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The UK punches above its weight. An island of 65 million people, it is the fifth largest economy and attracts tens of millions of visitors for business and pleasure, year in year out.[1] This will only continue as global trade increases and people become more transient.[2]

The border is the UK's front door to the world. Its effectiveness provides security to the nation and advertises the UK as open for business. The Home Office aims to admit 95 per cent of non-European Economic Area (EEA) passport holders within 45 minutes. This target is generally met, but increasing demand will put pressure on unreformed borders.[3] Long queues at the border are not just inconvenient for travellers, they are bad for business. They cost money and affect investment decisions. To create a "truly Global Britain",[4] the border must inspire confidence in its safety, effortlessly facilitate the transfer of cargo, and process visitors instantly.

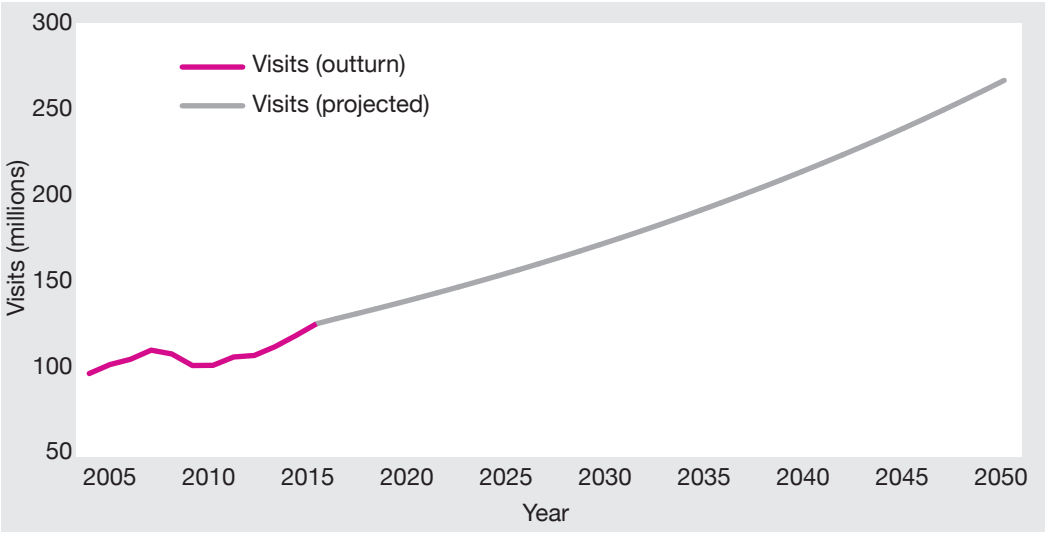
To do this, the UK must upgrade the border. Better use of data to understand demand, and more advanced technology – such as biometrics and artificial intelligence (AI) – to collect and analyse this information will improve risk assessments, while reducing queues. Achieving this is crucial in an ultra-competitive world: nations such as Australia, Singapore and the United States are rapidly updating their borders to compete for business and travellers, while setting the bar for security and tax compliance. Meeting these international benchmarks can turn the border into a national asset – one which should be front and centre of a global Britain.

Today's border: in demand

The UK is an increasingly attractive place to visit and trade. This is a good thing: growing demand means more jobs, opportunities and income. The UK's border must keep up with this demand to provide a world-class trading environment and seamless passenger experience.

In 2015, 123.3 million people entered the UK, which on current trajectory will double by 2050 (see Figure 1). In 2014-15 prices, processing this number of people would cost £722.9 million to administer – or 145 per cent of the current total UK Border Force budget.[5]

Figure 1: Total journeys to the UK, 2004 to 2050



Source: *Reform* calculations. Home Office, *Immigration Statistics, July to September 2016*, 1 December 2016.

1 Office for National Statistics, *United Kingdom Population Mid-Year Estimate*, 2016.
2 World Economic Forum, *Digital Borders: Enabling a Secure, Seamless and Personalized Journey*, 2017.
3 BBC News, 'Passport Queues "Could Be Longer after Brexit", Airports Warn', 15 January 2017.
4 Theresa May, 'The Government's Negotiating Objectives for Exiting the EU', 17 January 2017.
5 UK Parliament, *UK Border Force: Finance: Written Questions - 23143*, 2016.

