The Hague Centre for Strategic Studies

Flow Security and Dutch Defense and Security Policies

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SECURITY

HCSS identifies and analyzes the developments that shape our security environment. We show the intricate and dynamic relations between political, military, economic, social, environmental, and technological drivers that shape policy space. Our strengths are a unique methodological base, deep domain knowledge and an extensive international network of partners.

HCSS assists in formulating and evaluating policy options on the basis of an integrated approach to security challenges and security solutions.

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EXECUTIVE SUMMARY

In a world of complex supply chains, global flows are critical to the welfare of societies at large and must be secured. These include flows of goods and services, information, ideas, and technology, capital, people and the environment through both physical and digital domains.

In the Defense Document of February 2017, the Dutch Ministry of Defense designated 'flow security' as one of three principal strategic challenges. Flow security now stands on par with the two more familiar challenges of 'staying secure' (territorial defense of Dutch and NATO territory) and of 'bringing security' (peace support and crisis management operations geared towards promoting global stability and maintaining the international order). If nothing else, this represents an acknowledgement that contemporary security and defense is as much about ensuring uninterrupted access to resources – both tangible and intangible – as it is about safeguarding territorial integrity. Flows, after all, yield enormous economic, social, and cultural value, whether through trade, foreign investments, tourism, or the exchange of knowledge and ideas, though they remain vulnerable to intentional or accidental disruptions with possible cascading effects.

Modern day adversaries have clearly understood this and have developed hybrid, cross domain strategies and capabilities to target the flows that are vital to the sustenance of societies. An assortment of recent cases offers ample illustration of this development: from Russia's hacking of Ukraine's power grid (2015) and its deliberate interference in societal discourses in the US, the UK, France and the Netherlands (2016), to the Shadow Brokers' leaking of NSA hacking tools (2016) and the Lazarus group taking down millions of computers in the Wannacry attacks (2017). States worldwide, including Russia, China and Iran, have been beefing up their Area Access Aerial Denial (A2AD) capabilities, allowing them – next to defending their own assets – to credibly threaten others with denial of access to Sea, Air and Land Lines of Communication.

At the same time, mounting interconnectedness has also facilitated the growth of negative flows such as human trafficking, the trade in illicit goods including arms and drugs, international terrorism, and cybercrime. These can disrupt and undermine the resilience of societies. Modern societies are thus both fundamentally dependent *on* and critically vulnerable *to* flow (in)security.

As the problems associated with flow security grow in complexity, so too do the solutions geared towards solving them. The critical global flows on which our societies depend are diffusing and spreading beyond the control of states. Transnational actors (e.g. corporations, civil movements, organized crime and terrorist networks) which direct or influence the various flows are emerging as new power brokers. Although many different state and non-state actors have a stake in flow security, they do not necessarily have (or feel) the responsibility to provide and maintain that security. This creates a void which governments, including the Dutch government, grapple to fill because they must facilitate positive flows while keeping negative flows in check.

The current study defines what flow security is, describes why it is relevant to the Netherlands, and analyzes what it portends for security and defense policies. It outlines a set of policy recommendations concerning the implications of flow security for Dutch security and defense policies and the role, tasks and capabilities of the Dutch Defense Organization.

The Importance of Flows for the Netherlands

Flow security is a topical subject for the Netherlands because Dutch prosperity and stability depends heavily on the continuity of these flows, not only those in and out of the country, but also globally, given the interconnectedness of flow systems. Because of this, the protection of commodities, movement of capital, critical environmental resources, and the cyber domain at large should feature as an important component of Dutch security and defense policies.

Flows of **goods and services** generate up to 67% of Dutch GDP, provide the Netherlands with strategic resources, create employment, and facilitate country-wide access to consumer goods which are not produced locally. Flows of **information, ideas, and technology** accounted for 22.9% (€158.01bn) of GDP in 2015, bolster the competitiveness of the country's innovative sectors, and are key in propagating Dutch values internationally. **Capital** flows, which underpin the global financial system, are of relevance because the Netherlands' position as the world's 18th largest economy derives in no small part from the comparatively massive size of the FDI flows (measured both by inward and outward stocks). **People** flows are of importance to the Netherlands because they generate revenue through tourism and because they help the country address labor shortages in various sectors. Finally, **environmental** flows play a critical role in ensuring global and regional environmental stability.

Flow networks traverse multiple domains, run along extended multiple-input supply chains, and interact with a multitude of actors before delivering their content. Multiple critical hubs are situated along these chains. Some of these hubs, such as harbors and airports, serve multiple flows simultaneously. Global flows feature a high degree of co-dependence, not only because they interact with one-another (e.g., capital for goods), but because they traverse multiple connected domains. The combination of these dynamics renders flows vulnerable to ripple effects in which disruptions in one domain also affect another, and – by extension – to actors which have concluded that modern societies are vulnerable to disruptions of the flows which sustain them. From high-seas piracy to cybercrime, the fragmentation of the internet, and the increased sophistication of national cross domain coercive means, the integrity of global flows is under pressure.

The Implications of Flow Security for Dutch Security and Defense Policies

The adoption of flow security as a distinct strategic challenge has a range of implications for the roles, tasks and capabilities of not just the Dutch Defense Organization, but of the Dutch government as a whole. Security in the context of the intricate cross-domain character of flow systems requires the operationalization of a **whole-of-government approach** which is geared towards **improving the resilience and robustness** of flow systems as a whole, and includes the following implications:

» At the highest level, flow security as a (distinct) strategic challenge requires analysis of the **geostrategic environment through a flow security prism**. This involves mapping and monitoring global value chains, recognizing interdependencies in and across flow chains, identifying critical vulnerabilities *and* opportunities along these chains, and formulating and executing comprehensive flow security policies accordingly. Such policies should be informed by the

flow design principles that underpin the resilience and robustness of flow systems. These principles include building **diversity**, **redundancy**, and **layered segmentation** into the system, the **protection** of **critical nodes** and the ability to respond to developments **dynamically**.

» It also requires the establishment of a **networked National Security Council** (NSC) chaired by the prime minister, who is the designated official to coordinate the coherence between policies and to ensure their implementation. The NSC would strengthen existing interdepartmental consultation and coordination instead of establishing another organizational structure. In practical terms, one potential option would be to merge the two cabinet subcommittees *Ministeriële Commissie Veiligheid* (Ministerial Commission Security) and *Raad voor de Inlichtingen- en Veiligheidsdiensten* (Council for the Intelligence and Security Services). Analytical support can be provided by an existing network of agencies and knowledge institutes that reside both in and outside of government.

» Streamlining the collection of inputs to be used by the proposed **NSC will require the involvement of the Dutch Defense Organization.** Given its **intelligence assets** and associated organizational, doctrinal and procedural frameworks, the Ministry of Defense can provide a substantial part of the backbone of a **government-wide anticipation function** for analyzing and monitoring (flow) security risks and threats. This necessitates the implementation of a **legal framework** under which **intelligence agencies** can execute cyber flow security monitoring subject to **appropriate democratic checks and balances**. A case in point presents in forthcoming Dutch Telecom/ICT regulation, which will mandate telecom providers to report changes in ownership to the Ministry of Economic Affairs, and will empower various agencies (the AIVD included) to conduct in-depth analyses of incoming shareholders.

The Implications of Flow Security for the Dutch Defense Organization

Flow security also brings with it an assortment of implications for the Dutch Defense Organization. The most fundamental of these implications relates to its role in the provision of security.

» **Recognition of the increasing importance of the Defense Organization's role as a 'flow security contributor'**. The Dutch Defense Organization has a critical role to play in applying band aids to flow systems as disruptions arise. Because flow disruptions can present themselves in ad-hoc fashion, which – as was recently the case in the Dutch country of St. Maarten – may require the involvement of the armed forces, this requires increased commitment (financial or otherwise) to maintaining the readiness of deployment systems such as the C-130 Hercules. More generally, it requires rendering the Dutch Armed forces more flexible vis-à-vis operations in noncombat situations, and benefits from initiatives to adapt existing systems for use in disaster relief situations.

