operates a number of UAVs with autonomous capabilities.<sup>53</sup> In addition, there are civilian Czech UAV companies whose products may be adapted for military use in the near future.

## UAVs

- AeroVironment's RQ-11 Raven UAV<sup>54</sup> can navigate autonomously.<sup>55</sup>
- AeroVironment's Puma 3 AE tactical UAV<sup>56</sup> can navigate autonomously.<sup>57</sup>
- Boeing's ScanEagle<sup>58</sup> UAV operates fully autonomously.<sup>59</sup>
- Elbit Systems' Skylark I-LEX,<sup>60</sup> which is used for ISR, operates fully autonomously.<sup>61</sup>
- The Czech Primoco One 150-M UAV, which is currently only used for civilian purposes, was certified by the Czech Military Aviation Authority in October 2020, suggesting it may soon be used for military purposes.<sup>62</sup>

## 6.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

The Czech Republic uses Rafael's SPYDER air defence system,<sup>63</sup> which has some autonomous capabilities, including 'detecting threats while on-the-move and firing instantly after halt'.<sup>64</sup>

## 6.4. Data Analytics

N/A

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62 Primoco UAV, 'Primoco UAV SE Is Certified by the Military Aviation Authority'. Accessed 18 January 2021. <https://uav-stol.com/ar/news-ar/primoco-uav-se-is-certified-by-the-military-aviation-authority/>.

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64 Rafael Advanced Defense Systems, 'SPYDER Family', 2021. Accessed 10 January 2021. <https://www.rafael.co.il/worlds/air-missile-defense/air-defense/>.

## **6.5. Logistics and Personnel Management**

N/A

# 7. Denmark

## 7.1. AI Strategy

In March 2019, Denmark published a national AI strategy titled 'National Strategy for Artificial Intelligence'.<sup>65</sup> Additionally, Denmark published an AI strategy together with a number of Nordic and Baltic states titled 'AI in the Nordic-Baltic Region'.<sup>66</sup> Neither document mentions military applications of AI. Denmark has not published a military AI strategy.

## 7.2. Autonomous Vehicles

Denmark's military uses several unmanned aerial and underwater vehicles that can operate autonomously.

### UAVs

- AeroVironment's Puma 3 AE tactical UAV can navigate autonomously.<sup>67</sup>
- AeroVironment's RQ-11 Raven UAV can navigate autonomously.<sup>68</sup>

### UUVs

- Teledyne's Gavia AUV operates autonomously.<sup>69</sup>
- Saab's Double Eagle SAROV UUV,<sup>70</sup> which is used for naval MCM, operates autonomously.<sup>71</sup>

## 7.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

Denmark uses Raytheon's Advanced Medium-Range Air-to-Air Missile (AMRAAM) for air defence,<sup>72</sup> which has autonomous 'launch and leave' capabilities.<sup>73</sup>

The Royal Danish Navy uses several weapons with autonomous capabilities,<sup>74</sup> namely Boeing's Harpoon Block II anti-ship missile<sup>75</sup> and Leonardo's MU90 IMPACT Advanced Lightweight Torpedo, which has autonomous 'launch and forget' capabilities.<sup>76</sup>

Denmark is a partner in Lockheed Martin's F-35 Lightning II fighter aircraft programme,<sup>77</sup> which has several artificial intelligence components, including decision support and data analytics systems.<sup>78</sup> In the future, the F-35 will likely also use artificial intelligence to control unmanned drone 'wingmen', which could carry weapons, conduct ISR, or test enemy air defences.<sup>79</sup>

## 7.4. Data Analytics

N/A

## 7.5. Logistics and Personnel Management

N/A

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78 Kris Osborn, 'The F-35 Will Soon Be Equipped with Artificial Intelligence to Control Drone Wingmen'.

79 Osborn, 'The F-35 Will Soon Be Equipped with Artificial Intelligence to Control Drone Wingmen'.

## 8. Estonia

### 8.1. AI Strategy

In May 2019 Estonia published an AI strategy titled 'Estonia's National Artificial Intelligence Strategy 2019–2021'.<sup>80</sup> Additionally, Estonia published an AI strategy together with a number of Nordic and Baltic states titled 'AI in the Nordic-Baltic Region'.<sup>81</sup> Neither document mentions military applications of AI. Estonia does not have a public military AI strategy.

### 8.2. Autonomous Vehicles

Estonia's military uses a number of UAVs with autonomous capabilities and is currently leading the development of an autonomous UGV.

#### UAVs

- AeroVironment's Puma 3 AE tactical UAV can navigate autonomously.<sup>82</sup>
- AeroVironment's RQ-11 Raven UAV can navigate autonomously.<sup>83</sup>
- Northrop Grumman's RQ-4 Global Hawk UAV can operate autonomously.<sup>84</sup> It is a part of NATO's Alliance Ground Surveillance reconnaissance system, which operates in Estonia.<sup>85</sup>

#### UGVs

- With the help of the Estonian Ministry of Defence, Estonian defence company Milrem is leading the development of the THeMIS UGV, which can be controlled autonomously.<sup>86</sup>

### 8.3. Autonomous Air and Missile Defence Systems, Autonomous

### Missiles, and AI-Enabled Aircraft

Estonia uses MBDA's Mistral 2 short-range surface-to-air missiles for air defence.<sup>87</sup> Mistral 2 missiles operate autonomously in a 'fire-and-forget' fashion once fired.<sup>88</sup>

### 8.4. Data Analytics

N/A

### 8.5. Logistics and Personnel Management

N/A

80 Estonian Artificial Intelligence Deployment, 'Estonia's National Artificial Intelligence Strategy 2019–2021', Government of the Republic of Estonia, July 2019. Accessed 9 September 2021. [https://f98cc689-5814-47ec-86b3-db505a7c3978.filesusr.com/ugd/7df26f\\_27a618cb80a648c38be427194affa2f3.pdf](https://f98cc689-5814-47ec-86b3-db505a7c3978.filesusr.com/ugd/7df26f_27a618cb80a648c38be427194affa2f3.pdf).

81 Nordic Council of Ministers, 'AI in the Nordic-Baltic Region'.

82 *Defense Post*, 'Estonia and Portugal Procure AeroVironment Small Unmanned Aircraft Systems', 15 September 2018. Accessed 18 January 2021. <https://www.thedefensepost.com/2018/09/15/estonia-portugal-aerovironment-uas/>; AeroVironment, 'Puma 3', 2021. Accessed 13 January 2021. <https://www.avinc.com/tuas/puma-ae>.

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88 Army Technology, 'Mistral: Air Defence Missile System', Verdict Media Limited, 2021. Accessed 9 January 2021. <https://www.army-technology.com/projects/mistral-missile/>.

# 9. France

## 9.1. AI Strategy

In March 2018, France released a national strategy for AI titled 'For a Meaningful Artificial Intelligence: Towards a French and European Strategy'.<sup>89</sup> The strategy mentions that defence/security is one of four strategic sectors in which to apply AI and discusses establishing a European Agency for Disruptive Innovation, modelled on the US's DARPA (Defence Advanced Research Projects Agency), that would focus on AI research and military applications. In fact, after the document was published, France established the Defence Innovation Agency, which focuses on military applications of emerging technologies like AI and is headed by an AI expert.<sup>90</sup> Additionally, the document has a section that discusses the ethical implications of lethal automatic weapon systems and emphasises the importance of humanitarian law.

In September 2019, France released a national military strategy for AI titled 'Artificial Intelligence in Support of Defence',<sup>91</sup> which outlines the current and future role of AI in the French military. The strategy notes that military AI applications are already being developed and states that if the French military does not work to develop its own AI capabilities, it risks 'missing a major technological turning-point and losing the operational superiority they currently enjoy'. The document outlines seven priority areas for the Ministry of Defence to focus on, namely:

- decision support in planning and execution,
- collaborative combat,
- cyber defence and influence,
- logistics, support and operational readiness,
- intelligence,
- robotics and autonomy,
- administration and health.

It also notes that AI could be useful for military simulation, predictive maintenance, situational awareness, and resource management.

While the strategy stresses that France should be

self-reliant in developing military AI, it also describes three circles of countries that France should collaborate with to develop AI. The first circle includes close European partners that France already works with, such as Germany. The second circle comprises Australia, India, and the US, three non-European countries that already work closely with France. The third circle includes European and non-European 'countries with which opportunities for targeted cooperation may arise', such as Canada, the Republic of Korea, and Japan.

Throughout the document, the authors stress the importance of complying with the laws of war, even as weapons become increasingly autonomous. The strategy also notes that AI-enabled systems may actually help militaries follow international humanitarian law, as they can improve the distinction between combatants and non-combatants and enhance proportionality.

## 9.2. Autonomous Vehicles

The French military uses several autonomous vehicle systems and is currently undergoing a military modernisation programme known as Scorpion, which will continue to develop autonomous vehicle systems and integrate them into France's armed forces. Already the Scorpion programme has led the French military to acquire unmanned vehicles with autonomous capabilities, and it will continue to develop and acquire autonomous vehicles that can work with traditional military systems in order to enhance ISR, decision making, and situational awareness.<sup>92</sup>

### UAVs

- France, along with a number of other European countries, is currently developing the nEUROn demonstrator UAV,<sup>93</sup> which has several autonomous capabilities, including autonomous target recognition and ordnance management.<sup>94</sup>

89 Cédric Villani, 'For a Meaningful Artificial Intelligence: Towards a French and European Strategy', Conseil national du numérique. Government of France, 8 March 2018. Accessed 8 September 2021. [https://www.aiforhumanity.fr/pdfs/MissionVillani\\_Report\\_ENG-VF.pdf](https://www.aiforhumanity.fr/pdfs/MissionVillani_Report_ENG-VF.pdf).

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→ Elbit Systems' Skylark I-LEX,<sup>95</sup> which is used for ISR, operates fully autonomously.<sup>96</sup>

### UGVs

→ Nexter Robotics's Nerva micro-robots,<sup>97</sup> which were acquired as part of the Scorpion modernisation programme and are used for surveillance, can navigate semi-autonomously and will have more AI-enabled features in the future.<sup>98</sup>

→ Milrem's THeMIS UGV<sup>99</sup> can be controlled autonomously.<sup>100</sup>

### UUVs

→ ECA Group's A27-M AUV, which is used for mine countermeasures and surveillance, operates autonomously.<sup>101</sup>

→ France and UK have announced the Maritime Mine Counter Measure (MMCM) programme as of late 2020, a \$250 million programme to develop autonomous mine-hunting systems.<sup>102</sup>

## 9.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

France, along with Germany and Spain, is currently developing the Future Combat Air System (FCAS), which aims to create a sixth-generation fighter aircraft.<sup>103</sup> The aircraft will be a system of systems, many of which will be equipped with AI and neural networks.<sup>104</sup> For example, AI will allow the aircraft to team with unmanned platforms,<sup>105</sup> share information with other actors in a 'combat cloud',<sup>106</sup> and assist in pilot situational awareness and decision-making.<sup>107</sup>

Similarly, in September 2018, the French military launched the Man-Machine Teaming preliminary advanced study programme, a research programme that will explore how humans and machines can best work together in future aircraft.<sup>108</sup> The programme will work to define future cockpits,<sup>109</sup> examine the feasibility of flying fighter jets and unmanned drones together to evade air defence systems, and develop the best techniques to process and merge data from aircraft sensors,<sup>110</sup> much of which will require artificial intelligence and machine learning.<sup>111</sup> The study's subjects can be divided into six main themes:<sup>112</sup>

- Virtual assistants and intelligent cockpits
- Human-machine interactions
- Mission management
- Smart sensors
- Sensor services
- Robotic support and maintenance

The French Navy uses Leonardo's MU90 IMPACT Advanced Lightweight Torpedo,<sup>113</sup> which has autonomous 'launch and forget' capabilities.<sup>114</sup> France also uses Eurosam's SAMP/T

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102 *Maritime Executive*, 'UK and France Partner on Development of Autonomous Minehunting Vessel', 26 November 2020. Accessed 8 September 2021. <https://www.maritime-executive.com/article/uk-and-france-partner-on-development-of-autonomous-minehunting-vessel>.

103 Airbus, 'Future Combat Air System (FCAS): Shaping the Future of Air Power'. Accessed 4 January 2021. <https://www.airbus.com/defence/fcas.html>.

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114 Leonardo, 'Whitehead MU90'.

Air Defence System, which has autonomous capabilities<sup>115</sup> and protects against UAVs, cruise missiles, short-range ballistic missiles, and fighter aircraft.<sup>116</sup>

## 9.4. Data Analytics

The French military, along with MBDA, recently developed the Automatic Imaging Target Acquisition (2ACI) programme, which uses artificial intelligence to conduct automatic target recognition. 2ACI was installed on a heavy armoured vehicle as a demonstrator and may be integrated into the Scorpion modernisation programme in the future.<sup>117</sup>

Similarly, Thales recently developed and began implementing the TALIOS (Targeting Long-range Identification Optronic System) system for the French F4 Rafale fighter jet,<sup>118</sup> which uses AI to analyse sensor and image data for situational awareness, automatic target detection and recognition, and ISR.<sup>119</sup>

Thales and Dassault Aviation, two French defence companies, are developing the French military's ARCHANGE programme, which aims to strengthen the military's signals intelligence capabilities.<sup>120</sup> Aircraft equipped with the technology developed in this programme will use artificial intelligence to detect and analyse radar and radar signals.<sup>121</sup>

DRM, the French military intelligence agency, is actively pursuing AI technology that can effectively analyse data.<sup>122</sup> Already DRM is funding and working with French start-up EarthCube to use machine learning to analyse satellite images and other data.<sup>123</sup>

The French Navy uses Thales's BlueScan, which uses AI-enabled data analytics to monitor underwater acoustics and conduct anti-submarine warfare.<sup>124</sup>

## 9.5. Logistics and Personnel Management

Thales is currently developing an AI-enabled predictive maintenance system for the F4 Rafale fighter jet.<sup>125</sup>

## 9.6. Other

The French army uses MASA Group's AI-enabled SWORD simulation software for training purposes. SWORD is designed to 'improve training, analysis, and decision support' for commanding officers in the military by simulating highly realistic scenarios.<sup>126</sup>

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115 Vincent Boulanin and Maaike Verbruggen, 'Mapping the Development of Autonomy in Weapons Systems', *SIPRI Report* (Stockholm: SIPRI, 2017), [sipri.org/sites/default/files/2017-11/siprireport\\_mapping\\_the\\_development\\_of\\_autonomy\\_in\\_weapon\\_systems\\_1117\\_1.pdf](https://sipri.org/sites/default/files/2017-11/siprireport_mapping_the_development_of_autonomy_in_weapon_systems_1117_1.pdf); Eurosam, 'Eurosam: Ground-Launched Systems', 2019. Accessed 9 January 2021. <https://www.eurosam.com/products/ground-launched-systems/>.