These travellers come quite literally from across the globe. Around 95 per cent of travellers to the UK – as non-visa travellers, UK citizens or EEA citizens (see Figure 2) – can turn up without prior entry clearance and, subject to security and compliance checks, would be expected to be given leave to enter.

Figure 2: Baskets of visitors

Non-EEA nationals 15.3 million		**EEA nationals** 108.1 million	
Visa nationals 5.3 million	**Non-visa nationals** 10 million	**British citizens** 72.4 million	**Other EEA and Swiss nationals** 35.7 million
Require visa to enter country for any reason	Visa required for stays of six months or more for any reason	Absolute right to enter	Right to enter under free movement of people principle

Note: figures are from 2015, as reported in December 2016.
Sources: Home Office, *Immigration Statistics, July to September 2016*, 1 December 2016; Home Office, *Immigration Rules,* 3 January 2017

Currently, the UK Border Force, the executive authority tasked with carrying out Home Office and HM Revenue & Customs border policy, aims to process 95 per cent of passengers through passport control within 25 minutes for EEA citizens, and within 45 minutes for non-EEA citizens.[6] This is becoming an increasingly unrealistic target as the volume of internal passenger arrivals continues to grow.[7]

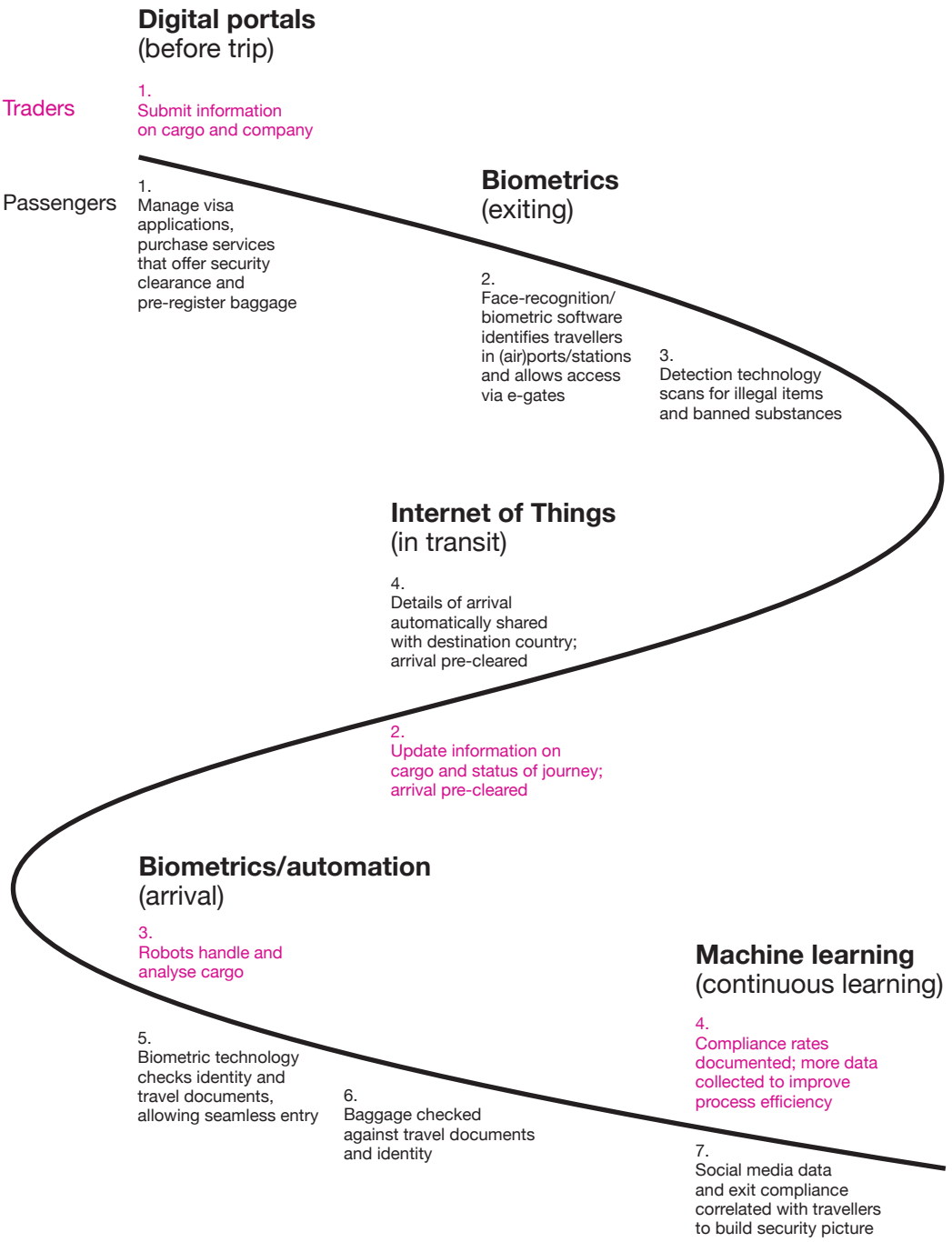
Trade is applying further pressure: UK trade, from baby products to tropical animals, is also expected to double – but by 2025.[8] In 2015 the number of trade 'units' – such as cargo containers or goods trailers – handled at UK ports rose by 4 per cent on the previous year, with 23.6 million units coming in and going out of UK major ports.[9] Processing this trade is made trickier by the decision to leave the European Union (EU): according to business leaders, across the board, UK customs will need to process four times as many imports a year – an increase of 300 million.[10]