» The Dutch Defense Organization should examine to what extent it can develop its role as a **custodian of security** in the wider **security ecosystem**. The overall security responsibility in flow security emerges – often more implicitly than explicitly – from the interplay of many different stakeholders within an ecosystem. The collection of information, the adoption of standards, and the protection of physical and virtual flows requires close cooperation with a mix of national and international private and public partners.

» The role of custodian is not hierarchical in that it is not about taking control and telling others what to do. The Dutch Defense Organization can act as **adviser**, **standard setter**, **facilitator**, **supervisor**, and sometimes even **de-facto regulatory power** in environments where no single actor has the incentive or the mandate to do so.

» Such a transformation would push the Dutch Defense Organization beyond its comfort zone, and would require it to communicate and collaborate with **unfamiliar partners** and parties, to **develop new structures and doctrines**, to **cultivate new skills**, and to **adapt to flexible decision-making and executive processes** also in environments where the power to act does *not* fall under command and control structures.

To be able to effectively contribute towards addressing the challenges specifically associated with flow security, the Dutch Defense Organization would benefit from supplementing its current portfolio with the following **material capabilities:**

» **Monitoring technologies** that can identify and track **flow particles** at the **micro-level,** while not impeding positive flows. Like ship and airplane transponders used in naval shipping and aviation, this will be of great value in monitoring sensitive materials, tracking human trafficking, or identifying the presence of malware in cyberspace. The Royal Netherland's Marechaussee's participation in the *seamless flow* program for the border passage at Schiphol serves as a promising example. More broadly, the advent of digital ledger technologies is expected to play a vital role. The Ministry of Defense's relatively **robust knowledge and innovation base** can and should be put to work in the area of technology assessment, concept development, and experimentation relating to this field, and should aim to integrate digital ledger technologies with the military sensor platforms and intelligence assets.

» **Combined sensor and weapon platforms that target** individual negative flow particles with **greater precision** so as not to interrupt the positive flow. Existing platforms may require specific add-ons, not currently in the inventory, and/or new operational concepts, doctrines and procedures, to be able to better deal with flow security challenges across domains.

» **Increased commitment to countering A2/AD capabilities** to offset the A2/AD capabilities of opponents. This will require greater investment in a wide range of deterrent, defensive, but also offensive counter A2/AD capabilities across the different services in the context of Dutch contributions to NATO. One specific counter-A2/AD technology which is of particular relevance for the Netherlands given the importance of the Port of Rotterdam presents in the development of robust mine countermeasures (and has been acknowledged by NATO as an alliance-wide capability gap). Countering the A2/AD advantages currently held by opponents, however, requires a wider range of capabilities, and includes stealth technology, anti-submarine warfare capabilities, deployable command and control naval and land assets, fire support capabilities, and means for electronic warfare.

Given the daunting nature of the challenge at hand, it is not surprising that Dutch security and defense organizations are currently insufficiently prepared to ward off the myriad of risks associated with flow security. Prudent policymakers therefore take flow security seriously and prepare accordingly. We hope that this study contributes to that end.

CHAPTER 1: INTRODUCTION - FLOW SECURITY, A NEW PARADIGM?

National security and defense have traditionally revolved around the territorial integrity (and, by extension, the sovereignty) of the nation state. But this viewpoint is antiquated in the context of a world of complex global supply chains in which corporations and individuals are increasingly critical to the welfare of societies at large. Contemporary national security and defense is as much about safeguarding territorial integrity as it is about ensuring uninterrupted access to global flows of goods and services, information, ideas, and technology, capital, people and the environment through both physical and digital domains. Contemporary adversaries understand this and have developed hybrid, cross-domain strategies and capabilities to target these flows. An assortment of recent cases offers ample illustration of this development: from Russia's hacking of Ukraine's power grid to interrupt its power supply in 2015 and its deliberate interference in societal discourses in the US, the UK, France and the Netherlands in 2016, to the Shadow Brokers' leaking of NSA hacking tools in 2016 and the Lazarus group taking down millions of computers in Wannacry attack in 2017 . States worldwide, including Russia, China and Iran, have been beefing up their Area Access Area Denial (A2/AD) capabilities so that they can now credibly threaten Sea, Air and Land Lines of Communication.

Meanwhile, the critical global flows on which our societies depend are diffusing and spreading from within the boundaries of the state to the global sphere beyond individual actor control. Transnational actors (e.g. corporations, civil movements, organized crime and terrorist networks) who feed, tap, direct or influence the various flows are emerging as new power brokers. As the problems associated with the security of these flows grow in complexity, so too do the solutions geared towards solving them. Although many different state and non-state actors have a stake in flow security, none necessarily have (or feel) a responsibility towards providing and maintaining that security. Despite the dynamism of global interconnectedness, nation-based identities will likely continue to provide central and identifying organizing concepts. Today's interconnected world is therefore not 'flat,' but 'uneven', with the contours of its networks affected by decisions made by state actors, co-existing with strong decentralized bottom-up dynamics.[1]

Dutch society's dependence on flows means its prosperity hinges on the continued functionality and maintenance of a multitude of nodes, relationships (whether interstate or otherwise) and production processes. This creates threats as well as opportunities, and affects the way in which we understand and therefore approach the provision of global security goods. It warrants affording flows a central place within the Dutch security discourse. To effectively address the vulnerabilities associated with flow security, the Netherlands security and defense organizations will need to work more tirelessly than ever before to integrate their efforts with national and international partners and institutions. The Netherlands must aim to adopt a whole of society approach internally, and spearhead initiatives which deter, circumvent and defend against actors that currently conduct under the radar sabotaging operations, by facilitating the identification and subsequent sanctioning of such actors and informing appropriate defensive and resilience increasing measures.

1. The mirage of 'flatness' in global affairs after Thomas L. Friedman's *The World Is Flat* (2005) and of 'the end of history' in political thought after Francis Fukuyama, *The End of History and the Last Man* (1992) - even if brought in a nuanced way in the actual books - has obscured the contours of the actually emerging global flow map, which in reality is far from evenly spread and far from being immune to political interference.

The Fundamental Importance of Flows

Transboundary arteries carrying people, ideas, money, energy, goods and services contribute significantly to global prosperity. There is nothing particularly new about this. Since prehistoric times our ancestors have spread across the globe and established polities that engaged in cross-regional social and economic relationships with one another. Western and Eastern tribes, cities, empires and states have warred and traded with and amongst one another since before Antiquity, dispersing language, religion, livestock, and cultural and technological practices in the process.[2] Throughout history, numerous socio-technological innovations have facilitated ever denser relations over ever greater distances. Successive waves of globalization in the late twentieth and early twenty-first centuries, in the period following the Second World War and after the end of the Cold War, have served to further consolidate global connectedness. These processes have propelled global flows to volumes which are unprecedented in history, transcending the state ability to control them.[3] Multinational corporations, which together account for eighty percent of global trade, are organized in vertically and horizontally integrated global supply chain networks that span the globe, and almost universally maintain just in time delivery schedules which render the delivery of end-products highly susceptible to even minor delays.[4]

If globalization has shown signs of slackening (at least by some measurements), it has coincided with the take-off of digital globalization and its corollary process of disintermediation.[5] Disintermediation fundamentally transforms the role of traditional men-in-the-middle organizations. In these past two decades, entire industries have already been disrupted by technologies which range from automated production processes to (more recently) the advent of drones and self-navigation within the transportation sector.[6] Nation-states now confront a similar challenge. They face the risk of being unable to reap the benefits of both physical and digital flows, while simultaneously being unable to protect their populations from the negative consequences stemming from them. These flows, after all, yield enormous value, whether through trade, foreign investments, tourism, or the exchange of knowledge and ideas, though they remain vulnerable to intentional or accidental disruptions with possible cascading effects. At the same time, mounting interconnectedness has also facilitated the growth of human trafficking, the trade in illicit goods including arms and drugs, international terrorism, and cybercrime. Such negative flows can disrupt and undermine the resilience of societies. Modern societies are fundamentally *dependent on* global flows and critically *vulnerable to* flow insecurity. Prudent policymakers therefore take flow security seriously.

2. Azar Gat, *War in Human Civilization*, 1 edition (Oxford: Oxford University Press, 2008). Ian Morris, *Why the West Rules--for Now: The Patterns of History, and What They Reveal About the Future*, Reprint edition (London: Picador, 2011).