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120 Christina Mackenzie, 'France Hires Two Firms to Soup up Jets with an Electronic Warfare Capability', C4ISRNET. Sightline Media Group, 14 January 2020. Accessed 10 January 2021. <https://www.c4isrnet.com/battlefield-tech/c2-comms/2020/01/14/france-hires-two-firms-to-soup-up-jets-with-an-electronic-warfare-capability/>.

121 Thales, 'Thales and Dassault Aviation Win Contract for France's New Strategic Airborne Intelligence Programme', 14 January 2020. Accessed 18 January 2021. <https://www.thalesgroup.com/en/worldwide-defence/radio-communications/news/thales-and-dassault-aviation-win-contract-frances-new>.

122 Pierre Tran, 'French Intelligence Agency Wants AI to Help Sort Masses of Raw Data', *Defense News*, 5 February 2018. Accessed 18 January 2021. <https://www.defensenews.com/global/europe/2018/02/05/french-intelligence-agency-seeks-ai-to-support-analysts/>.

123 Prelegins, 'Earthcube Overshoots Its Competitors', 22 September 2020. Accessed 28 October 2021. <https://www.prelegins.com/resources/press/earthcube-overshoots-its-competitors>; Adrian Bridgwater, 'French AI Defense Startup Tracks Geospatial Data With New Savoir-Faire', *Forbes*, 17 July 2020. Accessed 10 January 2021. <https://www.forbes.com/sites/adrianbridgwater/2020/07/17/french-ai-defense-startup-tracks-geospatial-data-with-new-savoir-faire/?sh=475088a86354>.

124 Thales, 'Collaborative Anti-Submarine Warfare', 2021. Accessed 28 October 2021. <https://www.thalesgroup.com/en/markets/defence-and-security/naval-forces/underwater-warfare/collaborative-anti-submarine-warfare>.

125 Thales, 'Thales to Develop New Connected Sensors for Rafale F4 Standard', 18 January 2019. Accessed 10 January 2021. <https://www.thalesgroup.com/en/group/press-release/thales-develop-new-connected-sensors-rafale-f4-standard>.

126 Magalie Veyrat, 'MASA Group Awarded Spanish Army Training Contract'.

# 10. Germany

## 10.1. AI Strategy

In November 2018, Germany published a national AI strategy titled 'Artificial Intelligence Strategy'. The strategy only mentions the military applications of AI a few times. It states that 'the competent ministries will take charge of any research conducted into the use of AI to protect the country's external security and for military purposes'.<sup>127</sup>

While the German military has not released a joint AI strategy, the German Army released its own AI strategy, titled 'Artificial Intelligence in Land Forces'.<sup>128</sup> The document predicts that in the future, war will be fought at machine speed, resulting in 'hyperwar', and so notes that it is important for the German armed forces to develop their AI military capabilities. Additionally, as German adversaries develop AI-enabled systems, the German army has trouble recruiting qualified people, and the amount of data collected increases, it will be essential for the German army to develop AI systems before a capability gap forms. The document outlines six main driving forces of German military AI development:

- AI capabilities of potential adversaries
- Increasing dynamics of combat operations
- Fewer qualified personnel available
- Declining relative purchasing power and shortage of resources
- Increasing quantity and density of information
- Increasing dynamics in the development of IT and AI

It also describes three main goals for German military AI:

- Increasing the efficiency of routine duty
- Improving capabilities on operations
- Addressing potential capability gaps

In order to achieve these goals, the document identifies five areas where AI can be applied in the military:

- **Image analysis:** Fast recognition and classification (from the air or ground) of disguised/camouflaged objects on the ground and of small targets in the air
- **Tactical UAS:** To be used as barriers and offensive weapons or in intelligence, surveillance, and reconnaissance (ISR) operations
- **Battle management systems:** C2, decision support,

and information management for 'hyperwar', in which AI conducts targeting, selects munitions and artillery for engagement, deploys forces, estimates possible hostile zones, and leads friendly forces in targeted attacks

- **Material and infrastructure:** Predictive maintenance and maintenance support, error analysis, resource allocation, and scheduling
- **Analysis method:** AI analyses big data sets to provide support on classic problems relating to data analysis and optimisation

The document stresses the importance of following IHL when developing AI-enabled military capabilities. Interestingly, in the past, top German officials have advocated for a ban on LAWS<sup>129</sup> and claimed that the German military would not use LAWS.<sup>130</sup> However, as mentioned by the land forces AI strategy document, the German military uses a number of military systems with autonomous capabilities. This seeming contradiction is explained by the specific definition of LAWS used by the German military. The land forces AI strategy document specifically excludes 'weapon systems that are not primarily intended to apply lethal force against people' from its definition of LAWS, so autonomous military systems that merely conduct ISR or Air and Missile Defence (AMD) do not technically count as LAWS.

The German Army plans to release two more strategy documents relating to AI, titled 'Robotics and Autonomous Systems (RAS) in Land Forces' and 'Digitisation in Land Forces'.

## 10.2. Autonomous Vehicles

The German military uses a number of unmanned vehicles with autonomous capabilities, including loitering munitions with 'man-in-the-loop' attack modes.<sup>131</sup>

### UAVs

- Spain and Germany developed the Barracuda demonstrator UAV, which operates completely autonomously.<sup>132</sup>

127 European Commission, 'Germany: Artificial Intelligence Strategy', 9 April 2019. Accessed 19 January 2021. [https://knowledge4policy.ec.europa.eu/publication/germany-artificial-intelligence-strategy\\_en](https://knowledge4policy.ec.europa.eu/publication/germany-artificial-intelligence-strategy_en).

128 German Army Concepts and Capabilities Development Centre, 'Artificial Intelligence in Land Forces: A Position Paper by the German Army Concepts and Capabilities Development Centre'. Bundeswehr, November 2019. Accessed 22 November 2020. <https://www.bundeswehr.de/resource/blob/156026/3f03afe6a20c35d07b0ff56aa8d04878/download-positionspapier-englische-version-data.pdf>.

129 Human Rights Watch, 'Germany: Support a Ban on "Killer Robots"', 14 March 2019. Accessed 22 December 2020. <https://www.hrw.org/news/2019/03/14/germany-support-ban-killer-robots#>.

130 Reuters, 'German Military Has No Plans to Acquire Robot Weapons: General', 15 February 2018. Accessed 18 January 2021. <https://uk.reuters.com/article/uk-germany-security-robots-idUKKCN1FZ2NA>.

131 Erico Guizzo, 'Autonomous Weapons "Could Be Developed for Use within Years", Says Arms-Control Group', *IEEE Spectrum*, 14 April 2016. Accessed 18 January 2021. <https://spectrum.ieee.org/automaton/robotics/military-robots/autonomous-weapons-could-be-developed-for-use-within-years>.

132 Army Technology, 'Barracuda Demonstrator Unmanned Air Vehicle Developed by EADS Military Air Systems', Verdict Media Limited. Accessed 19 January 2021. <https://www.army-technology.com/projects/barracuda-demonstrator-uav/>.

- AeroVironment's Puma 3 AE tactical UAV can navigate autonomously.<sup>133</sup>
- EMT Ingenieur's LUNA UAV has several autonomous features, including autonomous flight.<sup>134</sup>
- IAI's Harop UAV,<sup>135</sup> which operates as a loitering munition, has autonomous flight capabilities.<sup>136</sup>

### UGVs

- Milrem's TheMIS UGV<sup>137</sup> can be controlled autonomously.<sup>138</sup>

### UUVs

- Saab's Skeldar V-200 UAV, which the German Navy uses for mine countermeasures (MCM),<sup>139</sup> can autonomously conduct mine clearance missions at sea.<sup>140</sup>
- Currently, Poland and Germany are developing a swarm of biomimetic underwater vehicles for underwater intelligence, surveillance, and reconnaissance (SABUVIS II). This project is a continuation of a previous project developed by Portugal, Germany, and Poland (SABUVIS I).<sup>141</sup>

## 10.3. Autonomous Air and Missile Defence Systems, Autonomous

## Missiles, and AI-Enabled Aircraft

Germany, along with France and Spain, is currently developing the Future Combat Air System (FCAS), which aims to create a sixth-generation fighter aircraft.<sup>142</sup> The aircraft will be a system of systems, many of which will be equipped with AI and neural networks.<sup>143</sup> For example, AI will allow the aircraft to team with unmanned platforms,<sup>144</sup> share information with other actors in a 'combat cloud',<sup>145</sup> and assist in pilot situational awareness and decision-making.<sup>146</sup>

The German military uses several air defence systems that can be operated in autonomous mode, including Raytheon's Patriot air defence system<sup>147</sup> and Rheinmetall's MANTIS air system.<sup>148</sup> Germany also uses Diehl's AWISS active protection system, which operates autonomously against anti-tank missiles.<sup>149</sup>

The German Navy uses Leonardo's MU90 IMPACT Advanced Lightweight Torpedo,<sup>150</sup> which has autonomous 'launch and forget' capabilities.<sup>151</sup> Germany also employs Boeing's Harpoon Block II anti-ship missile,<sup>152</sup> which has some autonomous capabilities.<sup>153</sup> Additionally, Germany uses Raytheon's SeaRAM anti-ship cruise missile system, which has autonomous guidance capabilities.<sup>154</sup>

## 10.4. Data Analytics

Currently, the German Ministry of Defence is developing an

133 Mike Ball, 'German Navy Acquires AeroVironment Puma UAS', Unmanned Systems Technology, 8 May 2018. Accessed 19 January 2021. <https://www.unmannedsystemstechnology.com/2018/05/german-navy-acquires-aerovironment-puma-uas>; AeroVironment, 'Puma 3'.

134 Paul J. Springer, *Military Robots and Drones: A Reference Handbook* (Santa Barbara, CA: ABC-CLIO, 2013), 75.

135 Airforce Technology, 'Harop Loitering Munitions UCAV System', Verdict Media Limited. Accessed 19 January 2021. <https://www.airforce-technology.com/projects/haroploiteringmunitil/>.

136 Israel Aerospace Industries, 'HAROP: Loitering Munition System', Accessed 22 November 2020. <https://www.iai.co.il/p/harop>.

137 Milrem, 'Themis: Milrem'.

138 Army Technology, 'TheMIS Hybrid Unmanned Ground Vehicle'.

139 UMS Skeldar, 'First SKELDAR V-200 Platforms from Scanfil Make Way on to Frontline Ahead of Mass Production Planned for 2020'.

140 UMS Skeldar, 'Latest Activities at UMS Skeldar'.

141 European Defence Agency, 'EDA Expands Work on Autonomous Underwater Vehicles', 27 September 2019. Accessed 19 January 2021. <https://www.eda.europa.eu/info-hub/press-centre/latest-news/2019/09/27/eda-expands-work-on-autonomous-underwater-vehicles>.

142 Airbus, 'Future Combat Air System (FCAS): Shaping the Future of Air Power'.

143 Frank Wolfe, 'Flexible Neural Networks Needed for FCAS, Airbus Official Says', *Aviation Today*. Access Intelligence, 19 May 2020. Accessed 17 November 2020. <https://www.aviationtoday.com/2020/05/19/flexible-neural-networks-needed-fcas-airbus-official-says/>; Bellamy, 'How Neural Networks Are Already Showing Future Potential for Aerospace'.

144 Airbus, 'Future Combat Air System: Owning the Sky with the Next Generation Weapons System'.

145 Sprenger, 'Three European Air Forces Approve Performance Benchmarks for Next-Gen Fighter Jet'.

146 Airbus, 'Future Combat Air System: Owning the Sky with the Next Generation Weapons System'.

147 Army Technology, 'Patriot Missile Long-Range Air-Defence System'; John K. Hawley, 'Patriot Wars', Center for a New American Security, 25 January 2017. Accessed 20 November 2020. <https://www.cnas.org/publications/reports/patriot-wars>.

148 Army Technology, 'NBS MANTIS Air Defence Protection System', Verdict Media Limited. Accessed 19 January 2021. <https://www.army-technology.com/projects/mantis/>; German Army Concepts and Capabilities Development Centre, 'Artificial Intelligence in Land Forces: A Position Paper by the German Army Concepts and Capabilities Development Centre'.

149 Vincent C Müller, 'Autonomous Killer Robots Are Probably Good News,' In *Drones and Responsibility: Legal, Philosophical and Socio-Technical Perspectives on Remotely Controlled Weapons*, edited by Ezio Di Nucci and Filippo Santoni de Sio, 67–81, Ashgate, <https://doi.org/10.4324/9781315578187-4>; Boulanin and Verbruggen, 'SIPRI: Mapping the Development of Autonomy in Weapon Systems'.