Digital borders

Meeting increased demand, while ensuring the safety of the UK, requires government to collect and use data intelligently. Rather than a tangible barrier, the border should be a "process", in the words of Tony Smith, former Head of UK Border Force, and now a Global Border Security Consultant. Travellers and businesses could interact with border forces throughout their journey by providing data such as identity and journey status through smartphone apps and the 'Internet of Things'. This allows security and customs officials to build a better picture of those who will not pose a threat to the UK, which, coupled with a better use of technology such as iris scanning, can remove the need for the majority of people to queue at airports and terminals (see Figure 3).

6 Accenture, *The Digital Traveler. Automating Border Management Solutions to Facilitate Travel and Enhance Security*, 2014.
7 May Bulman, 'Plane Passengers Could See Waiting Times Double at UK Border Control after Brexit, Bosses Warn', *Independent*, 15 January 2017.
8 Billy Bambrough and Elisabeth Perlman, 'World Economic Forum 2017: Who Are the Biggest Winners from Globalisation and Free Trade?', *Verdict*, 9 January 2017.
9 Department for Transport, *UK Port Freight Statistics: 2015*, 2015.
10 Francis Elliott, 'Fears That Customs Computers Can't Cope', *The Times*, 23 January 2017.

Figure 3: Digital borders



Sources: *Reform* interviews. Accenture, *The Digital Traveler. Automating Border Management Solutions to Facilitate Travel and Enhance Security*, 2014; World Economic Forum, *Digital Borders: Enabling a Secure, Seamless and Personalized Journey*, 2017.

Digital portals: one-stop shops for sharing information

The first step to more efficient borders is sharing data early and through a single channel. Freight currently declares cargo, but through several separate systems, some of which are paper-based, resulting in duplication of information, potential error and increased administration cost.[11]