3. Parag Khanna, *Connectography: Mapping the Future of Global Civilization* (Random House Publishing Group, 2016).

4. "Unctad.org | 80% of Trade Takes Place in 'value Chains' Linked to Transnational Corporations, UNCTAD Report Says," accessed October 5, 2017, http://unctad.org/en/pages/PressRelease.aspx?OriginalVersionID=113. (more recent source) At present, already over 10% of the international trade in goods is e-commerce, while over half of the global services is digitized, which is widely seen as only the beginning.

5. James Manyika et al., "Digital Globalization: The New Era of Global Flows | McKinsey & Company" (McKinsey Global Institute, March 2016), http://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/digital-globalization-the-new-era-of-global-flows.

6. Stephan De Spiegeleire and Tim Sweijs, *StratMon 2016-2017: Volatility and Friction in the Age of Disintermediation* (The Hague: The Hague Centre for Strategic Studies, 2017).

Flow Security for the Netherlands

Flow security is a topical subject for the Netherlands because Dutch prosperity depends heavily on securing the integrity of flows of people, capital, information, technology, and goods and services which flow into (and through) the country, through both physical (air, sea, land and increasingly also space) and digital (cyber) supply lines. The global economy's partial dependence on the country's hubs, including Schiphol Airport, the Port of Rotterdam, and the Amsterdam Internet Exchange (AMS-IX) service not only transit a large volume of commodities (Port of Rotterdam, Schiphol Airport), but also serve to ferry people (Schiphol Airport) and data (Amsterdam Internet Exchange) between the world's landmasses. This earns the Netherlands a unique position as a 'systems country' within the global economy - a function which has earned it its appellation 'the gateway to Europe', and which is reflected in its performance on globalization-related indices such as the WEF Enabling Trade Index (2016),[7] the KOF Index of Globalization (2017),[8] and the DHL Global Connectedness Index (2016).[9] At the international level, the Netherlands scores 2nd, 1st, and 1st on these indices respectively. These flows are also of tremendous importance to the Netherlands itself. Given the degree to which interaction with international flows boosts the country's overall prosperity, it is undeniably in the Netherlands' national interest to ensure continuity vis-á-vis the country's current node function and to contribute to protecting the integrity of global flow systems. At the same time, the interconnectedness also renders it vulnerable to negative flows, which has prompted the Dutch Ministry of Defense to adopt 'flow security' as one of the three principal strategic challenges (see Textbox 1).

Textbox 1 Overview of the Dutch government's current stance on flow security

The emergence of flow security in Dutch foreign and security policy

Flow security as a term has only recently caught on in the defense and security debate in the Netherlands. The Hague Centre for Strategic Studies (HCSS) drew attention to the concept in its contribution to the interdepartmental Strategic Monitor 2013; and emphasized the broad range of 'flows' that have security challenges associated with them.[10] In the Dutch discourse, flow security has been typically associated with economic security. The latter is explicitly anchored in policy since in 2007, when the National Security Strategy (NSS)[11] named economic security as one of the five vital national interests next to territorial, ecological and physical security, as well as social and political stability. In the NSS, economic security is defined as "the undisturbed functioning of the Netherlands as an efficient and effective economy. For example, economic security may be affected if trade with a major foreign partner falters". As concrete threats, extreme energy and resource scarcity are mentioned.

7. World Economic Forum, "Economy Profiles," *Global Enabling Trade Report 2016* (blog), 2016, http://wef.ch/2faSFhA.
8. World Economic Forum, "The Global Enabling Trade Report 2016" (World Economic Forum, 2016), http://reports.weforum.org/global-enabling-trade-report-2016/economy-profiles/#economy=NLD.
9. Pankaj Ghemawat and Steven Altman, "DHL GLobal Connectedness Index 2016: The State of Globalization in an Age of Ambiguity" (Deutsche Post DHL Group, 2017), 30.
10. Bekkers Frank et al., "De Toekomst in Alle Staten" (The Hague: The Hague Centre for Strategic Studies, 2013), 74.
11. Ministry of Defence, "Strategie Nationale Veiligheid" (Ministry of Defence, 2007).

The International Security Strategy (ISS) from 2013 and its update[12] from 2014 bear witness to a growing awareness of the vulnerabilities of the Dutch economy to external threats. Economic security is named as one of three security challenges next to territorial defense and a functioning legal order. The description of economic security in the ISS, without explicitly using the term, fits within the broader security concept of flow security. On the one hand, reference is made to the importance of countering interruptions of production chains and flows. On the other hand, the ISS also addresses the need to protect strategic economic sectors and vital infrastructures. Risks and threats include piracy, cyber-attacks, cyber spying, fraud, corruption and all forms of organized crime. They also encompass territorial conflicts and blockades that endanger the strategic position of the Netherlands as a transit country and the security of supply of raw materials and energy. The IVS also introduces climate security as a 'new' but increasingly pressing theme. This development of a somewhat narrow interpretation to a broader understanding of economic security has continued in the recent defense policy letter to Parliament.[13] In this document, the term flow security was explicitly introduced; indeed, the term made a remarkable and forceful entry. Flow security now constitutes one of three 'strategic challenges' for Dutch Defense, next to the two more familiar challenges of 'staying secure' and 'bringing security'.[14] In the policy letter, the concept of flow security is framed as follows:

> *"The Netherlands derives a large share of its economic welfare from its function as a central node within the world economy. This is reflected in the country's runner-up position - it falls just below Singapore, but ahead of the United States, Germany, Ireland, and the United Kingdom - on McKinsey's connectedness index. The Netherlands is a 'systems country' in that the continued function of the world economy is (at least in part) dependent on its continued participation therein, and hosts flows which consist of everything from natural resources and trade in physical goods and services (these travel through the Amsterdam and Rotterdam harbors), to people (which travel through Schiphol airport) and data (internet exchanges such as AMS-IX are increasingly earning the country the title of 'digital gateway to Europe'). Maintaining the security of the Netherlands' node function - and, by extension, the security of the flows which it services - is (if only for economic reasons) undoubtedly in the country's best interests, and requires not only a commitment to protecting vital (domestic) infrastructure, but the active pursuit of initiatives which are geared towards securing continued freedom of operation within the world's global commons."*

Global flows are important to our country; there is little wonder that flow security has captured a central role in recent defense strategy and policy papers. However, images associated with the term differ. Note, for instance, that the current use of the term by the

12. Ministry of Foreign Affairs, "A Secure Netherlands in a Secure World" (Ministry of Foreign Affairs, 2013).; and Albert Koenders, "Beleidsbrief Internationale Veiligheid – Turbulente Tijden in Een Instabiele Omgeving" (Ministry of Foreign Affairs, 2014).

13. Jeanine Hennis-Plasschaert, "Houvast in Een Onzekere Wereld" (The Hague, Netherlands: Ministry of Defence, February 2017).

14. 'Flow security' is in essence the English language equivalent of the strategic challenge '*veilig verbinden*', next to the two other challenges '*veilig blijven*' (read: national and collective territorial defence) and '*veiligheid brengen*' (read: stability and peace support operations).

Dutch Ministry of Defense focuses on the protection of positive flows and not yet on dealing with negative ones. Security risks associated with negative flows are of concern, but are as of yet not explicitly discussed under the label of flow security. As an example, securing the cyber domain through network protection and through increasing private-sector resilience contributes to flow security by improving the integrity of (among others) information flows, but is not explicitly prescribed because it constitutes a policy initiative which addresses a challenge that is not *unique* to the dynamics associated with flow security. Furthermore, the description above centers on '*knooppunt Nederland*' acting as a central hub or relay node in various global flows places special emphasis on the need to secure relevant domestic infrastructure. While it is true that flow security exhibits a distinct overlap with critical infrastructure protection, border protection and territorial defense, it also addresses a range of other security challenges. Globally relevant flows stretch far beyond the Dutch main ports ('hubs') and direct access routes ('spokes'). Internationally dispersed infrastructure has a role to play not only in the maintenance of the Netherlands' contemporary welfare, but also in the facilitation of future flows and the furthering of global welfare. Just as the port of Rotterdam is of critical importance to the Netherlands' prosperity, so too are other nodes (for example the Port of Shanghai, the Port of Singapore, and Turkey's Kumport), which are situated along (or near to) China's new silk road. In that complementary perspective, both 'soft' and 'hard' instruments of national influence may be brought to bear. How and when can and should such instruments be wielded? As the *Wetenschappelijke Raad voor het Regeringsbeleid* (WRR) notes in its recent appreciation of Dutch defense strategy, "Economic security and flow security have only quite recently been put explicitly on the Dutch security agenda and are not embedded as full-fledged perspectives in the broader policy".[15]

How to Address Flow Security?