150 Naval Technology, 'The World's Deadliest Torpedoes'.

151 Leonardo, 'Whitehead MU90'.

152 Missile Defense Project, 'Harpoon'.

153 Boeing, 'Harpoon Block II'.

154 MBDA Missile Defence, 'RAM Block 2 Rolling Airframe Missile for Ship Self-Defence', 2018. Accessed 9 January 2021. <https://www.mbdadeutschland.de/wp-content/uploads/2018/03/RAM-e-18.pdf>.

early crisis development programme, which would use AI<sup>155</sup> to improve the military's ability to forecast and detect crises around the world.<sup>156</sup>

## 10.5. Logistics and Personnel Management

The German military is currently developing an AI-enabled air traffic management system called the System Wide Information Management (SWIM). SWIM will enable a number of relevant groups, including the weather service, military, airports, airlines, pilots, and air traffic controllers, to share data and organise airspace. It will also allow the integration of unmanned aircraft into airspace. The researchers expect SWIM to 'revolutionise future military air-borne operations'.<sup>157</sup>

## 10.6. Other

Poland, Germany, and the Netherlands are currently developing a new project called 'Communications and Radar Systems hardened with Artificial Intelligence in a contested electronic warfare environment' (CRAI), which will study the use of artificial intelligence for the benefit of military communications and radar systems, as military radiocommunication and radiolocation services are faced with increasing challenges, such as increased spectrum density and limited frequency bandwidth.<sup>158</sup>

German defence company Hensoldt recently released an AI-enabled electronic warfare system called 'Kalætron Attack'. Kalætron Attack uses AI to 'detect radar-based threats to air forces in record time and neutralise them with targeted electronic countermeasures'.<sup>159</sup> Kalætron Attack may be integrated into the German Air Force in the future.<sup>160</sup>

The German military is currently researching machine learning and AI methods to improve radar systems and create 'smart' sensors.<sup>161</sup>

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155 Ludwig Leinhos, 'Cyber Defence in Germany: Challenges and the Way Forward for the Bundeswehr', *Connections: The Quarterly Journal* 19, no. 1 (2020): 9–19. <https://doi.org/10.11610/connections.19.1.02>.

156 Digital-made-in.de, 'Shaping Digitalization: Implementation Strategy of the Federal Government', Federal Government of Germany, 30 December 2018. Accessed 9 September 2021. <https://www.bundesregierung.de/resource/blob/992814/1605342/284988700922725d63a0fb95db824024/digitalsierung-gestalten-englisch-download-bpa-data.pdf>.

157 Federal Ministry of Defence of Germany, 'Military Scientific Research Annual Report 2015: Defence Research for the German Armed Forces', 2015. Accessed 22 December 2020. <https://www.bmvg.de/resource/blob/13614/49cb1a0b29c0d92521c7e2f59a3f6b6e/g-03-download-military-scientific-research-annual-report-2015-englisch-data.pdf>.

158 European Defence Agency, 'Stronger Communication and Radar Systems with Help of AI', 31 August 2020. Accessed 30 November 2020, <https://www.eda.europa.eu/info-hub/press-centre/latest-news/2020/08/31/stronger-communication-radar-systems-with-help-of-ai>.

159 Hensoldt, 'Electronic Shield for Air Forces: Hensoldt's Kalætron Product Family Welcomes a New Addition', 23 April 2020. Accessed 19 January 2021. <https://www.hensoldt.net/news/electronic-shield-for-air-forces/>.

160 *Global Defence Technology*, 'NATO Investment Brings Electronic Warfare Back Into Fashion', no. 112 (June 2020). [https://defence.nridigital.com/global\\_defence\\_technology\\_jun20/nato-electronic-warfare-investment](https://defence.nridigital.com/global_defence_technology_jun20/nato-electronic-warfare-investment).

161 Defence Research for the German Armed Forces, 2020, 'Military Scientific Research Annual Report 2015'.

# 11. Greece

## 11.1. AI Strategy

Greece is currently developing a national AI strategy but has not yet released an AI strategy or a military AI strategy.<sup>162</sup> Additionally, Greece is working with consultancy group Ernst and Young to create an Artificial Intelligence Centre of Excellence in Greece.<sup>163</sup>

## 11.2. Autonomous Vehicles

Greece, along with a number of other European countries, is currently developing the nEUROn demonstrator UAV,<sup>164</sup> which has several autonomous capabilities, including autonomous target recognition and ordnance management.<sup>165</sup>

## 11.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

Greece uses Raytheon's Patriot air defence system,<sup>166</sup> which can operate in autonomous mode.<sup>167</sup> Additionally, the Greek Navy uses Raytheon's SeaRAM anti-ship cruise missile system, which has autonomous guidance capabilities.<sup>168</sup> Greece also employs Boeing's Harpoon Block II anti-ship missile,<sup>169</sup> which has some autonomous capabilities.<sup>170</sup>

## 11.4. Data Analytics

N/A

## 11.5. Logistics and Personnel Management

N/A

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<sup>162</sup> OECD, 'Policy Initiatives for Greece', OECD.ai,2021.. Accessed 19 January 2021. <https://www.oecd.ai/dashboards/policy-initiatives/?conceptUri=http%3A%2F%2Fkim.oecd.org%2FTaxonomy%2FGeographicalAreas%23Greece>.

<sup>163</sup> EKathimerini, 'EY to Create AI Center in Greece', 5 August 2019. Accessed 19 January 2021. <https://www.ekathimerini.com/243323/article/ekathimerini/business/ey-to-create-ai-center-in-greece>.

<sup>164</sup> Dassault Aviation, 'NEUROn, the European Combat Drone Demonstrator: Introduction'.

<sup>165</sup> Protti and Barzan, 'UAV Autonomy: Which Level Is Desirable? Which Level Is Acceptable? Alenia Aeronautica Viewpoint'.

<sup>166</sup> Army Technology, 'Patriot Missile Long-Range Air-Defence System', Verdict Media Limited, Accessed 8 January 2020. <https://www.army-technology.com/projects/patriot/>.

<sup>167</sup> Hawley, 'Patriot Wars'.

<sup>168</sup> United States Navy, 'RIM-116 Rolling Airframe Missile (RAM)', US Department of Defense, 17 January 2019. Accessed 19 January 2021. <https://www.navy.mil/DesktopModules/ArticleCS/Print.aspx?PortalId=1&ModuleId=724&Article=2168961>.

<sup>169</sup> Missile Defense Project, 'Harpoon'.

<sup>170</sup> Boeing, 'Harpoon Block II'.

# 12. Hungary

## 12.1. AI Strategy

In September 2020, Hungary released a national AI strategy titled 'Hungary's Artificial Intelligence Strategy 2020–2030'.<sup>171</sup> While Hungary has not released a military AI strategy, their national AI strategy does mention military applications of AI. The document states that Hungary already uses AI for 'testing autonomous vehicles in a military environment',<sup>172</sup> and one of Hungary's main goals for AI is the 'development of AI capabilities for military and national security purposes'. This goal has three subgoals:

- 'Development of basic infrastructure for developing and running programmes'
- 'Development and implementation of AI-based data collection and processing systems'
- 'AI-based support for the cyberspace used for military purposes'<sup>173</sup>

## 12.2. Autonomous Vehicles

The Hungarian military uses AeroVironment's RQ-11 Raven UAV, which can navigate autonomously.<sup>174</sup>

## 12.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

For air defence, Hungary uses Raytheon's Advanced Medium-Range Air-to-Air Missile (AMRAAM),<sup>175</sup> which has autonomous 'launch and leave' capabilities.<sup>176</sup> Additionally, Hungary uses MBDA's Mistral 2 very-short-range air defence missile system, which has fully autonomous 'fire and forget' capabilities.<sup>177</sup>

## 12.4. Data Analytics

N/A

## 12.5. Logistics and

## Personnel Management

N/A

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171 Ministry for Innovation and Technology, 'Hungary's Artificial Intelligence Strategy: 2020–2030', Government of Hungary, May 2020. Accessed 14 January 2021. <https://ai-hungary.com/api/v1/companies/15/files/146074/view>.

172 Ibid., 15.

173 Ibid., 38.

174 US Department of Defense, 'RQ-11B RAVEN Small Unmanned Aircraft Systems (SUAS)'.

175 Center for Strategic and International Studies, 'Hungary Purchases AMRAAM, NASAMS'. CSIS, 14 August 2020. Accessed 17 November 2020. <https://missilethreat.csis.org/hungary-purchases-amraam-nasams/>.

176 Military and Aerospace Electronics, 'Air Force Orders Hundreds of Raytheon AMRAAM Air-to-Air Missiles in \$573 Million Deal'; US Department of Defense, 'Selected Acquisition Report: AIM-120 Advanced Medium Range Air-to-Air Missile (AMRAAM)'.

177 Army Technology, 'Mistral: Air Defence Missile System'.

# 13. Iceland

## 13.1. AI Strategy

Iceland has not released an AI strategy or a military AI strategy; however, they published an AI strategy together with a number of Nordic and Baltic states titled 'AI in the Nordic-Baltic Region', which does not mention military applications of AI.<sup>178</sup> Iceland plans to release its national AI strategy in 2021.<sup>179</sup> It is important to note that Iceland is the only NATO country without a standing army.

## 13.2. Autonomous Vehicles

The Icelandic Coast Guard uses Teledyne's Gavia AUVs, which operate autonomously.<sup>180</sup>

## 13.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

N/A

## 13.4. Data Analytics

N/A

## 13.5. Logistics and Personnel Management

N/A

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178 Nordic Council of Ministers, 'AI in the Nordic-Baltic Region'.

179 OECD, 'Iceland's AI Strategy', OECD.ai, 16 November 2020. Accessed 24 November 2021.  
<https://oecd.ai/en/dashboards/policy-initiatives/http:%2F%2Faipo.oecd.org%2F2021-data-policyInitiatives-26847>.

180 Mike Ball, 'Teledyne Marine Delivers Unmanned Underwater Vehicles to UAE Navy', Unmanned Systems Technology, 21 February 2019. Accessed 19 January 2021. <https://www.unmannedsystemstechnology.com/2019/02/teledyne-marine-delivers-unmanned-underwater-vehicles-to-uae-navy/>.



# 14. Italy

## 14.1. AI Strategy

In August 2019, Italy published a national AI strategy titled 'National Strategy for Artificial Intelligence',<sup>181</sup> which does not mention military applications of AI. Italy does not have a military AI strategy.

## 14.2. Autonomous Vehicles

Italy's military uses a number of UAVs with autonomous capabilities and is in the process of developing an autonomous UAV with other European partners.

### UAVs

- AeroVironment's RQ-11 Raven UAV can navigate autonomously.<sup>182</sup>
- Boeing's ScanEagle<sup>183</sup> UAV operates fully autonomously.<sup>184</sup>
- Italy, along with a number of other European countries, is currently developing the nEUROn demonstrator UAV,<sup>185</sup> which has several autonomous capabilities, including autonomous target recognition and ordnance management.<sup>186</sup>

## 14.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

The Italian Air Force is working with Italian defence company Leonardo to develop AI applications in the aeronautical

sector in an initiative known as AIRtificial Intelligence.<sup>187</sup>

The Italian Navy uses Leonardo's MU90 IMPACT Advanced Lightweight Torpedo,<sup>188</sup> which has autonomous 'launch and forget' capabilities.<sup>189</sup>

Italy uses several air defence systems with autonomous capabilities, namely Eurosam's SAMP/T Air Defence System,<sup>190</sup> which protects against UAVs, cruise missiles, short-range ballistic missiles, and fighter aircraft,<sup>191</sup> and Leonardo's DARDO air defence system.<sup>192</sup>

Italy is a partner in Lockheed Martin's F-35 Lightning II fighter aircraft programme,<sup>193</sup> which has several artificial intelligence components, including decision support and data analytics systems.<sup>194</sup> In the future, the F-35 will likely also use artificial intelligence to control unmanned drone 'wingmen', which could carry weapons, conduct ISR, or test enemy air defences.<sup>195</sup>

Italy is working with the UK to develop the BAE Tempest next generation aircraft,<sup>196</sup> which will have an AI-enabled autonomous flight system that would enable the aircraft to fly without a pilot.<sup>197</sup>

## 14.4. Data Analytics

N/A

## 14.5. Logistics and Personnel Management

N/A

181 'Strategia Nazionale per l'Intelligenza Artificiale' [in Italian].

182 Army Technology, 'RQ-11 Raven Unmanned Aerial Vehicle', Verdict Media Limited, 2020. Accessed 6 January 2021. <https://www.army-technology.com/projects/rq-11-raven/>.

183 Boeing, 'Historical Snapshot'.

184 Boeing MediaRoom, 'Boeing/Insitu ScanEagle UAV Launched From Ship; Completes Historic Autonomous Flight'.

185 Dassault Aviation, 'NEUROn, the European Combat Drone Demonstrator: Introduction'.

186 Protti and Barzan, 'UAV Autonomy: Which Level Is Desirable? Which Level Is Acceptable? Alenia Aeronautica Viewpoint'.

187 Leonardo, 'Leonardo and Italian Air Force: New Artificial Intelligence Applications in the Aeronautical Sector', 12 December 2019. Accessed 19 January 2021. <https://www.leonardocompany.com/en/press-release-detail/-/detail/12-12-19-leonardo-and-italian-air-force-new-artificial-intelligence-applications-in-the-aeronautical-sector>.

188 Naval Technology, 'The World's Deadliest Torpedoes'.

189 Leonardo, 'Whitehead MU90'.

190 Boulain and Verbruggen, 'Mapping the Development of Autonomy in Weapons Systems'; Eurosam, 'Eurosam: Ground-Launched Systems'.

191 MDAA, 'SAMP/T Air Defence System (France and Italy)'.

192 James Farrant and Christopher M. Ford, 'Autonomous Weapons and Weapon Reviews: The UK Second International Weapon Review Forum', *International Law Studies* 93, no. 389 (2017). <https://digital-commons.usnwc.edu/cgi/viewcontent.cgi?article=1710&context=ils>; Boulain and Verbruggen, 'SIPRI: Mapping the Development of Autonomy in Weapon Systems'.

193 F-35 Lightning II, 'Italy F-35: Made in Italy – Delivered to the World'. Accessed 9 January 2021. <https://www.f35.com/global/participation/italy>.

194 Kris Osborn, 'The F-35 Will Soon Be Equipped with Artificial Intelligence to Control Drone Wingmen'.

195 Kris Osborn, 'The F-35 Will Soon Be Equipped with Artificial Intelligence to Control Drone Wingmen'.

196 BAE Systems, 'UK and Italian Industry to Partner on Tempest', 11 September 2019. Accessed 19 January 2021. <https://www.baesystems.com/en/article/uk-and-italian-industry-to-partner-on-tempest>.