11 Stephen Booth, Aarti Shankar, and Vicenzo Scarpetta, *Nothing to Declare* (Open Europe, 2017).

Passenger data sharing is also imperfect. Advanced passenger information (API) contains the full name, nationality, date of birth, gender and passport number of each traveller. This is now routinely captured by airlines and transmitted electronically to the UK Border Force in advance of arrival. These data are not, however, always used effectively. The National Audit Office (NAO) explained that some of the data are not processed quickly enough to prevent high-risk individuals from travelling to the UK.[12] One problem, according to Tony Smith, is that API data have not been fully integrated with data captured at the front line. Furthermore, as of September 2015, only 86 per cent of passengers provided API.[13] Although 100 per cent of scheduled arrivals are checked on arrival, information is not always supplied in advance for general aviation flights (civil aviation, such as private jets, other than scheduled air services), making them 'high-risk'.[14] Worryingly, 7.5 per cent of 'high-risk' flights from the Chief Inspector of Border's sample of 306 'high-risk' flights were not checked on arrival.[15] This implies that for over 4,000 flights across the year, the UK did not know the identity of people travelling to the country before arrival.[16]

A single digital system is needed to collect and store data, enabling a full risk assessment to be made. For passengers, traveller-identification systems can collect passport information, biometric data (such as a photo, submitted through a 'selfie') and baggage information.[17] According to the World Economic Forum, these data could be used to give compliant passengers 'Trusted Traveller' status, removing the need for passengers to submit the same data each time they travel to the UK.[18]

Other countries are doing this. Australia has an Electronic Travel Authority – a visa-waiver system – for all non-visa nationals.[19] This allows for an 'offshore-border' approach, where customs officials collect data from travel agents and airline companies and cross-reference it against relevant national databases to instantly identify risk. This has resulted in 50 per cent fewer travellers undergoing additional checks at airport immigration.[20] Each pre-arrival refusal saved Australian taxpayers $60,000 – though the corresponding figure for the UK has not been estimated.[21] Of the 17,516 people refused entry into the UK in 2015, just 5,061 (or 29 per cent) of these were identified before they travelled.[22]

Collecting compliance data through an Electronic Travel Authority in the UK could provide a system for international visitors to submit information, particularly for EEA and Swiss nationals, and non-visa nationals. The USA charges $14 per Electronic System for Travel Authorisation (ESTA); Charlie Elphicke MP has argued that this fee – of £10 – is fair.[23] James Canham, Managing Director at Accenture Border Services, believes people will be willing to pay for a "faster, smoother border". This could raise £450 million a year, equivalent to 80 per cent of the UK Border Force's 2016-17 budget.[24]

For traders, the UK should create a single digital portal for processing trade.[25] Increasing numbers of imports are coupled with increasing complexity of cargo: freights engage in 'groupage', whereby containers are filled with different items to make transport more efficient. James Canham points out that this is exceptionally complex to track, but using digital portals to share cargo information could allow the UK to understand which "entities" – that is, companies – can be trusted to deliver compliant goods. The most sophisticated systems can 'tap-in' to supply chain information to pull information from

12 National Audit Office, *E-Borders and Successor Programmes*, 2015, 45.
13 Ibid., 19.
14 Sam Bowman and Ed West, *The Border after Brexit* (Adam Smith Institute, 2016).
15 Home Affairs Select Committee, *Radicalisation: The Counter-Narrative and Identifying the Tipping Point*, 2017; Sam Bowman and Ed West, *The Border after Brexit*, 6.
16 Independent Chief Inspector of Borders and Immigration, *An Inspection of General Aviation and General Maritime*, 2015; Sam Bowman and Ed West, *The Border after Brexit*, 6.
17 World Economic Forum, *Digital Borders: Enabling a Secure, Seamless and Personalized Journey*, 8.
18 Ibid.
19 Australian Government, 'Electronic Travel Authority', Webpage, (10 May 2017).
20 Brian Karlovsky, 'Big Data Deployed to Protect Our Borders', *IDG News Service*, 28 August 2013.
21 Ibid.
22 Office for National Statistics, *Admissions Data Tables Immigration Statistics: December 2016*, 2016.
23 Charlie Elphicke, 'How to Fund and Gain Better Border Control Post-Brexit. I Propose a Visa Waiver System.', *Conservative Home*, 11 January 2017.
24 Theresa May, 'Commons Debate on "Border Force Budget" HC Deb 20 April 2016 Vol. 608'.
25 United Nations Economic Commission for Europe, *The Single Window Concept*, 2003.

these companies to reduce administration and cost further.[26] Government could underpin digital platforms with blockchain technology to enhance security (see Figure 4).