Governments, including the Dutch government, grapple with the question of how to keep negative flows in check while ensuring that the movement of positive flows is facilitated. This involves protecting the channels through which these flows travel, securing critical access points and hubs, and increasing the resilience of individual flow particles. Recognizing this, policymakers have devised numerous solutions on multiple levels and in various domains. From the anti-piracy mission in the Gulf of Aden (to protect vital sea lines of communication) and the US' Container Security Initiative (to increase the security of cargo transport) to Europol's European Counter Terrorism Centre (to address the threat of international terrorism) and the Budapest Convention on Cybercrime (to harmonize national responses to safeguard cyberspace), examples of such flow security solutions abound. Simultaneously, an uptick in actors resorting to more traditional solutions that essentially fend off flows has also been recorded. In the physical domain, approximately half of the fifty-one cross border walls in existence today were erected during this century.[16] In Europe, the refugee crisis was followed by the reintroduction of border controls in the

15. Wetenschappelijke Raad voor het Regeringsbeleid, "Veiligheid in Een Wereld van Verbindingen: Een Strategische Visie Op Het Defensiebeleid" (Den Haag: Wetenschappelijke Raad voor het Regeringsbeleid, 2017).

16. Ron E. Hassner and Jason Wittenberg, "Barriers to Entry: Who Builds Fortified Boundaries and Why? | International Security | MIT Press Journals," *International Security* 40, no. 1 (Summer 2015), http://www.mitpressjournals.org/doi/full/10.1162/ISEC_a_00206.

Schengen area. In the US, the Trump administration imposed a travel ban for nationals from specific countries. This trend is mirrored in cyberspace, where governments of all stripes are drawing up measures – whether to protect their citizens from terrorism (see the US' NSA) or to limit their access to uncontrolled information (see China's 'great firewall') – which fundamentally erode the freedom of communications over the internet. These two different types of responses are broadly representative of two different perspectives on how to design flow security solutions.

The first perspective argues that global flows yield both threats and opportunities which at their core are *networked* in nature, despite the fact that policymakers continue to approach them along neat, Westphalian, linear lines. Because traditional security approaches and doctrines rooted in static understandings of security no longer suffice, it is proposed that "it is time to develop those strategies and to integrate statecraft with webcraft, the art of designing, building, and managing networks', in order to promote the resilience of our systems.[17] The key word here is *eco-system* – and, by extension – *openness*. The strategic objective is 'not domination, which brings obligation, but leverage, which generates value."[18]

The second perspective shares to varying degrees the observation that threats and opportunities may be networked in nature, but above all sees the solution in protecting and harnessing these risks through *closed* solutions. It is about trying to regain control over these flows by (re)surrecting physical and virtual barriers, as propagated by sovereigntist minded politicians.[19] Within this second perspective, the importance of gatekeeping in networked systems is emphasized, one that rests on "the construction and development of secure, carefully designed communities to manage everything from trade to cyber-information to scientific research."[20] The key word here is *closed*, and the strategic objective is about attaining or preserving the position of 'gatekeeper' instead of 'gatekept'.[21] A more nuanced position holds that "walls are no more intrinsically bad than unfettered flows are intrinsically good". Instead, "a peaceful and prosperous world order, one which is neither a stagnant securocracy nor a perennially unstable chaoplex, depends upon a balance between the two."[22] This requires – as is reflected in the Netherlands' ability to *manage* rather than *block* encroaching water flows – acceptance of the reality that flows can never be completely stopped, and the adoption of measures which adaptively address the negative externalities associated with their continued movement.

The different solutions that are proposed within these two perspectives reflect the explorative nature of strategic thought concerning flow security. They represent early attempts to formulate responses to new security challenges, that have not yet matured into fully developed, coherent visions from which strategies and doctrines can be derived.

17. Anne-Marie Slaughter, "How to Succeed in the Networked World," *Foreign Affairs*, October 4, 2016, https://www.foreignaffairs.com/articles/world/2016-10-04/how-succeed-networked-world.

18. Khanna.

19. Stephan De Spiegeleire, Clarissa Skinner, and Tim Sweijs, *The Rise of Populist Sovereignism: What It Is, Where It Comes from and What It Means for International Security and Defense* (HCSS, 2017), https://hcss.nl/report/rise-populist-sovereignism-what-it-where-it-comes-and-what-it-means-international-security.

20. Joshua Cooper Ramo, *The Seventh Sense: Power, Fortune, and Survival in the Age of Networks*, Unabridged edition (Little, Brown & Company, 2016), 571.

21. Ramo, 590.

22. David J. Betz, "Webs, Walls, and Wars," *Global Crime* 17, no. 3–4 (October 1, 2016): 296, https://doi.org/10.1080/17440572.2016.1179631.

Structure of This Study

This study seeks to contribute to this emerging body of thought and the development of such a vision. It defines what flow security is, considers its constituent elements, describes its relevance to the Netherlands, and analyzes what it portends for security policies. Chapter 2 develops a taxonomy to capture and describe the characteristics of flows. The taxonomy is relevant for the identification of options for the various ways in which flows can be secured. Chapter 3 empirically describes the relevance of the following five critical flows for the Netherlands: goods and services, knowledge and ideas, capital, people, and the environment. On the basis of empirical analysis, Chapter 4 identifies a set of flow security solutions that can be used as a basis for policy, strategy and capability development for the Dutch government and, in particular, the Dutch Defense Organization.

CHAPTER 2: CONCEPTUALIZING AND IDENTIFYING FLOWS

Flow security implies that flows have their own specific security challenges, and, by implication, security solutions associated with them. A more traditional static security paradigm exclusively focuses on the *nodes* in the network, or, in other words, on the origins and destinations of the flows. Nodes - such as border checkpoints, transport hubs, media offices, internet exchange points, technology research facilities, military assembly areas - have a geographical location and fall under the legal jurisdiction of a particular nation-state. The flow security paradigm, in contrast, places *moving flows* central. Flows transcend borders, are often fluid and always dynamic, and should not and cannot be necessarily understood in geographic terms. Their origin is harder to pinpoint (e.g., ecological flows, cyber-attacks), or is no longer relevant (e.g., 'memes' going viral). It is this emphasis on the flows themselves that is central to the concept of flow security. This chapter describes how flows can be best conceptualized and analyzed with an eye to the development of security policies, and explains and elaborates the selection of five critical flows.

Fundamental Features of Flows: A Taxonomy

The development of flow security policies starts with a proper delineation of the concept of a flow and its constituent elements. As a noun, the word 'flow' describes *either* 'the action or fact of moving along in a steady, continuous stream' *or* 'a steady, continuous stream or supply of something'. Though these definitions remain exceptionally general in their description, they also reveal a number of fundamental flow characteristics. First, flows are *comprised* of something. Second, that *something* which makes up the flow is *mobile* in that it moves. Third, that movement is *continuous*, or not interrupted, and fourth, the movement has a vector which transports it from one point to another. This definition is more or less ubiquitous with the definitions put forth in the fields of physics, engineering and mathematics, which universally subscribe to the notion of a flow as 'a continuous motion of points over time' or 'the motion of particles in a liquid.' Within these definitions, two enumerations are of particular relevance. The first concerns the reference to 'points' and 'particles'. These terms (both expressed in the plural) indicate the presence of *multiple* - and, given the fact that both *particles* and *points* are terms which refer to bodies (whether of matter or of data) - a *multitude of* such entities *within* the flow. More importantly, a particle (in physics) can be ascribed physical and chemical properties, and is thus a form of mass. This is relevant because in the case of unconscious physical objects - in this case flow 'particles' - which are inanimate by nature, they must be acted on by an external force to move.[23] As flows move particles between locations, this implies that the movement of particles within a flow is contingent on the presence of an input force.