197 Eric Adams, 'Meet the UK's New, Very British Fighter Jet'. *Wired*, 6 August 2018. Accessed 19 January 2021. <http://wired.com/story/uk-very-british-tempest-fighter-jet>.

# 15. Latvia

## 15.1. AI Strategy

In February 2020 Latvia released its national AI strategy titled 'Developing Artificial Intelligence Solutions'.<sup>198</sup> Additionally, Latvia published an AI strategy along with a number of Nordic and Baltic states titled 'AI in the Nordic-Baltic Region', which does not mention military applications of AI.<sup>199</sup>

While Latvia does not have a military AI strategy, their national AI strategy briefly mentions military AI, saying that in the future, AI will be used for military purposes such as intelligence processing and decision support.<sup>200</sup>

## 15.2. Autonomous Vehicles

Latvia uses several unmanned aerial, ground, and underwater vehicles and is currently developing a UGV with Estonia and several other nations.

### UAV

→ AeroVironment's Puma 3 AE tactical UAV<sup>201</sup> can navigate autonomously.<sup>202</sup>

### UGV

→ Latvia is helping Estonia defence company Milrem<sup>203</sup> develop the THeMIS UGV, which can be controlled autonomously.<sup>204</sup>  
→ DCD Group's Husky Mine Detection Vehicle can operate semi-autonomously.<sup>205</sup>

### UUV

→ ECA Group's A9-M AUV, which is used by the Latvian Navy for MCM, operates autonomously.<sup>206</sup>

## 15.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

N/A

## 15.4. Data Analytics

N/A

## 15.5. Logistics and Personnel Management

N/A

198 Informatīvais ziņojums, 'Par mērķlīgā intelekta risinājumu attīstību' [in Latvian].

199 Nordic Council of Ministers, 'AI in the Nordic-Baltic Region'.

200 European Commission, 'Latvia AI Strategy Report: Knowledge for Policy', 2020. Accessed 22 December 2020. [https://knowledge4policy.ec.europa.eu/ai-watch/latvia-ai-strategy-report\\_en](https://knowledge4policy.ec.europa.eu/ai-watch/latvia-ai-strategy-report_en).

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## 16. Lithuania

### 16.1. AI Strategy

In April 2019, Lithuania published a national AI strategy titled 'Lithuanian Artificial Intelligence Strategy: A Vision for the Future'.<sup>207</sup> Additionally, Lithuania published an AI strategy together with a number of Nordic and Baltic states titled 'AI in the Nordic-Baltic Region'.<sup>208</sup> Neither document mentions military applications of AI. Lithuania does not have a military AI strategy.<sup>209</sup>

### 16.2. Autonomous Vehicles

Unlike its Baltic neighbours Estonia and Latvia, Lithuania has not joined the Estonian-led THeMIS UGV project, citing cost.<sup>210</sup>

### 16.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

Lithuania uses Kongsberg's NASAM air defence system,<sup>211</sup> which has some autonomous capabilities.<sup>212</sup>

### 16.4. Data Analytics

N/A

### 16.5. Logistics and Personnel Management

N/A

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209 Ministry of Economy and Innovation, 'Lithuanian Artificial Intelligence Strategy', 2018.

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212 Kongsberg, 'Fire Distribution Center (FDC)', Kongsberg Defence and Aerospace. Accessed 19 January 2021. <https://www.kongsberg.com/kda/products/defence-and-security/integrated-air-and-missile-defence/nasams-air-defence-system/nasams-fire-distribution-center-fdc/>.

# 17. Luxembourg

## 17.1. AI Strategy

In May 2019, Luxembourg published a national AI strategy titled 'Artificial Intelligence: A Strategic Vision for Luxembourg', which does not mention military applications of AI.<sup>213</sup> Luxembourg has not published a military AI strategy.

## 17.2. Autonomous Vehicles

N/A

## 17.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

N/A

## 17.4. Data Analytics

N/A

## 17.5. Logistics and Personnel Management

N/A

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<sup>213</sup> Government of the Grand Duchy of Luxembourg, 'Artificial Intelligence: A Strategic Vision for Luxembourg', 2020. Accessed 4 December 2020. [https://digital-luxembourg.public.lu/sites/default/files/2020-09/AI\\_EN\\_0.pdf](https://digital-luxembourg.public.lu/sites/default/files/2020-09/AI_EN_0.pdf).

# 18. Montenegro

## 18.1. AI Strategy

Montenegro does not have an AI strategy or a military AI strategy.

## 18.2. Autonomous Vehicles

N/A

## 18.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

N/A

## 18.4. Data Analytics

N/A

## 18.5. Logistics and Personnel Management

N/A

# 19. The Netherlands

## 19.1. AI Strategy

The Netherlands published a national AI strategy titled 'Strategic Action Plan for Artificial Intelligence' in October 2019 and is currently developing a military AI strategy.<sup>214</sup>

The Dutch AI strategy has an entire section dedicated to the use of AI to enhance national security. It notes that there are a number of ways to apply AI to the military, including 'the field of decision support, intelligence gathering, data analysis and accelerated responsiveness'. The strategy also notes that 'another advantage of AI systems for the Ministry of Defence is the possibility of intervening in areas that are not accessible to people due to Anti-Access/Area Denial weapon systems'. Additionally, the Dutch MoD has a Robotic Autonomous Systems unit, which focuses on developing robotic and autonomous systems for the military.

Artificial intelligence also plays a role in the Royal Netherlands Army (RNLA) document 'Vision of the Army: Security through Foresight', which states that the RNLA will continue researching a number of emerging technologies, including artificial intelligence.<sup>215</sup>

## 19.2. Autonomous Vehicles

The Dutch military uses a number of unmanned aerial and underwater vehicles with autonomous capabilities and is currently in the process of developing several UGVs with autonomous capabilities.

### UAVs

→ AeroVironment's RQ-11 Raven UAV can navigate autonomously.<sup>216</sup>

→ Boeing's ScanEagle217 UAV operates fully autonomously.<sup>218</sup>

→ Saab's Skeldar V-200 UAV, which the Royal Netherlands Navy (RNLN) uses for mine countermeasures (MCM), can autonomously conduct mine clearance missions at sea.<sup>219</sup>

### UGVs

→ The RNLA RAS unit is experimenting with Milrem's TheMIS UGV,<sup>220</sup> which can be controlled autonomously.<sup>221</sup>

→ The RNLA RAS unit is currently developing Rheinmetall's Mission Master UGV, which can operate autonomously.

### UUVs

→ Kongsberg's REMUS 100 AUV, which the RNLN uses for MCM, operates autonomously.<sup>222</sup>

→ ECA Group's A-18M AUV, which the RNLN uses for MCM, operates autonomously.<sup>223</sup>

## 19.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

The Netherlands uses Raytheon's Patriot air defence system,<sup>224</sup> which can operate in autonomous mode.<sup>225</sup> Additionally, the Netherlands uses Thales's ship-mounted, short-range air defence system Goalkeeper, which operates autonomously.<sup>226</sup> The Netherlands also uses Boeing's Harpoon Block II anti-ship missile,<sup>227</sup> which has some autonomous capabilities.<sup>228</sup>

214 Ministry of Economic Affairs and Climate, 'Strategic Action Plan For Artificial Intelligence', Government of the Netherlands, October 2019. Accessed 2 January 2021. <https://www.government.nl/documents/reports/2019/10/09/strategic-action-plan-for-artificial-intelligence>.

215 Royal Netherlands Army, 'Vision of the Army: Security through Foresight', Ministerie van Defensie, 5 November 2018. Accessed 9 January 2021. <https://english.defensie.nl/downloads/publications/2018/11/05/vision-of-the-army>.

216 Army Technology, 'RQ-11 Raven Unmanned Aerial Vehicle'.

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221 Army Technology, 'TheMIS Hybrid Unmanned Ground Vehicle'.

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223 Nathan Gain, 'Opening the Toolbox: ECA's Solution for the Belgian-Dutch MCM Program', *Naval News*, 26 June 2019. Accessed 19 January 2021. <https://www.navalnews.com/naval-news/2019/06/opening-the-toolbox-ecas-solution-for-the-belgian-dutch-mcm-program/>.

224 Raytheon, 'Sweden, US Sign Agreement For Patriot: Sixteen Nations Now Rely on Patriot System for Missile Defense; Raytheon', 2018. Accessed 8 September 2021. <https://www.raytheon.com/news/feature/sweden-us-sign-agreement-patriot>.

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227 Missile Defense Project, 'Harpoon'.

228 Boeing, 'Harpoon Block II'.

The Netherlands is a partner in Lockheed Martin's F-35 Lightning II fighter aircraft programme,<sup>229</sup> which has several artificial intelligence components, including decision support and data analytics systems.<sup>230</sup> In the future, the F-35 will likely also use artificial intelligence to control unmanned drone 'wingmen', which could carry weapons, conduct ISR, or test enemy air defences.<sup>231</sup>

## 19.4. Data Analytics

N/A

## 19.5. Logistics and Personnel Management

N/A

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<sup>229</sup> Lockheed Martin, 'F-35 for the Netherlands'. Accessed 19 January 2021.

<https://www.lockheedmartin.com/en-us/products/f-35/f-35-global-partnership/f-35-netherlands.html>.

<sup>230</sup> Kris Osborn, 'The F-35 Will Soon Be Equipped with Artificial Intelligence to Control Drone Wingmen'.

<sup>231</sup> Kris Osborn, 'The F-35 Will Soon Be Equipped with Artificial Intelligence to Control Drone Wingmen'.

## 20. North Macedonia

### 20.1. AI Strategy

North Macedonia does not have an AI strategy or a military AI strategy; however, the Ministry of Defense published a 'Long-Term Defense Capability Development Plan 2019–2028' document, which does mention using AI for personnel management.

### 20.2. Autonomous Vehicles

The North Macedonian military uses AeroVironment's RQ-11 Raven UAV,<sup>232</sup> which can navigate autonomously.<sup>233</sup>

### 20.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

N/A

### 20.4. Data Analytics

N/A

### 20.5. Logistics and Personnel Management

The North Macedonian MoD 'Long-Term Defense Capability Development Plan' describes how the military hopes to use AI for human resource management in the next decade. 'The vision of the Strategy envisages integration information technology, artificial intelligence and management of organisational knowledge in the processes of the System, so as to plan and direct the creation, maintenance and development of professional and motivated human potential in the defence'.<sup>234</sup>

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<sup>232</sup> Army of the Republic of North Macedonia, 'Training with Tactical UAV "RAVEN"'. Accessed 19 January 2021. <http://www.arm.mil.mk/operations-command/obuka-so-taktichko-bespilotno-letalno-raven/?lang=en>.

<sup>233</sup> Army Technology, 'RQ-11 Raven Unmanned Aerial Vehicle'.

<sup>234</sup> Republic of North Macedonia Ministry of Defence, 'Long-Term Defence Capability Development Plan: 2019–2028', May 2019. Accessed 6 January 2021. <http://www.mod.gov.mk/wp-content/uploads/2019/10/LTDCDP-2019-2028-finalna-verzija.pdf>, 27.



# 21. Norway

## 21.1. AI Strategy

In January 2020, Norway published a national AI strategy titled 'National Strategy for Artificial Intelligence', which does not mention defence. Norway has not published a military AI strategy.

## 21.2. Autonomous Vehicles

The Norwegian military has used UUVs with autonomous capabilities for several decades and is currently developing a UGV with autonomous capabilities.

### UUVs

- Kongsberg's REMUS 100 AUV operates autonomously.<sup>235</sup>
- Kongsberg's HUGIN AUV can operate autonomously.<sup>236</sup>

### UGVs

- Norway is helping Estonia defence company Milrem<sup>237</sup> develop the THeMIS UGV, which can be controlled autonomously.<sup>238</sup>

## 21.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

The Royal Norwegian Navy uses the Aegis Ballistic Missile Defence system,<sup>239</sup> which is capable of autonomous missile defence operations.<sup>240</sup>

The Norwegian military employs several missiles with autonomous capabilities. The Navy uses Kongsberg's Naval Strike Missile and the Royal Norwegian Air Force uses Kongsberg's Joint Strike Missile, both of which rely on autonomous target recognition to detect and hit the correct target.<sup>241</sup>

Norway is a partner in Lockheed Martin's F-35 Lightning II fighter aircraft programme,<sup>242</sup> which has several artificial intelligence components, including decision support and data analytics systems.<sup>243</sup> In the future, the F-35 will likely also use artificial intelligence to control unmanned drone 'wingmen', which could carry weapons, conduct ISR, or test enemy air defences.<sup>244</sup>

## 21.4. Data Analytics

N/A

## 21.5. Logistics and Personnel Management

N/A

235 Naval Technology, 'REMUS-100 Automatic Underwater Vehicles'.

236 Per Espen Hagen, Nils Størkersen, Karstein Vestgård, Per Kartvedt, and Geir Sten, 'Operational Military Use of the HUGIN AUV in Norway', Proceedings UDT Europe 2003 (2003): 123–130.

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242 Lockheed Martin, 'Global Participation: The Centerpiece of 21st Century Global Security'.

243 Kris Osborn, 'The F-35 Will Soon Be Equipped with Artificial Intelligence to Control Drone Wingmen'.

244 Kris Osborn, 'The F-35 Will Soon Be Equipped with Artificial Intelligence to Control Drone Wingmen'.

## 22. Poland

### 22.1. AI Strategy

In August 2019 the Polish government published its AI strategy<sup>245</sup> 'Artificial Intelligence Development Policy in Poland for 2019–2027'.<sup>246</sup> The strategy encourages the Polish Ministry of Defence to further develop AI for military purposes. However, it also notes that the use of AI in military systems like drones and autonomous weapons is ethically questionable.

While Poland has not released a military AI strategy, the Polish Ministry of Defence published a document titled 'Polish Defence in the Perspective of 2032', which outlines Polish military plans for the future, including Polish plans for military AI. The document states that by 2032, Poland 'will possess autonomous systems enabling commanders to grasp the full operational picture and to take faster decisions'.<sup>247</sup>

### 22.2. Autonomous Vehicles

Poland's military uses a number of unmanned aerial, ground, and underwater vehicles with autonomous capabilities and is currently developing several other unmanned vehicles with autonomous capabilities.