Figure 4: Blockchain: secure digital records

Blockchain, a tamper-proof record of transactions, could digitise travel and cargo information. It would provide a single 'truth' of a journey, accessible to authorised parties, ensuring that only the relevant bodies can retrieve sensitive trade and personal information.

For freight, this could be revolutionary. Danish transport company Maersk points to a "simple" shipment of food from East Africa to Europe going through almost 30 people and organisations, including 200 different interactions and communications between them.[27] Maersk believes that using blockchain to provide a clear documentation of trade can save "billions" through reducing fraud, dispute arbitration and administration costs.[28]

For government, better data on incoming goods could help increase tax and duty collection. The UK collected around £3 billion in customs duties in 2015-16,[29] and while HMRC estimates the excise duties tax gap, it provides no figures for customs. Nevertheless, a recent EU investigation found that UK ports failed to collect €2 billion in customs duties on Chinese textiles alone between 2013 and 2016.[30]

Internet of Things: real-time data sharing

This understanding of goods and travellers can be further enhanced through using real-time data sharing between objects — that is, using the Internet of Things.

Check-in counters or aeroplanes can communicate the status of travellers. This provides up-to-date information on arrival numbers and can improve the airport experience by signposting people after touching down. In Miami, for example, sensors provide personalised directions to passengers' smartphone apps.[31] According to Sita, an IT company, 86 per cent of airlines believe the Internet of Things will generate benefits by 2018.[32]

Real-time data on cargo can allow border officials to more accurately target inspections. In 2008, the NAO reported that up to 3 per cent of imports were physically inspected.[33] According to Tony Smith, it can take up to a day for a UK Border Force search team to completely unload a targeted container. Maersk has recently equipped its fleet with sensors which can provide data on its 270,000 refrigerators.[34] The company says that sharing this information with border forces helps inspection decisions, and reduces any inspection time taken from six hours to 12 minutes.[35]

The Internet of Things can also aid security, especially for in-demand ports. Concerns have been raised about ships travelling to the EU taking suspicious routes in 'high-risk' areas, off the coast of northern Africa.[36] Hamburg, Europe's second-busiest container port, receives real-time data from sensors in vehicles, roads and bridges, to best enable it

26 Johan Ponten, *Single Window - Best Practice and the Way Forward*, 2011, 3.
27 Gertrude Chavez-Dreyfuss, 'IBM, Maersk in Blockchain Tie-up for Shipping Industry', *Reuters*, 6 March 2017.
28 Future Travel Experience, 'Could Blockchain Technology Pave the Way for the Introduction of Global Single Passenger Tokens?', Webpage, (June 2016).
29 The Statistics Portal, 'United Kingdom (UK) HMRC Customs Duty Receipts from Year 2015/2016 (in Million GBP)', Webpage, (2016).
30 Jim Brunsden and Vanessa Houlder, 'Britain Faces €2bn EU Bill for Chinese Customs Fraud', *Financial Times*, 8 March 2017.
31 Franklin Morris, 'Five Ways IoT Will Change How You Experience Air Travel', *Internet of Things Blog*, 13 October 2016.
32 Sita, *Airline IT Trends Survey 2015*, 2015.
33 HM Revenue and Customs, *The Control and Facilitation of Imports*, 2008, 22.
34 The Cool Star, 'Maersk Line Introduces Remote Container Management "game-change"', Webpage, (26 April 2016).
35 Ibid.
36 Sam Jones, 'Europe's Ports Vulnerable as Ships Sail without Oversight', *Financial Times*, 4 February 2016.

to organise vehicle traffic.[37] This information needs to be shared securely amongst ports,[38] and can be used to detect fraud and crime by understanding whether containers move along declared routes.[39] The UK, home to some of the world's busiest ports, could benefit from such an approach.[40]

Biometrics: invisible barriers

The culmination of this data sharing is a reduction of physical borders. For passengers, this is a radical new offering: the removal of traditional border gates.