The second relevant enumeration lies in the reference to these 'particles' as traveling *in* and *through* a liquid. Liquid represents a form of matter which is bound together largely to the strength of the intermolecular bonds. Aside from affirming the notion that flows - much like liquid - are made up of a multitude of smaller wholes, it also underscores the partial dependence of a liquid's molecules on

23. Analogous to the Aristotelian concept of motion, see http://www.iep.utm.edu/aris-mot/

one-another to move. The ability of water for example to form streams and rivers is essentially an artifact of billions of minuscule magnetic attractions between H_2O molecules. This in turn touches on the phenomenon of in-flow co-dependency, and introduces the notion of flow circularity. Flow circularity refers to the fact that flows which *deposit* particles somewhere must somehow be replenished at their source if they are to maintain their continuous motion.[24] This is in keeping with the notion that matter can be neither created nor destroyed (only 'transformed' into other forms of matter), and implies that in order to 'flow' in the long term, the particles which make up a flow must be replenished at a rate which equals their depletion rate.[25][26] This replenishment can also take the form of *substitution* or *exchange*. The aggregation of these observations points towards flows as taking the form of multitudes of **particles** which are continuously **moved** and **replenished** *through* **environments** by **vectors** which ferry them *between* **locations**. In describing the five critical flows, we will make use of a taxonomy that includes the following elements:

1. **Flow Particle**: in keeping with the previously outlined observation that flows consist of particles, the transported item (or 'particle') element header provides an overview of the items which make up a flow. Depending on the flow category, these may be as varied as the makeup of goods and services category (which incorporates everything from oil to iPhones) or as uniform as the capital category (which incorporates all sorts of financial flows).

2. **Relevance**: relevance refers to a flow category's importance from an economic and societal perspective. Relevance is described by supplementing an overview of the flow's international impact with an overview of the flow's contribution to the Netherlands. To facilitate a cost-benefit approach to policymaking, flow impacts are (where possible) provided in monetary terms.

3. **Flow Domains and Hubs**: building upon the notion that flows travel through environments, an overview of domains through which flow particles must traverse is provided on a per-flow basis. The possible flow domains are air, sea, land, space, and cyberspace. In keeping with the literature's reference to flows as transporting particles *between* locations, an overview of relevant flow hubs is provided. From a perspective in which global flows are made up of continuously moving (internationally distributed) particles, hubs – not end points – are of relevance for policymakers. This is because upon a flow particle reaching its end point, it has (arguably) completed its journey successfully. Because of this, interventions can only be viably staged during *either* the mobile (e.g., *while* goods are loaded onto a cargo ship or transported) or immobile periods (e.g., after goods are unloaded *from* a cargo ship) which transpire *before* the particle reaches its end point.

24. See USGS, "The Water Cycle Summary, USGS Water Science School," USGS: Science for a Changing World, 2016, https://water.usgs.gov/edu/watercyclesummary.html. In the case of a river, such replenishment takes the form of a 'water cycle' in which evaporated water forms clouds which eventually redeposit it into the environments from which it originated.

25. It is additionally adopted within the field of philosophy, where paradigms of thought such as the Chinese Yin and Yang and the Indian Saṃsāra posit that every force is balanced by an opposite (i.e.: life and death) to which it inevitably contributes (i.e.: shadows cannot exist without light).

26. This circular dynamic is also routinely observed within natural environments, with the cyclical nature of several elements' uptake processes (see Carbon and Nitrogen cycles) being well established within the environmental sciences. A recurring trend within the aforementioned (Carbon, Nitrogen, and water) cycles manifests in the observation that the particles which make up their 'flows' originate from several sources. As an example, the water molecules that deposit into oceans may - before 'rebooting' their cycles through evaporation (and eventual precipitation) - originate from (among others) melted snow, glacial lakes, and evaporated groundwater. See John Arthur Harrison, "The Nitrogen Cycle | Earth Science," Visionlearning, 2003, https://www.visionlearning.com/en/library/Earth-Science/6/The-Nitrogen-Cycle/98. for an explanation of the Nitrogen cycle; see also Holli Riebeek, "The Carbon Cycle : Feature Articles," June 16, 2011, https://earthobservatory.nasa.gov/Features/CarbonCycle/page4.php. for an overview of the Carbon cycle.

4. **Flow Characteristics**: as an overview of flow particles and flow domains provides little in the way of actionable policy points, an analysis of strategic flow characteristics is provided. Information provided within this category highlights an overview of trends which result from the flow particle's operational qualities, its mode of transport, and its interaction with its flow environment. As a general rule, this element header provides an overview of the flow particle's travel velocity, whether it is replicable or non-replicable, whether its transport requires logistical planning, and whether it can be physically intercepted or not.

5. **Threats to the Flow**: threats to the flow are those factors that threaten a flow's continued movement. These should ideally be countered in the case of positive flows, and warrant sabotage in the case of negative flows. Threats by-and-large derive from the flow's characteristics, and thus relate to the way it travels through relevant flow domains.

6. **Threats from the Flow**: threats from the flow headers provide an overview of the negative externalities brought on by the continued movement of negative flows.

7. **Flow Stakeholders**: expanding upon the notion that flow particles require both physical force (propulsion) and – depending on the flow – human engagement to be mobile, the flow stakeholders element header provides an overview of the relevant actor categories that may impact the flow's movement. This list summarily includes an oversight of threatening actors, but also provides an overview of potential partners.

8. **Critical Co-flows**: as – in the age of globalization – the flow categories included within this paper are frequently integrated to the point that securing them requires a holistic view of one international flow network rather than a view of the dynamics of singular flow categories, the critical co-flows element sub header presents information which relates to each flow's impact on the other. This information aims to provide policymakers with an overview of possible cascade effects of policies, and serves to increase situational awareness.

The elements which make up this taxonomy are summarized in **Table 1**:

Table 1 Overview of elements which make up modern flow taxonomy

Flow Element	Element Description
Flow Particle	The objects which are moved by the flow.
Relevance	Overview of the flow's relevance at the global level and to the Netherlands.
Flow Domains	The environment(s) through which the flow travels.
Flow Hubs	Infrastructure which acts as a convergence point and facilitates flow logistics.
Flow Characteristics	Strategically notable, flow-specific characteristics which derive from the nature of the mobile object, its interaction with its flow environment, and its dependence on relevant flow hubs.
Threats to the Flow	Dynamics which threaten to disrupt the continued movement of the flow.
Threats from the Flow	Negative externalities associated with the flow's movement or with the objects which it transports.
Flow Stakeholders	Categories of actors which interact with aspects of the flow's movement.
Critical Co-flows	Other flow categories which - due to structural dependences - are instrumental to a flow's continued movement.

This taxonomy is geared towards equipping policymakers with several strategic levers. First – in offering a concise view of the flow's relevance to the Netherlands – it provides the foundations for the development of policies to secure those flows. Second, in synthesizing an overview of each flow's anatomy – an image which is created through the combination of flow domains, flow hubs, flow characteristics, and stakeholders – it offers basic insight into which solutions (and, by extension, which departments) are likely to be involved. As flow security – in requiring not only the protection of positive flows, but also the defense against negative ones – by and large demands policymakers to view flows as global (circular) systems which transport a vast volume of mobile objects, an anatomical view lubricates the planning process by identifying physical infrastructure and relevant chokepoints which are instrumental in facilitating the logistical processes that allow mobile objects to reach their intended destinations. Finally, this taxonomy strives to address the reality that modern flows exist within circular (and often co-dependent) flow *systems* rather than in flow vacuums by including an overview of critical co-flows. This is geared towards providing policymakers with a holistic view of flow security, and should serve to inform the reader vis-a-vis critical mechanisms which flow categories are *indirectly* dependent on.