#### UAVs

- WB Group's WARMATE loitering munition operates fully autonomously and loiters until it detects a target,<sup>248</sup> which it then destroys in 'suicide drone' fashion.<sup>249</sup>
- Boeing's ScanEagle<sup>250</sup> UAV operates fully autonomously.<sup>251</sup>

#### UGVs

- The Perun UGV, which can be operated in manual or autonomous mode, is currently under development for the Polish Army.<sup>252</sup>

#### UUVs

- Currently, Poland and Germany are developing a swarm of biomimetic underwater vehicles for underwater intelligence, surveillance, and reconnaissance (SABUVIS II). This project is a continuation of a previous project developed by Portugal, Germany, and Poland (SABUVIS I).<sup>253</sup>
- Teledyne's Gavia AUV, which is used for naval MCM, operates autonomously.<sup>254</sup>
- Saab's Double Eagle SAROV UUV,<sup>255</sup> which is used for naval MCM, operates autonomously.<sup>256</sup>

### 22.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

Poland uses Raytheon's Patriot air defence system,<sup>257</sup> which can operate in autonomous mode.<sup>258</sup> In addition, Poland's Borsuk IFV can be implemented with an autonomous active defence system.<sup>259</sup>

The Polish Navy uses several autonomous weapon systems, namely Kongsberg's Naval Strike Missile, which relies on autonomous target recognition to detect and hit the correct target,<sup>260</sup> Leonardo's MU90 IMPACT Advanced

245 European Commission, 'Poland AI Strategy Report: Knowledge For Policy', 2021. Accessed 14 February 2021. [https://ec.europa.eu/knowledge4policy/ai-watch/poland-ai-strategy-report\\_en](https://ec.europa.eu/knowledge4policy/ai-watch/poland-ai-strategy-report_en).

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249 Juliusz Sabak, 'Warmate: Polish Loitering Munition. "Two Export Agreements Have Been Already Signed"', Defence24.com, 28 April 2016. Accessed 6 January 2021. <https://www.defence24.com/warmate-polish-loitering-munition-two-export-agreements-have-been-already-signed>.

250 Stephen Trimble, 'Insitu Receives Contract to Deliver ScanEagles to Poland', Flight Global, 24 September 2010. Accessed 7 September 2021. <https://www.flightglobal.com/insitu-receives-contract-to-deliver-scaneagles-to-poland/96043.article>.

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252 Army Recognition, 'MSPO 2020: Polish-Made Perun Armed UGV Unarmed Ground Vehicle Tested in the Field', 11 September 2020. Accessed 14 February 2021. [https://www.armyrecognition.com/mspo\\_2020\\_news\\_official\\_show\\_daily/mspo\\_2020\\_polish-made\\_perun\\_armed\\_ugv\\_unarmed\\_ground\\_vehicle\\_tested\\_in\\_the\\_field.html](https://www.armyrecognition.com/mspo_2020_news_official_show_daily/mspo_2020_polish-made_perun_armed_ugv_unarmed_ground_vehicle_tested_in_the_field.html).

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255 Saab, 'Saab Receives Polish Order for Double Eagle SAROV', 10 February 2020. Accessed 14 February 2021. <https://www.saab.com/newsroom/stories/2020/february/saab-receives-polish-order-for-double-eagle-sarov>.

256 Saab, 'Double Eagle Family', 2021. Accessed 9 January 2021. <https://www.saab.com/products/double-eagle>.

257 Raytheon, 'Sweden, US Sign Agreement for Patriot: Sixteen Nations Now Rely on Patriot System for Missile Defense', 2018. Accessed 2 January 2021. <https://www.raytheon.com/news/feature/sweden-us-sign-agreement-patriot>.

258 Hawley, 'Patriot Wars'.

259 Jerzy Rzeszczyński, 'Polish Borsuk IFV Unveiled? Two Variants of the New Vehicle', Defence24, 6 December 2016. Accessed 23 April 2021. <https://www.defence24.com/polish-borsuk-ifv-unveiled-two-variants-of-the-new-vehicle>.

260 Kongsberg, 'NSM-JSM Missiles'.

Lightweight Torpedo,<sup>261</sup> which has autonomous 'launch and forget' capabilities;<sup>262</sup> and Boeing's Harpoon Block II anti-ship missile,<sup>263</sup> which has some autonomous capabilities.<sup>264</sup>

In 2024, Poland is expected to receive Lockheed Martin's F-35 Lightning II fighter aircraft,<sup>265</sup> which has several artificial intelligence components, including decision support and data analytics systems.<sup>266</sup> In the future, the F-35 will likely also use artificial intelligence to control unmanned drone 'wingmen', which could carry weapons, conduct ISR, or test enemy air defences.<sup>267</sup>

## 22.4. Data Analytics

N/A

## 22.5. Logistics and Personnel Management

N/A

## 22.6. Other

Poland, Germany, and the Netherlands are currently developing a new project called 'Communications and Radar Systems hardened with Artificial Intelligence in a contested electronic warfare environment' (CRAI). This project will study the use of artificial intelligence for the benefit of military communications and radar systems, as military radiocommunication and radiolocation services are faced with increasing challenges, such as increased spectrum density and limited frequency bandwidth.<sup>268</sup>

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263 Missile Defense Project, 'Harpoon'.

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266 Kris Osborn, 'The F-35 Will Soon Be Equipped with Artificial Intelligence to Control Drone Wingmen'.

267 Kris Osborn, 'The F-35 Will Soon Be Equipped with Artificial Intelligence to Control Drone Wingmen'.

268 European Defence Agency, 'Stronger Communication and Radar Systems with Help of AI'.

# 23. Portugal

## 23.1. AI Strategy

In June 2019 Portugal published a national AI strategy titled 'AI Portugal 2030', which does not mention military applications of AI.<sup>269</sup> While Portugal has not published a military AI strategy, it has issued a request for proposals to develop autonomous systems.<sup>270</sup>

## 23.2. Autonomous Vehicles

Portugal uses a number of unmanned aerial, underwater, and surface vehicles, with a focus on UUVs. The Portuguese military has conducted extensive research on UUVs,<sup>271</sup> and Portugal has hosted NATO exercises working to develop autonomous underwater vehicles.<sup>272</sup>

### UAVs

→ Tekever's AR-4 UAV<sup>273</sup> can navigate autonomously.<sup>274</sup>

### UUVs

→ The SeaCon AUV, developed by the Portuguese Navy, can operate autonomously.<sup>275</sup>

→ Teledyne's Gavia AUV, which is used for naval MCM, operates autonomously.<sup>276</sup>

→ L3 OceanServer's Iver UUV<sup>277</sup> operates autonomously.<sup>278</sup>

### USVs

The SWORDFISH USV can operate autonomously.<sup>279</sup>

## 23.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

Portugal uses Thales's ship-mounted, short-range air defence system, Goalkeeper, which operates autonomously.<sup>280</sup> Additionally, Portugal uses Raytheon's Phalanx close-in weapon system,<sup>281</sup> which can be operated autonomously.<sup>282</sup> Portugal also uses Boeing's Harpoon Block II anti-ship missile,<sup>283</sup> which has some autonomous capabilities.<sup>284</sup>

## 23.4. Data Analytics

N/A

## 23.5. Logistics and Personnel Management

N/A

269 Incode2030, 'AI Portugal 2030: Portuguese National Initiative on Digital Skills', 2019. Accessed 23 April 2021. [https://www.incode2030.gov.pt/sites/default/files/julho\\_incode\\_brochura.pdf](https://www.incode2030.gov.pt/sites/default/files/julho_incode_brochura.pdf).

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## 24. Romania

### 24.1. AI Strategy

In June 2019, Romania published an AI strategy titled 'Romania in the Era of Artificial Intelligence: A Strategy for the Development and Adoption of AI Technology at a Country Level'.<sup>285</sup> While the strategy does not discuss how Romania plans to use AI in the military, it does note that national security and defence will be impacted by AI.<sup>286</sup>

### 24.2. Autonomous Vehicles

The Romanian military uses AeroVironment's RQ-11 Raven UAV, which can navigate autonomously.<sup>287</sup>

### 24.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

Romania uses Raytheon's Advanced Medium-Range Air-to-Air Missile (AMRAAM) for air defence,<sup>288</sup> which has autonomous 'launch and leave' capabilities.<sup>289</sup> Romania also uses Raytheon's Patriot air defence system,<sup>290</sup> which can operate in autonomous mode.<sup>291</sup>

### 24.4. Data Analytics

N/A

### 24.5. Logistics and Personnel Management

N/A

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## 25. Slovakia

### 25.1. AI Strategy

Slovakia does not have an AI strategy or a military AI strategy. However, the government did publish a document titled '2030 Digital Transformation Strategy for Slovakia', which mentions civilian uses of AI.<sup>292</sup>

### 25.2. Autonomous Vehicles

N/A

### 25.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

N/A

### 25.4. Data Analytics

N/A

### 25.5. Logistics and Personnel Management

N/A

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<sup>292</sup> Ministry of Investments, Regional Development, and Informatization of the Slovak Republic, '2030 Digital Transformation Strategy for Slovakia'. <https://www.mirri.gov.sk/wp-content/uploads/2019/10/SDT-English-Version-FINAL.pdf>.

## 26. Slovenia

### 26.1. AI Strategy

Slovenia is currently developing a national AI strategy, but it has not yet been publicly released.<sup>293</sup> Slovenia is also in the process of establishing an International Research Centre on AI.<sup>294</sup>

While Slovenia does not have a military AI strategy, in a statement at the United Nations, a representative stated that Slovenia advocates ‘the development of Autonomous Weapons Systems under strictly defined conditions’. The statement said that ‘artificial intelligence will improve military efficiency, make data processing more accurate and targeting more effective, with fewer casualties and damage and consequently result in a higher level of respect for international humanitarian law... artificial intelligence can serve to support the military decision making process and contribute to certain advantages’.<sup>295</sup>

### 26.2. Autonomous Vehicles

N/A

### 26.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

N/A

### 26.4. Data Analytics

N/A

### 26.5. Logistics and Personnel Management

N/A

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## 27. Spain

### 27.1. AI Strategy

In March 2019, Spain published its national AI strategy, titled 'Spanish RDI Strategy in Artificial Intelligence'. However, it does not mention military applications of AI. Spain does not have a military AI strategy.

The Spanish Army started an initiative known as 'Fuerza 2035' that focuses on modernising the Spanish army and developing new military technology. The Fuerza 2035 strategy document states that in the future, the Spanish army will need to develop artificial intelligence and autonomous vehicle capabilities, including swarm technology and autonomous robots.<sup>296</sup>

According to a report conducted by Brigade 35, an experimental brigade in the Spanish Army established by Fuerza 2035, autonomous and robotic systems will play a role in four main areas:

- Logistical support, in which autonomous vehicles can supply first-line units (with water, food, ammunition, etc), manage supply warehouses, and evacuate wounded soldiers
- Intelligence, in which autonomous vehicles equipped with sensors can conduct ISR
- Command and control, in which AI and big data analysis can support decision-making, autonomous systems can direct communication traffic over multiple networks, AI can support electronic warfare, and AI can analyse complex battlefields
- Protection, in which AI and augmented reality can improve situational awareness<sup>297</sup>

### 27.2. Autonomous Vehicles

Spain's military uses several UAVs with autonomous

capabilities and is in the process of developing an autonomous UAV with other European partners.

#### UAVs

- AeroVironment's RQ-11 Raven UAV can navigate autonomously.<sup>298</sup>
- Boeing's ScanEagle<sup>299</sup> UAV operates fully autonomously.<sup>300</sup>
- Spain, along with a number of other European countries, is currently developing the nEUROn demonstrator UAV,<sup>301</sup> which has several autonomous capabilities, including autonomous target recognition and ordnance management.<sup>302</sup>
- Spain and Germany developed the Barracuda demonstrator UAV, which operates completely autonomously.<sup>303</sup>

### 27.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

Spain uses Raytheon's Patriot air defence system,<sup>304</sup> which can operate in autonomous mode,<sup>305</sup> and the Aegis Ballistic Missile Defence system,<sup>306</sup> which is capable of autonomous missile defence operations.<sup>307</sup> Additionally, Spain employs Boeing's Harpoon Block II anti-ship missile,<sup>308</sup> which has some autonomous capabilities.<sup>309</sup>

In May 2019, Spain joined the joint French-German Future Combat Air System (FCAS), which aims to create a sixth-generation fighter aircraft.<sup>310</sup> The aircraft will be a system of systems, many of which will be equipped with AI and neural networks.<sup>311</sup> For example, AI will allow the aircraft to team with unmanned platforms,<sup>312</sup> share information with other

296 Ministerio de Defensa, 'Ejército De Tierra: Fuerza 35', Gobierno de España, 2019. Accessed 7 September 2021. [https://ejercito.defensa.gob.es/Galerias/Descarga\\_pdf/EjercitoTierra/Publicaciones/fuerza\\_35.pdf](https://ejercito.defensa.gob.es/Galerias/Descarga_pdf/EjercitoTierra/Publicaciones/fuerza_35.pdf); Ejército de Tierra, 'Resumen Ejecutivo "FUERZA 35"', Ministerio de Defensa. Gobierno de España. Accessed 7 September 2021. [https://ejercito.defensa.gob.es/en/estructura/briex\\_2035/resumen\\_ejecutivo\\_fuerza\\_35.html?\\_\\_locale=en](https://ejercito.defensa.gob.es/en/estructura/briex_2035/resumen_ejecutivo_fuerza_35.html?__locale=en).

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308 Missile Defense Project, 'Harpoon'.

309 Boeing, 'Harpoon Block II'.

310 Airbus, 'Future Combat Air System (FCAS): Shaping the Future of Air Power'.

311 Wolfe, 'Flexible Neural Networks Needed for FCAS, Airbus Official Says'; Bellamy, 'How Neural Networks Are Already Showing Future Potential for Aerospace'.