This is not science fiction. Countries are employing a range of technology to speed up travel, with approaches such as iris scanning being piloted across the globe.[41]

This provides the benchmark for the UK Border Force's "excellent service" aim.[42] In the Netherlands, an e-gate programme processed passengers in less than 15 seconds.[43] Dubai's smart gates detect travellers' faces, allowing them almost-instant access through gates.[44] Whilst e-gates in the UK do have similar processing times, they are not used at all entry points and they can currently only be used by citizens from the EEA. Whether this will change after Brexit is not yet clear.[45]

Even these barriers may soon become redundant, however. Australia is implementing a "contactless" system, which aims to process 90 per cent of passengers without human contact.[46] This could include invisible borders, with CCTV providing facial recognition for passengers that simply walk out of a door, without any stop points, making it more efficient than a train barrier. Only a very small number of passengers, which advanced data identifies as a potential security threat, will be intercepted by staff on arrival.

Using technology in this way can improve security. Advance facial-recognition software, currently being trialled in China, has an accuracy of 99.8 per cent, compared with 90 per cent accuracy for people (as reported in The Glasgow Face Matching Test).[47]

Collecting these data comes with a responsibility to protect them. This is paramount. But despite concerns raised, people are willing to share their personal data with countries they are travelling to. Survey research reveals that 56 per cent of people would share biometric data if it made border processing faster.[48] A generation raised on sharing selfies online will not blink at the thought of sharing a picture of their face to gain faster entry.

Artificial intelligence: freeing humans

Technology can help staff be more productive. 48 per cent of organisations surveyed by Accenture say that improving the work of staff is their primary objective in using predictive analytics.[49] This allows staff to focus their efforts on high-priority travellers or cargo, potentially helping improve today's low morale.[50] In 2016, employee engagement for UK Border Force staff was rated at 41 per cent, the lowest in the Civil Service.[51]

This is being done across the globe. In Los Angeles, robotic handling of cargo has been

37 Steve Banker, 'The Hamburg Port Authority's Impressive IoT Project', *Forbes*, 1 April 2016.
38 Government must decide how secure it requires these technologies to be and ensure that security is embedded in Internet of Things technology from the earliest stage. See: Federal Trade Commission, *Start with Security: A Guide for Business. Lessons Learned from FTC Cases*, 2015.
39 Accenture, *Crossing Boundaries: Emerging Technologies at the Border*, 2017, 7.
40 Department for Transport, *UK Port Freight Statistics: 2015*.
41 World Economic Forum, *Digital Borders: Enabling a Secure, Seamless and Personalized Journey.*
42 UK Border Force, '"About Us"', 2017.
43 Accenture, *The Digital Traveler. Automating Border Management Solutions to Facilitate Travel and Enhance Security*.
44 Franklin Morris, 'Five Ways IoT Will Change How You Experience Air Travel'.
45 Gavin Haines, 'Will Brexit Mean Longer Queues at Passport Control?', *The Telegraph*, 20 February 2017.
46 Michael Koziol, '"World First": Government Moves to Radically Overhaul Australia's International Airports', 22 January 2017.
47 Mike Burton, David White, and Allan McNeill, 'The Glasgow Face Matching Test', *Behavior Research Methods* 42, no 1; Timothy Revell, 'Chinese Tourist Town Uses Face Recognition as an Entry Pass', *New Scientist*, 17 November 2016.
48 Accenture, *How Can Border Management Solutions Better Meet Citizens' Expectations*?, 2014.
49 Accenture, *Crossing Boundaries: Emerging Technologies at the Border*, 7.
50 Cabinet Office, *Civil Service People Survey 2016*, 2016.
51 Ibid.

estimated to improve productivity by as much as 30 per cent.[52] Rotterdam Port describes itself as "an IT company that handles containers."[53] It has partnered with University College London to use AI to read x-rays of suspect cargo, taking 3.5 seconds compared with 10 minutes for humans.[54]

Using technology will free up border staff to do what they do best: question high-risk travellers and traders. Humans are better than robots at logical reasoning, coordinating between multiple people, identifying social and emotional states and responding appropriately.[55] Instead of rubber stamping hundreds of passports a day, border staff can focus their attention on higher-risk targets.