Five Critical Flows

In the context of deep interconnectedness, identifying which flows are critical to the functioning of societies and economies is of paramount importance. We differentiate between flows of goods and services, information, ideas and technology, capital, people, and environment. These respectively refer to the global trade in physical goods and services, the transfer of ideas, knowledge, and innovation, the global transfer of capital, the movement of people, and the movement of particles which underpin the global ecosystem. This categorization largely aligns with those put forth by previous contributors to flow security[27] – and is comprised of categories which correlate strongly with increases in global prosperity.[28] It is comprehensive because it incorporates consumable (expendable) flows as well as supplementary (supporting) flows, and thus – from a security perspective – lends itself well to structural analysis through the lens of a wide range of flow domains. These included flow categories are discussed in further detail below.

Flows of goods and services are comprised of all international trade. This category includes the import and export of (raw) materials which are used to produce intermediary (component and subcomponent category) goods, the final goods which are comprised of them, and the provision of physical services. These flows may be associated with positive as well as negative effects. With regards to positive flows within this category, these are goods which are not available within the Netherlands natively, and include goods such as metallic substances which are used in industrial processes, key energy commodities such as oil, natural gas and coal, agricultural products, and cellular devices. Negative flows of goods and services manifest in illicit arms trade networks, human trafficking, and the drug trade.

27. Erik Brattberg and Daniel S. Hamilton, eds., *Global Flow Security: A New Security Agenda for the Transatlantic Community in 2030* (Washington, D.C.: Center for Transatlantic Relations, 2014).; see also James Manyika et al., "Global Flows in a Digital Age: How Trade, Finannance, People, and Data Connect the World Economy" (McKinsey Global Institute, 2014).

28. .Manyika et al., "Global Flows in a Digital Age: How Trade, Finannance, People, and Data Connect the World Economy," 2.

Flows of ideas, information, and technology move along digital supply lines. In addition to covering the movement of quaternary international trade,[29] such as information services, ICT and R&D, this flow category incorporates human knowledge and ideas which may travel between entities through both tangible and intangible means and domains. This flow category's positive impact derives from its role in facilitating the sharing of ideas and information and the dissemination of knowledge. In the age of the knowledge economy, these processes are unhindered by geographic boundaries, and allow internationally dispersed individuals, enterprises and governments to collaborate with and learn from one-another. The cross-border data streams which comprise this flow category oftentimes generate more economic value than traditional flows of traded goods, and are increasingly recognized as a critical driver of world innovation.[30] With regards to the negative impacts of such flows, these present on multiple fronts. Aside from facilitating the spread of misinformation and extremist ideas (both of which may pose a threat to national security), information flows render users (and, frequently, entire nations) dependent on foreign-owned (and often corporate-owned) infrastructure. This trend constitutes a negative development in-part due to the proliferation of questions surrounding user privacy and the integrity of state intelligence within the online domain, and in part because the flow of ideas is increasingly characterized by a clash between liberal and illiberal world views (with Vladimir Putin's Russia at the illiberal forefront). It is additionally relevant to note that the mechanisms (domains) which facilitate the movement of positive flows of information through the cyber domain also facilitate (and host) illicit markets on the dark web, and thus contribute to the negative impacts associated with the illicit flow of goods and services indirectly.

Flows of capital/financial flows comprise flows which move capital between entities. These may take the form of transfers which constitute compensation for an acquired good, service, or stock, but may equally present as foreign direct investment (FDI) initiatives or as state directives to secure adequately robust foreign reserves. These flows are subject to market forces. Because of this, fluctuations are typically understood as reflecting investor confidence in the market to which a currency is linked. As with all other flows, capital/financial flows take positive and negative forms. With regards to positive flows within this category, these manifest (among others) in the role that currency exchanges play in allowing consumers to interact with foreign markets and in the potential economic growth brought on by FDI. The (potential) negative impact of these flows take the form of international co-dependence within the global banking sector, the volatile value of e-goods such as cryptocurrencies, and the illicit marketplaces hosted on the dark web.

Flows of people constitute the movement of people across borders. This category comprises of tourism, labor flows and non-labor related migration flows (asylum seekers, refugees and internally displaced persons). Tourism and labor make up positive flows: foreign tourism spending brings revenue and boosts employment while inflow of labor adds economic value by boosting productivity, knowledge and innovation potential. The impact of refugee flows on a host economy remains to be seen and depends on the success of their labor market integration, the acceptance

29. Quaternary sector is a relatively new concept. It refers to all intellectual activity associated with innovation and consists of those industries providing information services, such as computing, ICT (information and communication technologies), consultancy (offering advice to businesses) and R&D (research, particularly in scientific fields). Some definitions also include the entertainment industry. See for example Ralf Lisch, *Measuring Service Performance. Practical Research for Better Quality* (England: Gower Publishing Ltd, 2014), 16.

30. Pastora Valero, "This Is Why We Should Care about the Free Flow of Data between Countries" (World Economic Forum (WEF), July 2016).

of the host population, and the flexibility of the receiving economy to change its output mix. Altogether, tourists (both domestic and foreign), immigrants (both skilled and unskilled) and refugees may enrich intellectual, social and cultural life, bring diversity of values and pave the way towards a more tolerant, inclusive and resilient society. In contrast, uncontrolled migration flows, group animosity between migrants and the host population, the spread of pathogens through global travel - with a potential to cause pandemics - and 'brain drain' produce negative effects and need to be kept in check.

Environmental flows are made up of particles whose continued movement is considered to be of critical importance to the survival of organic life on earth. This flow is made up of Carbon flows (transported by the Carbon cycle), flows of clean water and air, and ecosystem flows (which essentially constitute the movement of organic energy through an ecosystem). Each of these can be either positive or negative, with positive effects deriving from a stable (and continued) flow, and negative flows deriving from the transport of polluting agents. Environmental flows are universally characterized by their high dependence on in-flow equilibrium. In the context of environmental flows, the concept of equilibrium denotes the presence of a system which does not accumulate 'loose' flow particles because the rate at which such particles are emitted equals the rate at which they are absorbed. Humans routinely negatively impact this equilibrium through the omission of excess particles or through the removal of absorption mechanisms, and − in doing so − constitute the main threat *to* these flows and propagate the threats associated *with* them.

In the next chapter will discuss these five critical flows using the taxonomy proposed in the first part of this chapter.

CHAPTER 3: AN EMPIRICAL ANALYSIS OF FIVE CRITICAL FLOWS

The Netherlands is a central node in a globalized society. Dutch security and prosperity is heavily dependent on economic, social, cultural flows. These flows harness both threats and opportunities. This chapter discusses five critical flows on the basis of the taxonomy developed in chapter 2. The chapter concludes with a synthesis of the main insights that emerge from our analysis.

Flows of Goods and Services

Flow Particles

Flows of goods and services are comprised of all non-quaternary (see footnote 29) international trade. This includes unprocessed (raw) materials which are used to produce goods, intermediate goods (components), end products which do not require further processing, the provision of - whether physical or otherwise - services, and everything in-between. Though a great majority of these flows are contingent on complementary capital flows (as, ordinarily, goods and services are not provided without payment), these categories' continued movement is subject to vastly differing potential pitfalls. This is particularly true of strategically important raw materials such as petroleum, various raw earth elements, and several of the elements which are used as fertilizers in agriculture, as these constitute high-politics sub-flows whose continuation is frequently subject to top-down political motivations rather than bottom-up market forces. Because of this, this paper tackles these flows independently.

The importance of the flow

The past decades have witnessed the phenomenon of international trade in goods and services proliferate significantly. Whereas such trade made up only 24.2% of world GDP in 1960, that percentage has increased to 58% in 2016.[31] This increase is especially significant when one considers that – in the same period – world GDP skyrocketed from $1.367 trillion to $75.544 trillion, meaning that (in current US dollars) the gross *value* of international trade has increased from a measly $0.33 trillion to a whopping $43.8 trillion between 1960 and 2016.[32] This trend is indicative of a significant increase in international trade volume, and has brought with it unprecedented improvements in human welfare – life expectancy at birth, which was estimated at 52 in 1960 and at 71 in 2016, has soared - and prosperity.[33] It has also facilitated (and has been facilitated *by*) an explosive growth in the international service sector, the value of which – in increasing from accounting for 9% of world exports in 1970 to accounting for approximately

31. World Bank, "Trade (% of GDP)," The World Bank Data, 2017, https://data.worldbank.org/indicator/NE.TRD.GNFS.ZS.
32. World Bank, "GDP (Current US$)," The World Bank Data, 2017, https://data.worldbank.org/indicator/NY.GDP.MKTP.CD.
33. World Bank, "Life Expectancy at Birth, Total (Years)," The World Bank Data, 2017, https://data.worldbank.org/indicator/SP.DYN.LE00.IN.