312 Airbus, 'Future Combat Air System: Owning the Sky with the Next Generation Weapons System'.



actors in a 'combat cloud',<sup>313</sup> and assist in pilot situational awareness and decision-making.<sup>314</sup>

## 27.4. Data Analytics

The Spanish Navy uses Thales's BlueScan,<sup>315</sup> which uses AI-enabled data analytics to monitor underwater acoustics and conduct anti-submarine warfare.<sup>316</sup>

## 27.5. Logistics and Personnel Management

Spanish defence company Indra Sistemas is developing the Soprene project, which uses AI and neural network systems to conduct predictive maintenance on the Spanish Navy's fleet.<sup>317</sup> Additionally, the Spanish Air Force is working with Airbus to develop AI-enabled autonomous drones and augmented reality that can inspect the state of air force systems, detect defects, and predict system maintenance.<sup>318</sup>

## 27.6. Other

The Spanish Army uses MASA Group's AI-enabled SWORD simulation software for training purposes. SWORD is designed to 'improve training, analysis, and decision support' for commanding officers in the military by simulating highly realistic scenarios.<sup>319</sup>

Spanish state-owned shipbuilding company Navantia uses AI to design ships, relying on AI-enabled simulations and modelling.<sup>320</sup> Similarly, Airbus uses AI to design some parts of FCAS.<sup>321</sup>

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313 Sebastian Sprenger, 'Three European Air Forces Approve Performance Benchmarks for Next-Gen Fighter Jet', *Defense News*, Sightline Media Group, 26 May 2020. Accessed 10 January 2021. <https://www.defensenews.com/global/europe/2020/05/26/three-european-air-forces-approve-performance-benchmarks-for-next-gen-fighter-jet/>.

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## 28. Turkey

### 28.1. AI Strategy

In August 2021, Turkey published its national AI strategy, titled 'National Artificial Intelligence Strategy 2021–2025', which does not mention military applications of AI.<sup>322</sup>

While the Turkish Ministry of National Defence has not released an official military AI strategy, top defence officials have mentioned the role of AI in the military. For instance, the Undersecretary for Defense Industries, Ismail Demir, stated, "We can consider the autonomous systems that may come to the agenda in the near future. The automatising of the naval, land and air systems is one of the most discussed subjects. The products that will be utilized autonomously in the battlefields from the micro systems to the grand platforms need to operate uninterruptedly".<sup>323</sup>

In addition, the Undersecretary for Defense Industries released a document titled '2018–2022 Defense Industry Sectoral Strategy Document',<sup>324</sup> which discusses the future role of unmanned and intelligent systems in the Turkish military.<sup>325</sup> The document predicts that unmanned and autonomous systems will become increasingly important in the future and stresses the importance of domestic development of unmanned and autonomous systems in order to decrease reliance on foreign weapons providers, many of whom have imposed export restrictions on Turkey in recent years. It describes autonomous weapons and swarming technology as a third military revolution, after gunpowder and nuclear weapons.

In recent years, Turkey has greatly expanded its domestic drone industry, and today it is one of the most advanced developers of drones in the world.<sup>326</sup> As a result, Turkey's military uses a number of unmanned aerial, ground, surface, and underwater vehicles. Many of Turkey's drones operate autonomously and act as loitering munitions, also known as 'suicide drones', which loiter in the air until they find their target and then hit the target with an explosive.<sup>327</sup>

#### UAVs

- Turkish Aerospace Industry's (TAI) Anka S UAV navigates and flies fully autonomously.<sup>328</sup>
- STM's ALPAGU fixed-wing tactical attack UAV can operate fully autonomously and uses machine and deep learning to optimise image-based targeting.<sup>329</sup>
- STM's KARGU rotary wing attack UAV can operate autonomously<sup>330</sup> and uses machine learning to optimise image-based targeting and facial recognition.<sup>331</sup> Currently, Turkey is developing swarm capabilities for KARGU drones.<sup>332</sup>
- STM's TOGAN multirotor reconnaissance micro-UAV can operate autonomously<sup>333</sup> and uses deep learning for ISR purposes.<sup>334</sup>
- Baykar's AKINCI UAV can operate fully autonomously and uses artificial intelligence to support signal processing, sensor fusion, and situational awareness in real time.<sup>335</sup>
- Bayraktar's TB2 tactical UAV has some autonomous capabilities, including autonomous navigation.<sup>336</sup>

### 28.2. Autonomous Vehicles

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330 STM, 'KARGU: Rotary Wing Attack UAV'. Accessed 7 September 2021. <https://www.stm.com.tr/en/kargu-autonomous-tactical-multi-rotor-attack-uav>.

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332 Joseph Trevithick, 'Turkey Now Has Swarming Suicide Drones It Could Export', *The Drive*, Brookline Media, 18 June 2020. Accessed 12 February 2021. <https://www.thedrive.com/the-war-zone/34204/turkey-now-has-a-swarming-quadcopter-suicide-drone-that-it-could-export>.

333 STM, 'TOGAN: Autonomous Multi-Rotor Reconnaissance UAV'. Accessed 7 September 2021. <https://www.stm.com.tr/en/togan>.

334 Can Kasapoğlu and Barış Kirdemir, *Rising Drone Power: Turkey on the Eve of Its Military Breakthrough*. Centre for Economics and Foreign Policy Studies (2018), 26.

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336 Army Technology, 'Bayraktar TB2 Tactical UAV', Verdict Media Limited. Accessed 7 September 2021. <https://www.army-technology.com/projects/bayraktar-tb2-tactical-uav/>.

## UGVs

→ Turkish defence company ASELSAN is currently developing UGVs with autonomous capabilities for the Turkish military.<sup>337</sup>

## UUVs

→ Turkish defence company Albayrak Savunma is currently developing an autonomous underwater mine called Wattozz, whose shape and movement is based on a stingray's.<sup>338</sup>

## USVs

→ ASELSAN's Albatros-K Unmanned Surface Target Boat can operate autonomously.<sup>339</sup>

N/A

## 28.6. Other

TAI has developed an artificial intelligence simulator that will be used to design and develop future aircraft.<sup>344</sup>

## 28.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

ASELSAN developed the PULAT Active Protection System as part of a tank modernisation programme. PULAT is attached to tanks and defends them autonomously.<sup>340</sup> Turkey also uses Boeing's Harpoon Block II anti-ship missile,<sup>341</sup> which has some autonomous capabilities.<sup>342</sup>

Currently, TAI is working on a fifth-generation aircraft programme known as the TF-X programme, which will use artificial intelligence and neural networks.<sup>343</sup>

## 28.4. Data Analytics

N/A

## 28.5. Logistics and Personnel Management

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341 Missile Defense Project, 'Harpoon'.

342 Boeing, 'Harpoon Block II'.

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344 Burak Ege Bekdil, 'Turkey Develops AI-Based Simulator for Light Fighter Jet', *C4ISRNet*, 8 September 2020. Accessed 7 September 2021. <https://www.c4isrnet.com/artificial-intelligence/2020/09/08/turkey-develops-ai-based-simulator-for-light-fighter-jet/>.

# 29. United Kingdom

## 29.1. AI Strategy

The UK does not have a military AI strategy. In 2018, the UK released an industrial national AI strategy titled 'AI Sector Deal',<sup>345</sup> which does not refer to the defence sector. On 19 November 2020, the UK government announced a new agency focusing on artificial intelligence<sup>346</sup> as part of a wider boost of defence spending; however, few details are known concerning the agency's scope and structure. There is potential for the agency to draw on, or coordinate, the work facilitated by existing government departments, including the 'Development, Concepts and Doctrine Centre, the AI Centre of Expertise under Defence Digital, Dstl's AI Laboratory, the Strategic Command's jHub, the Army's 6 Division, the RAF's Rapid Capabilities Office and the Navy's Digital Services piece'.<sup>347</sup>

The Defence Transformation Framework lists 'Machine Learning, Artificial Intelligence, and Data Science (software)' as one of seven foundational technology families (with Autonomous Systems and Robotics another family).<sup>348</sup> Additionally, a House of Lords report titled 'AI in the UK: Ready, Willing and Able?' discusses LAWS.<sup>349</sup> The report notes that while the UK Ministry of Defence (MoD) has stated that 'the UK does not possess fully autonomous weapon systems and has no intention of developing them', the British government 'has also opposed the proposed international ban on the development and use of autonomous weapons'. The report points out that despite the UK's statement on LAWS, the MoD is developing military systems like the BAE Taranis, which have been described as autonomous. This seeming contradiction can be explained by the UK's narrow definition of LAWS. The MoD has separate definitions for 'automated' and

'autonomous' systems, in which 'autonomous' systems must be capable of 'understanding higher-level intent and direction' rather than merely responding 'to inputs from one or more sensors' following a logical, 'predefined set of rules in order to provide an outcome'.

Within the MoD's Department for Defence, Science and Technology Laboratory (Dstl), an 'AI Lab' was created in 2018.<sup>350</sup> In November 2020, the UK government announced a £16.5 billion funding boost to the UK defence sector and announced the creation of a new agency dedicated to AI.<sup>351</sup> Some of this funding will go to developing 'autonomous vehicles, swarm drones, and cutting-edge battlefield awareness systems', all of which will likely rely on AI.<sup>352</sup> The UK will probably announce further details on military AI investment when the full results of the Integrated Review<sup>353</sup> are released in 2021.

In 2019, the Royal Navy founded NavyX, the Royal Navy's 'Autonomy and Lethality Centre', one of several innovation centres across the British military.<sup>354</sup> NavyX has begun investing in autonomous maritime vessels such as BAE's PAC24 sea boats.<sup>355</sup>

## 29.2. Autonomous Vehicles

The British military uses a number of unmanned aerial, ground, underwater, and surface vehicles with autonomous capabilities. In 2018 the MoD started the Autonomous Warrior experiment, in which the military is working to develop autonomous aerial and ground cargo vehicles that can reduce the danger to troops during combat by conducting surveillance and resupplying frontline soldiers.<sup>356</sup>

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346 Gov.uk, 'PM to Announce Largest Military Investment in 30 Years', Ministry of Defence, 19 November 2020. Accessed 15 February 2021. <https://www.gov.uk/government/news/pm-to-announce-largest-military-investment-in-30-years>.

347 Trevor Taylor, 'Unpacking the UK's Newly Announced Centre on Artificial Intelligence', *RUSI Commentary*, 14 December 2020. Accessed 29 October 2021. <https://rusi.org/explore-our-research/publications/commentary/unpacking-uks-newly-announced-centre-artificial-intelligence>.

348 Ministry of Defence, 'Defence Technology Framework'. Government of the UK, September 2019. Accessed 15 January 2021. [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/830139/20190829-DTF\\_FINAL.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/830139/20190829-DTF_FINAL.pdf).

349 House of Lords, 'AI in the UK: Ready, Willing and Able?' Select Committee on Artificial Intelligence. UK Parliament, 16 April 2018. Accessed 7 September 2021. <https://publications.parliament.uk/pa/ld201719/ldselect/ldai/100/100.pdf>, 101–105.

350 Gov.uk, 'Flagship AI Lab announced as Defence Secretary Hosts First Meet between British and American Defence Innovators', Ministry of Defence, 22 May 2018. Accessed 10 February 2021. <https://www.gov.uk/government/news/flagship-ai-lab-announced-as-defence-secretary-hosts-first-meet-between-british-and-american-defence-innovators>.

351 Gov.uk, 'PM to Announce Largest Military Investment in 30 Years', Ministry of Defence, 19 November 2020. Accessed 15 February 2021. <https://www.gov.uk/government/news/pm-to-announce-largest-military-investment-in-30-years>.

352 Ministry of Defence, 'Defence Secures Largest Investment since the Cold War', Gov.uk, 19 November 2020. Accessed 7 September 2021. <https://www.gov.uk/government/news/defence-secures-largest-investment-since-the-cold-war>.

353 Gov.uk, 'Integrated Review (Ministry of Defence)', Ministry of Defence, 14 September 2020. Accessed 8 September 2021. <https://www.gov.uk/government/collections/integrated-review-ministry-of-defence>.

354 Royal Navy, 'NavyX', Ministry of Defence. Accessed 8 September 2021. <https://www.royalnavy.mod.uk/news-and-latest-activity/operations/united-kingdom/navy-x>.

355 *Desider*, 'Maritime Combat System Leads Innovation on HMS Argyll', Ministry of Defence, October 2019. Accessed 8 September 2021. [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/836896/October-desider-online-v3.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/836896/October-desider-online-v3.pdf).

356 Mark Lancaster, 'British Army Set to Redefine Warfare with Joint Autonomous Warrior', Gov.uk. Ministry of Defence, 20 June 2018. Accessed 8 September 2021. <https://www.gov.uk/government/news/british-army-set-to-redefine-warfare-with-joint-autonomous-warrior>.

This paper does not include an exhaustive list of unmanned vehicles with autonomous capabilities used by the British military, instead describing several illustrative examples of unmanned vehicles with autonomous capabilities in use.

### UAVs

- Thales's Watchkeeper UAV operates autonomously.<sup>357</sup>
- BAE Systems' Taranis, an unmanned combat aircraft system demonstrator programme, has a number of autonomous capabilities.<sup>358</sup>
- AeroVironment's RQ-11 Raven UAV can navigate autonomously.<sup>359</sup>
- Boeing's ScanEagle<sup>360</sup> UAV operates fully autonomously.<sup>361</sup>
- AeroVironment's Puma 3 AE tactical UAV<sup>362</sup> can navigate autonomously.<sup>363</sup>

### UGVs

- The MoD has ordered three VIKING 6x6 Unmanned Ground Vehicles from HORIBA MIRA which use AI-enabled navigation to resupply frontline troops.<sup>364</sup>

### UUVs

- Kongsberg's REMUS 100 AUV<sup>365</sup> operates autonomously.<sup>366</sup>
- ECA Group's A27-M AUV, which is used for mine countermeasures and surveillance, operates autonomously.<sup>367</sup>

- The Royal Navy's NavyX programme is using AI for mine hunting.<sup>368</sup> The Navy's autonomous submarine 'Manta'<sup>369</sup> has reconnaissance and surveillance capabilities. NavalX is also collaborating with the US within the London Tech Bridge programme.<sup>370</sup>
- The France and UK have announced the Maritime Mine Counter Measure (MMCM) programme as of late 2020, a \$250 million programme to develop autonomous mine-hunting systems.<sup>371</sup>

### USVs

- L3Harris's MAST-9<sup>372</sup> and MAST-13 ASVs can navigate autonomously.<sup>373</sup>
- Sonardyne International is developing sensors for USVs that will enable some autonomous capabilities.<sup>374</sup>

## 29.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

As part of the UK's Future Combat Air System (FCAS) programme, the UK is working with Italy to develop the BAE Tempest next-generation aircraft,<sup>375</sup> which will have an AI-enabled autonomous flight system that would enable the aircraft to fly without a pilot.<sup>376</sup> The wider industry alliance 'TeamTempest' was created in 2018 and includes GEUK, GKN, Collins Aerospace, Martin Baker, QinetiQ, Bombardier, and Thales UK, along with UK universities and

357 British Army, 'Watchkeeper', Ministry of Defence, 28 August 2020. Accessed 8 September 2021. <https://www.army.mod.uk/news-and-events/news/2020/08/watchkeeper/>.