Machine learning: constantly improving the picture

Collecting this information can constantly refine the UK Border Force's understanding of travellers and imports to build an ever-clearer picture of risk. Collecting further information, such as social-media profiles or exit data, for example, can correlate compliance with certain individuals.[56]

Machine learning – a form of AI capable of learning from new data – also presents significant opportunities to mine this 'big data' in place of humans who cannot comprehend it. Collaborations are afoot to apply machine learning to anonymised data sets from airline companies to identify patterns that might suggest risks amongst passengers and cargo, with a proof-of-concept planned in Asia.[57] Machines may also use this data to develop human-like 'hunches' in anomalous data, which can highlight something as not quite how it should be.[58] This provides a more sophisticated identification of discrepancies where there may have been few precedents from which to 'learn'.

For those who don't pose a threat, machine learning can speed up travelling. As a passenger uses the system more and more, the system will learn about the passenger and identify them faster and faster.[59]

This is the opportunity of digital borders: an ever-more-sophisticated use of data to improve safety and efficiency for travellers and traders alike. As the front door to the globe, UK borders need to use cutting-edge technology to achieve this. This will make the border a true national asset, delivering a world-class border for a world-leading economy.

52 Erica E Phillips, 'Massive Robots Keep Docks Shipshape', *Wall Street Journal*, 27 March 2016.
53 JOC.com, 'Europe's Automated Terminals Face Steep Hurdles to Productivity Targets', Webpage, (2017).
54 'Machines Are Learning to Find Concealed Weapons in X-Ray Scans', *The Economist*, 3 December 2016.
55 James Manyika, Michael Chui, Mehdi Miremadi, Jacques Bughin, Katy George, Paul Wilmott, and Martin Dewhurst, *Harnessing Automation for a Future That Works*, 2017, 29.
56 Btihaj Ajana, 'Augmented Borders: Big Data and the Ethics of Immigration Control', *Journal of Information Communication and Ethics in Society* 13, no.1 (March 2015).
57 'Developing Data-Driven Solutions for Faster, More Secure Border', *Homeland Security News Wire*, 11 April 2017.
58 'Machines Are Learning to Find Concealed Weapons in X-Ray Scans'.
59 Planet biometrics, 'Accenture's Cyrille Bataller on AI and Biometric Borders', Webpage, 30 June 2016.

Accenture. *Crossing Boundaries: Emerging Technologies at the Border,* 2017.

———. *How Can Border Management Solutions Better Meet Citizens' Expectations?,* 2014.

———. *The Digital Traveler. Automating Border Management Solutions to Facilitate Travel and Enhance Security,* 2014.

Australian Government. 'Electronic Travel Authority'. Webpage, 10 May 2017.

BBC News. 'Passport Queues "Could Be Longer after Brexit", Airports Warn', 15 January 2017.

Billy Bambrough and Elisabeth Perlman. 'World Economic Forum 2017: Who Are the Biggest Winners from Globalisation and Free Trade?' *Verdict,* 9 January 2017.

Brian Karlovsky. 'Big Data Deployed to Protect Our Borders'. *IDG News Service,* 28 August 2013.

Brunsden, Jim, and Vanessa Houlder. 'Britain Faces €2bn EU Bill for Chinese Customs Fraud'. *Financial Times*, 8 March 2017.

Btihaj Ajana. 'Augmented Borders: Big Data and the Ethics of Immigration Control'. *Journal of Information Communication and Ethics in Society* 13, no.1 (March 2015).

Cabinet Office. *Civil Service People Survey 2016*, 2016.

Charlie Elphicke. 'How to Fund and Gain Better Border Control Post-Brexit. I Propose a Visa Waiver System.' *Conservative Home*, 11 January 2017.

Department for Transport. *UK Port Freight Statistics: 2015*, 2016.

'Developing Data-Driven Solutions for Faster, More Secure Border'. *Homeland Security News Wire*, 11 April 2017.