25% of world exports in 2014 − has more than doubled in three short decades.[34] The proliferation of (the volume of) global good and service flows directly reflects global population growth, which has increased international demand for the products delivered by such flows, and has − in turn − mandated producers which wish to maximize their profits into globalizing their supply chains. Looking at the globalized value chain of an end product such as Apple's China-assembled iPhone, production of the device's 23 discernable components is currently outsourced to over 50 international companies,[35] all of which (in turn) preside over value chains that supply them with the necessary raw materials and subcomponents they need to fill their orders. This phenomenon renders the delivery of end products increasingly dependent on the delivery of the intermediary goods which comprise them, and − because even the delivery of intermediary goods is dependent on recycling processes and the delivery of hardware needed for raw material extraction − means that contemporary flows of goods and services constitute intricate, circular flow systems in which even small disruptions can translate into major supply deficits.

With regards to relevance at the national level, the Netherlands' vested interest in safeguarding the system which facilitate the flow of goods and services internationally derives from the fact that the country remained a net importer in 2015 ($454 billion in imports and $428B in exports), and generated 67% of its GDP through trade in 2014.[36] The country's reliance on free trade is further bolstered by the economic contribution of the Port of Rotterdam, which employs over 41,000 people, handled over 72% of all international commerce in goods and services with the Netherlands in 2015 (a vast majority of which originate from either North America or Asia), and services a wider hinterland of over 40,000,000 European consumers.[37] In addition to the economic benefits associated with facilitating trade, continued international flows of goods and services provide the Netherlands with significant quantities of strategically important raw materials such as petroleum (which makes up 17.4% of the Netherlands' total imports and 15.5% of its exports). It also delivers economically relevant goods such as computers and telephones, which − in accounting for $17,9 billion and $14 billion of Dutch imports respectively[38] − make up (after petroleum) the country's largest import category. These represent not only a hugely profitable endeavor for Dutch distributors such as Bol.com and Coolblue, but also a source of local employment which facilitates information-and-technology flows within the Netherlands. The regional taxonomy of the Netherlands' global trade relationships is further explored in Figure 1.

34. World Bank, "Exports of Goods and Services (BoP, Current US$)," The World Bank Data, 2017, https://data.worldbank.org/indicator/BX.GSR.GNFS.CD.; see also Prakash Loungani et al., "World Trade in Services: Evidence from A New Dataset," IMF Working Paper (International Monetary Fund, 2017).

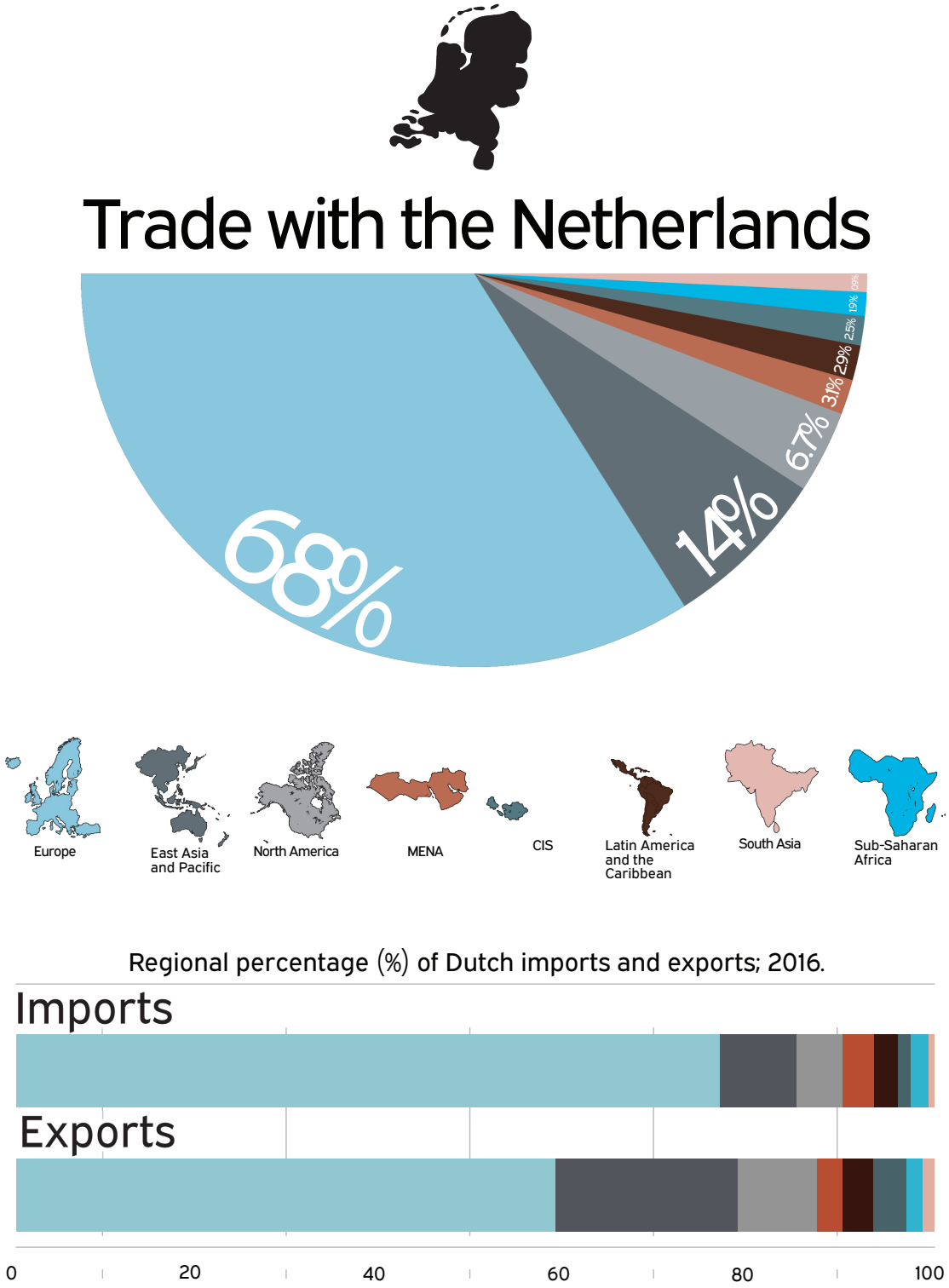
35. Christopher Minasians, "Where Are Apple Products Made? How Much Does the iPhone Cost to Make?," Macworld, 2017, http://www.macworld.co.uk/feature/apple/where-are-apple-products-made-3633832/.

36. The Observatory of Economic Complexity, "OEC - Netherlands (NLD) Exports, Imports, and Trade Partners," OEC, 2017, http://atlas.media.mit.edu/en/profile/country/nld/.