358 Airforce Technology, 'Taranis Unmanned Combat Air VEHICLE (UCAV) Demonstrator', Verdict Media Limited. Accessed 8 September 2021. <https://www.airforce-technology.com/projects/taranis/>.

359 Army Technology, 'RQ-11 Raven Unmanned Aerial Vehicle', Verdict Media Limited, 2021. Accessed 6 January 2021. <https://www.army-technology.com/projects/rq-11-raven/>.

360 Boeing, 'Historical Snapshot'.

361 Boeing MediaRoom, 'Boeing/Insitu ScanEagle UAV Launched From Ship; Completes Historic Autonomous Flight'.

362 Defense World, 'UK Royal Navy's Puma Drone Undergoes First Operational Testing', 9 October 2020. Accessed 8 September 2021. [https://www.defenseworld.net/news/28040/UK\\_Royal\\_Navy\\_\\_\\_s\\_Puma\\_Drone\\_Undergoes\\_First\\_Operational\\_Testing](https://www.defenseworld.net/news/28040/UK_Royal_Navy___s_Puma_Drone_Undergoes_First_Operational_Testing).

363 AeroVironment, 'Puma 3'.

364 Gov.uk, 'Dstl Acquires First Fleet of Autonomous Ground Vehicle Systems', Ministry of Defence, 16 March 2020. Accessed 8 September 2021. <https://www.gov.uk/government/news/dstl-acquires-first-fleet-of-autonomous-ground-vehicle-systems>.

365 Defense World, 'Royal Navy Demonstrates REMUS 600 UUV at "Unmanned Warrior 16"', 15 October 2016. Accessed 8 September 2021. [https://www.defenseworld.net/news/17365/Royal\\_Navy\\_Demonstrates\\_REMUS\\_600\\_UUV\\_At\\_\\_Unmanned\\_Warrior\\_16\\_#](https://www.defenseworld.net/news/17365/Royal_Navy_Demonstrates_REMUS_600_UUV_At__Unmanned_Warrior_16_#).

366 Naval Technology, 'REMUS-100 Automatic Underwater Vehicles'.

367 ECA Group, 'ECA Group Confirms Important AUV Order for FR/UK Underwater Mine Countermeasure Programme'.

368 Royal Navy, 'Contract Sees Cutting-Edge Autonomous Minehunters for Royal Navy', Ministry of Defence, 26 November 2020. Accessed 8 September 2021. <https://www.royalnavy.mod.uk/news-and-latest-activity/news/2020/november/26/201126-mcm-announcement>.

369 George Allison, 'Royal Navy Awards Contract for Large Autonomous Submarine', *UK Defence Journal*, 5 March 2020. Accessed 8 September 2021. <https://ukdefencejournal.org.uk/royal-navy-awards-contract-for-large-autonomous-submarine/>.

370 US Navy Office of Information, 'US Navy Opens Tech Bridge Network in London', 20 October 2020. Accessed 8 September 2021. <https://www.navy.mil/Press-Office/News-Stories/Article/2388230/us-navy-opens-tech-bridge-network-in-london/>.

371 *Maritime Executive*, 'UK and France Partner on Development of Autonomous Minehunting Vessel', 26 November 2020. Accessed 8 September 2021. <https://www.maritime-executive.com/article/uk-and-france-partner-on-development-of-autonomous-minehunting-vessel>.

372 L3Harris, 'ASView Control System', Accessed 8 September 2021. <https://www.asvglobal.com/l3-asv-and-dstl-complete-1380-km-of-autonomous-reconnaissance-missions-at-autonomous-warrior/>.

373 L3Harris, 'ASView Control System'.

374 Martin Manaranche, 'Sonardyne Tests Navigation Systems for Autonomous Surface Vehicles for UK MOD', *Naval News*, 27 May 2020. Accessed 8 September 2021. <https://www.navalnews.com/naval-news/2020/05/sonardyne-tests-navigation-systems-for-autonomous-surface-vehicles-for-uk-mod/>.

375 BAE Systems, 'UK and Italian Industry to Partner on Tempest'.

376 Eric Adams, 'Meet the UK's New, Very British Fighter Jet', *Wired*, 6 August 2018. Accessed 8 September 2021. <http://wired.com/story/uk-very-british-tempest-fighter-jet>.

SMEs.<sup>377</sup> Research undertaken by the group includes the pursuit of scalable autonomy through operational modes including ‘manned, unmanned and optionally-manned platforms, with onboard and offboard data processing and a range of pilot decisions aids when manned flight is being conducted’.<sup>378</sup>

The British military uses MBDA’s Brimstone missile, which has autonomous functions.<sup>379</sup> Unlike other guided missiles, Brimstone is not assigned a specific target; instead, it is assigned to a target area, where the missile autonomously selects and attacks targets.<sup>380</sup>

## 29.4. Data Analytics

Within the Royal Air Force (RAF), Team Tempest highlights information advantage as a crucial aspect of warfighting, noting that the integration of multiple integrated sensors will work to gather and cross-check data sources, producing usable information that can be shared with other aircraft in a ‘combat cloud’.<sup>381</sup> Examples of current projects on data analytics include a current Army HQ project with Deloitte LLP to provide a data analytics capability.<sup>382</sup> The 2020 tender for that project builds on the centre of excellence for data analytics launched jointly by the British army and Deloitte in 2018.<sup>383</sup> The RAF and Navy have since launched similar capability-building projects.<sup>384</sup>

## 29.5. Logistics and Personnel Management

The Defence Transformation Framework lists ‘modernised logistics and support’ as an application area, highlighting the potential of autonomous and data-driven systems to form resilient networks, and artificial intelligence to automate

processes and reduce cognitive burden across the supply chain.<sup>385</sup> Military logistics projects include the Defence and Security Accelerator’s competition on ‘last mile resupply’, which focuses on effective delivery of critical supplies to colleagues on the front line.<sup>386</sup> Through the competition, in 2017 providers SEA and TTP were contracted to deliver neural net demand forecast systems to anticipate supply and demand at the front line and ensure timely supply delivery.<sup>387</sup>

## 29.6. Other

Innovation has also been funded through Dstl’s Defence and Security Accelerator (DASA), with January 2020 seeing the first funding wave of £4 million awarded towards projects to research AI capabilities in warships.<sup>388</sup> In mid-2020 DASA launched a second competition: ‘Intelligent Ship Phase 2’.<sup>389</sup> The MOD’s Developments, Concepts and Doctrine Centre has highlighted human-machine teaming as a theme of central importance.<sup>390</sup>

The Royal Navy has demonstrated delivery of several major digital projects with AI components, including Project Nelson.<sup>391</sup>

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377 Jeremy Quin and Ben Wallace, ‘New Industry Leaders Partner with Team Tempest to Deliver Next Generation Combat Aircraft’, Gov.uk. Ministry of Defence, 20 July 2020. Accessed 8 September 2021. <https://www.gov.uk/government/news/new-industry-leaders-partner-with-team-tempest-to-deliver-next-generation-combat-aircraft>.

378 Royal Air Force, ‘Team Tempest’. Accessed 8 September 2021. <https://www.raf.mod.uk/what-we-do/team-tempest/the-tech/>.

379 Missile Defense Project, ‘Brimstone’, Center for Strategic and International Studies, 6 December 2017. Accessed 10 September 2021. <https://missilethreat.csis.org/missile/brimstone/>.

380 Boulanin and Verbruggen, ‘Mapping the Development of Autonomy in Weapon Systems’; Eurosam, ‘Eurosam: Ground-Launched Systems’, 49–50.

381 Royal Air Force, ‘Team Tempest’.

382 Gov.uk, ‘Provision of a Data Analytics Capability (DAC)’, Ministry of Defence, 15 November 2019. Accessed 8 September 2021. <https://www.digitalmarketplace.service.gov.uk/digital-outcomes-and-specialists/opportunities/11154>.

383 Deloitte, ‘Data Analytics Is Helping the British Army Save Lives and Money’. Accessed 8 September 2021. <https://www2.deloitte.com/uk/en/pages/impact-report-2019/stories/british-army.html>.

384 Ibid.

385 Ministry of Defence, ‘Defence Technology Framework’.

386 Gov.uk, ‘Competition Summary: Autonomous Last Mile Resupply’, Ministry of Defence, 29 June 2017. Accessed 8 September 2021.

<https://www.gov.uk/government/publications/accelerator-competition-autonomous-last-mile-supply/competition-summary-autonomous-last-mile-resupply>.

387 Cohort PLC, ‘SEA and TTP Awarded Contract to Streamline Battlefield Supply Technology’, 20 September 2017. Accessed 8 September 2021. <https://www.cohortplc.com/news/press-release/sea-and-ttp-awarded-contract-streamline-battlefield-supply-technology>.

388 DefenceTalk, ‘UK MoD Announces Revolutionary Artificial Intelligence Warship Contracts’, 15 January 2020. Accessed 8 September 2021. <https://www.defencetalk.com/uk-mod-announces-revolutionary-artificial-intelligence-warship-contracts-73115/>.

389 Gov.uk, ‘Competition: Intelligent Ship Phase 2’, Ministry of Defence, 29 June 2020. Accessed 8 September 2021. <https://www.gov.uk/government/publications/competition-intelligent-ship-phase-2>.

390 Development, Concepts and Doctrine Centre, ‘Joint Concept Note 1/18, Human Machine Teaming’, UK Ministry of Defence, 2021.

391 Nazrin Wilkinson, ‘About the Royal Navy’s NELSON’, Gov.uk. Ministry of Defence, 21 November 2019. Accessed 8 September 2021. <https://defencedigital.blog.gov.uk/2019/11/21/nelson-royal-navys-data-digital-programme/>.

## 30. United States

### 30.1. AI Strategy

In February 2019, US President Donald Trump released an executive order detailing a national AI strategy for the US titled 'Executive Order on Maintaining American Leadership in Artificial Intelligence'; however, the executive order does not mention military applications of AI.<sup>392</sup>

In the same month, the US became the first state to release a defence-specific AI strategy, publicly issuing an executive summary and corresponding report fact sheet titled: '2018 DoD Artificial Intelligence Strategy Harnessing AI to Advance Our Security and Prosperity'.<sup>393</sup> The strategy highlights the imperative to develop AI, as 'other nations, particularly China and Russia, are making significant investments in AI for military purposes'.<sup>394</sup> It outlines four strategic focus areas for military AI:

- Delivering AI-enabled capabilities that address key missions
- Partnering with leading private sector technology companies, academia, and global allies and partners
- Cultivating a leading AI workforce
- Leading in military ethics and AI safety

In order to deliver AI-enabled capabilities that address key missions, the executive summary describes four main areas in which to apply AI in the military, namely:

- **Improving situational awareness and decision-making:** 'AI applied to perception tasks such as imagery analysis can extract useful information from raw data and equip leaders with increased situational awareness. AI can generate and help commanders explore new options so that they can select courses of action that best achieve mission outcomes, minimizing risks to both deployed forces and civilians'.
- **Increasing safety of operating equipment:** AI 'has the potential to enhance the safety of operating aircraft, ships, and vehicles in complex, rapidly changing situations by alerting operators to hidden dangers'.
- **Implementing predictive maintenance and supply:** AI can be used 'to predict the failure of critical parts, automate diagnostics, and plan maintenance based

on data and equipment condition. Similar technology will be used to guide provisioning of spare parts and optimize inventory levels. These advances will ensure appropriate inventory levels, assist in troubleshooting, and enable more rapidly deployable and adaptable forces at reduced cost'.

- **Streamlining business processes:** AI will be used with the objective of reducing the time spent on highly manual, repetitive, and frequent tasks. By enabling humans to supervise automated tasks, AI has the potential to reduce the number and costs of mistakes, increase throughput and agility, and promote the allocation of DoD resources to higher-value activities and emerging mission priorities.

The document notes that it is essential for the US to continue funding and supporting AI research in academia, industry, and within the DoD. It also stresses the importance of considering ethics and safety when using AI and notes that the US aims to be an international leader in developing guidelines to ensure the safe and ethical use of military AI. The strategy can be seen to draw on the Third Offset Strategy, created in 2014 with the goal of maintaining the US's 'military-technology edge' relative to the US's adversaries.<sup>395</sup>

The strategy emphasises the need for a coordinated, centralised approach to AI in the military. Specifically, it calls upon the US Joint Artificial Intelligence Centre (JAIC), in conjunction with the Defense Advanced Research Projects Agency (DARPA), to lead the American military approach to AI. The JAIC was created in 2018 as 'the focal point for the execution of the DoD strategy'.<sup>396</sup> Since its foundation, the JAIC has outlined and begun to work towards six mission initiatives:<sup>397</sup>

- **Joint Warfighting Operations:** 'Integrate AI-enabled applications into systems, processes, and platforms to provide sustained competitive military advantage to the United States – with the objective to deter adversaries or, if deterrence fails, to fight and win'.<sup>398</sup>
- **Warfighter Health:** 'Deliver AI-enabled capabilities to create a better, stronger, and more relevant 21st-century

392 White House, 'Executive Order on Maintaining American Leadership in Artificial Intelligence', 2019. Accessed 24 November 2021. <https://trumpwhitehouse.archives.gov/presidential-actions/executive-order-maintaining-american-leadership-artificial-intelligence/>.