Erica E Phillips. 'Massive Robots Keep Docks Shipshape'. *Wall Street Journal*, 27 March 2016.

Francis Elliott. 'Fears That Customs Computers Can't Cope'. *The Times*, 23 January 2017.

Franklin Morris. 'Five Ways IoT Will Change How You Experience Air Travel'. *Internet of Things Blog*, 13 October 2016.

Future Travel Experience. 'Could Blockchain Technology Pave the Way for the Introduction of Global Single Passenger Tokens?' Webpage, June 2016.

Gavin Haines. 'Will Brexit Mean Longer Queues at Passport Control?' *The Telegraph*, 20 February 2017.

Gertrude Chavez-Dreyfuss. 'IBM, Maersk in Blockchain Tie-up for Shipping Industry'. *Reuters*, 6 March 2017.

HM Revenue and Customs. *The Control and Facilitation of Imports*, 2008.

Home Affairs Select Committee. *Radicalisation: The Counter-Narrative and Identifying the Tipping Point*, 2017.

Independent Chief Inspector of Borders and Immigration. *An Inspection of General Aviation and General Maritime*, 2015.

James Manyika, Michael Chui, Mehdi Miremadi, Jacques Bughin, Katy George, Paul Wilmott, and Martin Dewhurst. *Harnessing Automation for a Future That Works*, 2017.

JOC.com. ‘Europe’s Automated Terminals Face Steep Hurdles to Productivity Targets’. Webpage, 2017.

Johan Ponten. *Single Window – Best Practice and the Way Forward*, 2011.

‘Machines Are Learning to Find Concealed Weapons in X-Ray Scans’. *The Economist*, 3 December 2016.

May Bulman. ‘Plane Passengers Could See Waiting Times Double at UK Border Control after Brexit, Bosses Warn’. *Independent*, 15 January 2017.

May, Theresa. ‘Commons Debate on “Border Force Budget” HC Deb 20 April 2016 Vol. 608’.

———. ‘The Government’s Negotiating Objectives for Exiting the EU’, 17 January 2017.

Michael Koziol. ‘“World First”: Government Moves to Radically Overhaul Australia’s International Airports’, 22 January 2017.

Mike Burton, David White, and Allan McNeill. ‘The Glasgow Face Matching Test’. *Behavior Research Methods* 42, no 1 (n.d.).

National Audit Office. *E-Borders and Successor Programmes*, 2015.

Office for National Statistics. *Admissions Data Tables Immigration Statistics: December 2016*, 2016.

———. *United Kingdom Population Mid-Year Estimate*, 2016.

Planet biometrics. ‘Accenture’s Cyrille Bataller on AI and Biometric Borders’. Webpage, 30 June 2016.

Sam Bowman and Ed West. *The Border after Brexit.* Adam Smith Institute, 2016.

Sam Jones. ‘Europe’s Ports Vulnerable as Ships Sail without Oversight’. *Financial Times*, 4 February 2016.

Sita. *Airline IT Trends Survey 2015*, 2015.

Stephen Booth, Aarti Shankar, and Vicenzo Scarpetta. *Nothing to Declare*. Open Europe, 2017.

Steve Banker. ‘The Hamburg Port Authority’s Impressive IoT Project’. *Forbes*, 1 April 2016.

The Cool Star. ‘Maersk Line Introduces Remote Container Management “game-change”’. Webpage, 26 April 2016.

The Statistics Portal. ‘United Kingdom (UK) HMRC Customs Duty Receipts from Year 2015/2016 (in Million GBP)’. Webpage, 2016.

Timothy Revell. ‘Chinese Tourist Town Uses Face Recognition as an Entry Pass’. *New Scientist*, 17 November 2016.

UK Border Force. ‘“About Us”’, 2017.

UK Parliament. *UK Border Force: Finance: Written Questions – 23143*, 2016.

United Nations Economic Commission for Europe. *The Single Window Concept*, 2003.

World Economic Forum. *Digital Borders: Enabling a Secure, Seamless and Personalized Journey*, 2017.

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