393 US Department of Defense, 'Fact Sheet: 2018 DoD Artificial Intelligence Strategy Harnessing AI to Advance Our Security and Prosperity', 2018. Accessed 15 February 2021. <https://media.defense.gov/2019/Feb/12/2002088964/-1/-1/1/DOD-AI-STRATEGY-FACT-SHEET.PDF?source=GovDelivery>.

394 US Department of Defense, 'Summary of the 2018 Department of Defense Artificial Intelligence Strategy: Harnessing AI to Advance Our Security and Prosperity', 2019. Accessed 10 September 2021. <https://media.defense.gov/2019/Feb/12/2002088963/-1/-1/1/SUMMARY-OF-DOD-AI-STRATEGY.PDF>, 4.

395 Philip S. Anton, Megan McKernan, Ken Munson, James G. Kallimani, Alexis Levedahl, Irv Blickstein, Jeffrey A. Drezner, and Sydne Newberry, *Assessing Department of Defense Use of Data Analytics and Enabling Data Management to Improve Acquisition Outcomes*. Santa Monica, CA: RAND Corporation, 2019. [https://www.rand.org/pubs/research\\_reports/RR3136.html](https://www.rand.org/pubs/research_reports/RR3136.html); Daniel Fiott, 'Europe and the Pentagon's Third Offset Strategy', *RUSI Journal* 161, no. 1 (2016): 26–31; Govini, 'Department of Defense: Artificial Intelligence, Big Data, and Cloud Taxonomy'. Accessed 8 September 2021. [https://securityandtechnology.org/wp-content/uploads/2020/07/govini\\_dod\\_ai\\_bigdata\\_cloud\\_taxonomy.pdf](https://securityandtechnology.org/wp-content/uploads/2020/07/govini_dod_ai_bigdata_cloud_taxonomy.pdf).

396 Joint Artificial Intelligence Center, 'Home', Department of Defense. Accessed 8 September 2021. <https://www.ai.mil/>.

397 JAIC, 'A Timeline of Transformation: The JAIC's Journey from AI Startup to AI Practitioners', Joint Artificial Intelligence Center. Department of Defense, 20 July 2020. Accessed 8 September 2021. [https://www.ai.mil/blog\\_07\\_20\\_20-a\\_timeline\\_of\\_transformation.html](https://www.ai.mil/blog_07_20_20-a_timeline_of_transformation.html).

398 JAIC, 'Mission Initiatives', Joint Artificial Intelligence Center. Department of Defense. Accessed 8 September 2021. [https://www.ai.mil/mi\\_joint\\_warfighting\\_operations.html](https://www.ai.mil/mi_joint_warfighting_operations.html).

military medical force to support the health, readiness, and resilience of the warfighter and their families'.<sup>399</sup>

- **Business Process Transformation:** 'Transform DoD business processes by using artificial intelligence capabilities to increase productivity of service members, automate mundane tasks, and improve data management'.<sup>400</sup>
- **Threat Reduction and Protection:** 'Develop an AI system that will improve the safety and efficacy of disaster response operations'.<sup>401</sup>
- **Joint Logistics:** 'Develop AI-enabled solutions that increase operational readiness, create more efficient maintenance practices, and minimize costs'.<sup>402</sup>
- **Joint Information Warfare:** 'use AI to shrink critical timelines for cyber-threat situational awareness... detect threats and malicious activities... [and] further network incident detection and user activity monitoring product evaluations, to rapidly prototype GOTS products for network mapping'.<sup>403</sup>

The JAIC has taken several steps to accomplish these mission initiatives. For example, to work towards joint warfighting operations, the JAIC is working with the United States Army Special Operations Command 'to deliver 20 small unmanned air systems (sUAS) that can navigate autonomously indoors' which 'will enhance the provision of aggregate data, help DoD better understand how sUAS can be integrated into tactical operations, and drive development of new sUAS Tactics, Techniques, and Procedures'.<sup>404</sup> Similarly, the JAIC has already begun working with the US Army to 'improve the availability of military aircraft, specifically the UH/HH-60 'Black Hawk' helicopter, using artificial intelligence (AI) to minimize downtime due to unscheduled maintenance'.<sup>405</sup>

In February 2020, the Department of Defense officially adopted five ethical principles, stating that any AI must be used in a responsible, equitable, traceable, reliable, and governable way.<sup>406</sup> The JAIC is responsible for upholding these ethical principles throughout the DoD. In September 2020, the US hosted a two-day AI 'Partnership for Defense'

dialogue with military and defence representatives from Australia, Canada, Denmark, Estonia, Finland, France, Israel, Japan, Norway, the Republic of Korea, Sweden, and the United Kingdom.<sup>407</sup> A subsequent Joint Statement outlines that the Partnership 'brings together like-minded nations to promote the responsible use of AI, advance shared interests and best practices on AI ethics implementation, establish frameworks to facilitate cooperation, and coordinate strategic messaging on AI policy... [T]he Partnership creates a unique ecosystem by which to collaborate on responsible AI'.<sup>408</sup>

While the following sections outline a range of initiatives and programmes underway, they do not represent an exhaustive overview of the activity coordinated by the Department of Defense.

## 30.2. Autonomous Vehicles

The United States military uses a number of unmanned aerial, underwater, and surface vehicles with autonomous capabilities. This paper does not include an exhaustive list of unmanned vehicles with autonomous capabilities used by the US military, instead describing several examples of unmanned vehicles with autonomous capabilities in use.

### UAVs

- In December 2020, AI-algorithm 'ARTUp' was utilised to help the co-pilot of the 'Dragon Lady' test flight. The algorithm was developed in-house, by the air force's Air Combat Command U-2 Federal Laboratory, and assisted with tactical navigation and sensor employment.<sup>409</sup>
- AeroVironment's RQ-11 Raven UAV can navigate autonomously.<sup>410</sup>
- General Atomics has integrated the Agile Condor, an AI-driven targeting computer, on its MQ-9 Reaper drone, as part of a technology demonstration for the

399 Hassan A. Tetteh, 'Joint Artificial Intelligence Center (JAIC) and the Warfighter Health Mission', Joint Artificial Intelligence Center. Department of Defense, 26 February 2020. Accessed 8 September 2021. [https://www.ai.mil/blog\\_02\\_26\\_20-jaic\\_warfighter\\_health.html](https://www.ai.mil/blog_02_26_20-jaic_warfighter_health.html).

400 JAIC, 'Leading the JAIC's Intelligent Business Automation, Augmentation, and Analytics Mission Initiative', Joint Artificial Intelligence Center. Department of Defense, 4 March 2020. Accessed 8 September 2021. [https://www.ai.mil/blog\\_03\\_04\\_20.html](https://www.ai.mil/blog_03_04_20.html).

401 JAIC, 'The JAIC Is Supporting National Guard Efforts to Combat Destructive Wildfires', Joint Artificial Intelligence Center. Department of Defense, 1 October 2019. Accessed 8 September 2021. [https://www.ai.mil/blog\\_09\\_16\\_19.html](https://www.ai.mil/blog_09_16_19.html).

402 JAIC, 'Army Major Accelerating the JAIC's Predictive Maintenance Mission Initiative', Joint Artificial Intelligence Center. Department of Defense, 10 January 2020. Accessed 8 September 2021. [https://www.ai.mil/blog\\_02\\_10\\_20-jbbs\\_brobinsion.html](https://www.ai.mil/blog_02_10_20-jbbs_brobinsion.html).

403 JAIC, 'Integrating AI and Cyber into the DoD', Joint Artificial Intelligence Center. Department of Defense, 28 October 2019. Accessed 8 September 2021. [https://www.ai.mil/blog\\_10\\_25\\_19-integrating-ai-and-cyber-into-the-dod.html](https://www.ai.mil/blog_10_25_19-integrating-ai-and-cyber-into-the-dod.html).

404 JAIC, 'Mission Initiatives'.

405 JAIC, 'Army Major Accelerating the JAIC's Predictive Maintenance Mission Initiative'.

406 US Department of Defense, 'DOD Adopts Ethical Principles For Artificial Intelligence', 14 February 2020. Accessed 9 January 2021. <https://www.defense.gov/Newsroom/Releases/Release/Article/2091996/dod-adopts-ethical-principles-for-artificial-intelligence>.

407 JAIC Public Affairs, 'JAIC Facilitates First-Ever International AI Dialogue for Defense', Joint Artificial Intelligence Center, 16 September 2020. Accessed 23 December 2020. [https://www.ai.mil/news\\_09\\_16\\_20-jaic\\_facilitates\\_first-ever\\_international\\_ai\\_dialogue\\_for\\_defense\\_.html](https://www.ai.mil/news_09_16_20-jaic_facilitates_first-ever_international_ai_dialogue_for_defense_.html).

408 AI Partnership for Defense (AI PfD), 'AI Partnership For Defense (AI PfD) 15–16 September 2020 Joint Statement', 2020. Accessed 23 April 2021. [https://www.ai.mil/docs/AI\\_PfD\\_Joint\\_Statement\\_09\\_16\\_20.pdf](https://www.ai.mil/docs/AI_PfD_Joint_Statement_09_16_20.pdf).

409 Ryan Browne, 'Artificial Intelligence Co-Pilots US Military Aircraft for the First Time', CNN (Cable News Network), 16 December 2020. Accessed 8 September 2021. <https://edition.cnn.com/2020/12/16/politics/air-force-flight-artificial-intelligence/index.html>.

410 Army Technology, 'RQ-11 Raven Unmanned Aerial Vehicle', 2021. Accessed 6 January 2021. <https://www.army-technology.com/projects/rq-11-raven/>.



US air force.<sup>411</sup>

- Examples of additional drones within the US's fleet include the MQ-1 Predator, RQ-4 Global Hawk, RQ-7B Shadow, RQ-21 Blackjack, CQ-10 SnowGoose, RQ-170 Sentinel, ScanEagle, Avenger, and MQ-8 Fire Scout.<sup>412</sup>

#### UUVs

- L3 OceanServer's Iver UUV413 operates autonomously.<sup>414</sup>

#### USVs

- Leidos is leading a DARPA initiative to develop SeaHunter, an autonomous, unmanned surface vehicle.<sup>415</sup>

### 30.3. Autonomous Air and Missile Defence Systems, Autonomous Missiles, and AI-Enabled Aircraft

The US military uses Lockheed Martin's F-35 Lightning II fighter aircraft programme, which has several artificial intelligence components, including decision support and data analytics systems. In the future, the F-35 will likely also use artificial intelligence to control unmanned drone 'wingmen', which could carry weapons, conduct ISR, or test enemy air defences.

The American military employs several air defence systems with autonomous capabilities, including Raytheon's Patriot air defence system<sup>416</sup> and the Aegis Ballistic Missile Defence system.<sup>417</sup>

The US Army is currently developing Cannon-Delivered

Area Effects Munition (C-DAEM) shells,<sup>418</sup> which will use AI technology to guide artillery towards moving targets.<sup>419</sup>

### 30.4. Data Analytics

The Algorithmic Warfare Cross Functional Team, also known as Project Maven, is often credited as having 'jumpstarted' the use of AI by the DoD through its work on procuring and deploying AI solutions for image recognition.<sup>420</sup> The first phase of Project Maven involved intelligence processing as part of counter-ISIS operations, using computer vision and machine learning to identify hostile activity across the intelligence material.<sup>421</sup> More broadly, the US uses a range of data analytics capabilities, ranging from commercial off-the-shelf tools to contracted solutions, which include 'text understanding and extraction of corporate news feeds; early detection and categorization of programme problems; data integration for risk analysis; and supply-chain network analysis'.<sup>422</sup> A RAND report on defence analytics and acquisitions highlights the 'Integrated Logistics, Installations, and Mission Support Decision Analysis' (LIMS IV) system as an example of a data-analytics integrated information system used within the US Air Force. LIMS IV integrates data from over 70 systems and includes capabilities related to logistics readiness, maintenance and repair,<sup>423</sup> and mission support.<sup>424</sup>

### 30.5. Logistics and Personnel Management

In 2017 the Army Logistics Support Activity (LOGSA) issued a contract with IBM Watson relating to just-in-time repair parts distribution, building on a project in which IBM Watson developed an 'individualized maintenance plan'

411 Joseph Trevithick, 'MQ-9 Reaper Flies with AI Pod That Sifts through Huge Sums of Data to Pick out Targets', *The Drive*. Brookline Media, 4 September 2020. Accessed 8 September 2021. <https://www.thedrive.com/the-war-zone/36205/reaper-drone-flies-with-podded-ai-that-sifts-through-huge-sums-of-data-to-pick-out-targets>.

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for Stryker vehicles.<sup>425</sup> By effectively managing system repairs, the army estimated at the time that the Watson system, if scanning 10% of shipping requests, could save \$100 million a year on emergency repairs.<sup>426</sup>

The Naval Air Warfare Center Aircraft Division (NAWCAD) has similarly employed an AI algorithm within the 'Army-Developed Composite Learning Algorithm for Records Evaluation' system to facilitate data processing for aircraft maintenance,<sup>427</sup> while the F-35 Lightning II incorporates an Autonomic Logistics Information System (ALIS), which provides lifecycle maintenance information.<sup>428</sup>

In December 2020, Lockheed Martin announced a programme working with the US Navy on maintenance logistics, through which an integrated logistics system would draw information from over 20 sources and allow sailors and Marines Corps members to manage potential repairs or systems failures on a range of vessels.<sup>429</sup>

The pandemic has also highlighted the impact of AI-enabled technology. In response to COVID-19, in March 2020, the JAIC launched Project Salus, a supply chain designed to predict and identify critical supply chain shortages.<sup>430</sup>

## 30.6. Other

The 2021 US defence budget requested \$1.8 billion to enhance the 'speed of manoeuvre and lethality in contested environments' and a focus on human-machine teaming, with an additional \$800 million to AI to be designated for JAIC and Project Maven projects.<sup>431</sup>

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