37. Centraal Bureau voor de Statistiek, "Fact Sheet Port of Rotterdam 2014" (Centraal Bureau voor de Statistiek, 2015).

38. The Observatory of Economic Complexity, "OEC - Netherlands (NLD) Exports, Imports, and Trade Partners."

Figure 1 Regional taxonomy of trade with the Netherlands[39]



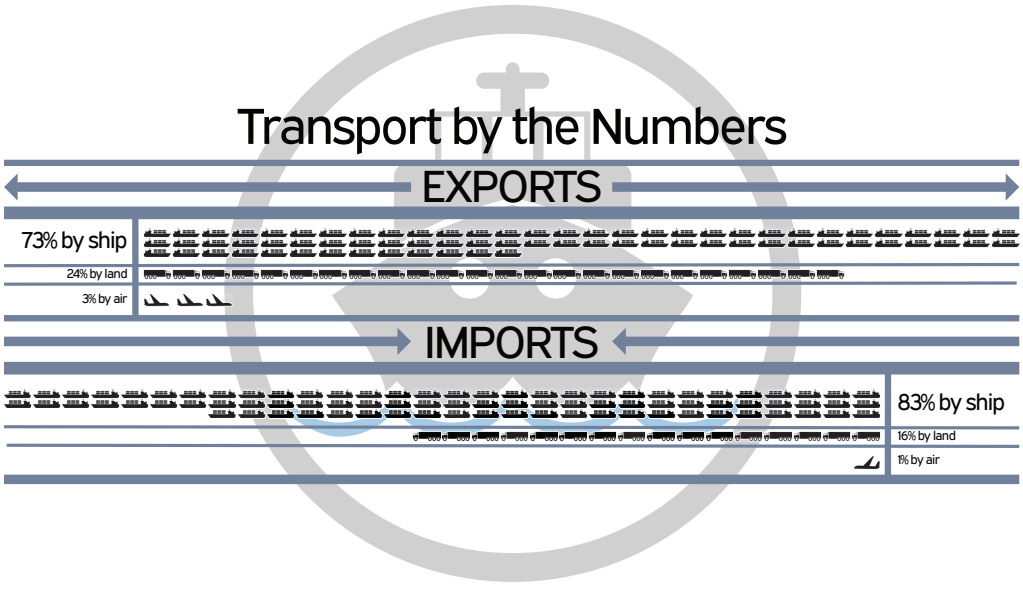
39. WITS, "Netherlands | Exports and Imports | by Country 2016 | WITS | Data," 2017, https://wits.worldbank.org/CountryProfile/en/Country/NLD/Year/2016/TradeFlow/EXPIMP#.

Flow Domains and Critical Hubs

Domains

The movement of goods and services has traditionally occurred by means of land, air, or sea freight. These forms of transport involve goods being ferried from location A to location B by trucks, trains, planes, barges, or cargo ships. Of these, transport by sea – by far the most economical – accounts for the largest volume of world trade. Approximately 90% of international trade in goods is carried by ships which traverse oceans and (to a lesser extent) rivers,[40] with land and air transport accounting for the remaining 10% of freight operations. In 2015, the ocean domain's role as the predominant flow environment for goods and services amounted to approximately 90,000 vessels transporting 10407 million tons of cargo by sea.[41] Though the ratios between the volume of land, air, and sea transport differ at the local and regional levels because transport over land and through the air is responsible for transferring goods between (both *to* and *from*) international harbors and landlocked hinterlands, the Netherlands' interests skew strongly towards ensuring the integrity of global sea freight. This is because ocean-borne imports account for over 410 million tons (72% of the total) and exports 190 million tons (42.1% of the total) of the country's commerce annually.[42] This breakdown is further explored in Figure 2.

Figure 2 Breakdown of the means of transportation by which goods enter and leave the Netherlands[43]



With regards to hubs which are instrumental to ensuring a continuation in the flow of goods and services, these hubs differ (to some degree) between the goods and services subsection of this flow

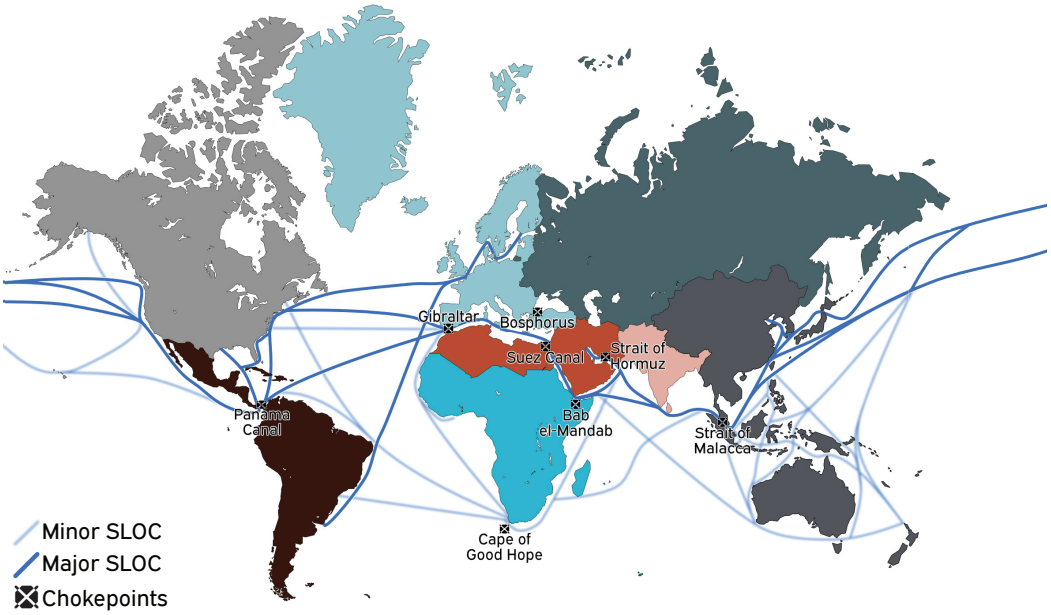
40. Centraal Bureau voor de Statistiek, "ICT, Kennis En Economie 2017" (Centraal Bureau voor de Statistiek, 2017).
41. "Review of Maritime Transport 2016," Review of Maritime Transport (Geneva: UNCTAD, 2016).
42. Centraal Bureau voor de Statistiek, "Transport and Mobility 2106" (The Hague: Statistics Netherlands, 2016), 38.
43. Data adapted from Statistics Netherlands, "Transport of Goods in the Netherlands Hits New Record," webpagina, September 22, 2016, http://www.cbs.nl/en-gb/news/2016/25/transport-of-goods-in-the-netherlands-hits-new-record.

category. Hubs which are central to the continuation of the flow of goods include harbors, airports, and – to a lesser extent – the local shipping warehouses and post offices which are involved in distributing goods to consumers at the local level. While each of these hubs is associated directly with a specific domain (i.e.: harbors are associated with the sea domain), the fact that goods often traverse several domains (i.e.: they travel *from* a land hub *to* a sea hub) means that hubs which are not directly associated with a flow domain can represent chokepoints for the flow system at large. Moving on to flows which provide services to consumers, these typically take the form of people flows. As a result, they commonly rely on a network of air, sea, and land-related hubs (i.e.: train stations, airports, harbors) to move from point A to point B.

Characteristics of the flow

Characteristics endemic to the flow of goods and services tie in closely to the domains through which they move. Intuitively, the flow velocity of physical goods and services – largely because they need to traverse the air, land, and/or sea domains – is limited by the form of transport employed to displace them. Being physical, these are also tangibly visible, require logistical planning and consistent oversight to move (a necessity which several multinational companies – DHL, DPD, FedEx, and UPS included – have built their business models on) and have a flow volume that is limited by transport capacity in the short term and by resource scarcity in the long term. This differentiates them considerably from crypto services, which – once designed and available – require limited per-transaction oversight to flow, can be duplicated infinitely, and can (depending on file size) move from point A to point B almost instantaneously. In addition, the flow of goods and services – due in large part to the phenomenon of globalized value chains – is characterized by circular in-flow co-dependence and (in the case of ocean-based flows) by its need to traverse various **chokepoints**. These are displayed in Figure 3.

Figure 3 Global Ocean Chokepoints[44]



44. SLOC and chokepoint data adapted from J.-P. Rodrigue, C. Comtois, and B. Slack, *The Geography of Transport Systems* (New York: Routledge, 2017), https://people.hofstra.edu/geotrans/.

Threats

Factors which threaten the continuation of flows of goods and services largely derive – from the Netherlands' perspective – from the domains, hubs, and characteristics associated with it. As such, it can be surmised that the flow of goods and services is threatened by phenomena which impede cargo ships (and, by extension, international trade) from functioning at full and optimal capacity. These can be roughly broken down into physical and nonphysical categories. The physical category consists of the proliferation of A2/AD technologies and piracy. The nonphysical category consists of phenomena such as cyber interference and of socio-political development.

With regards to A2/AD technologies, these are weapons which aim to deny enemy forces – and, potentially, merchant ships – the freedom to enter into a theater of operations as a whole (A2) and to deny them the freedom to operate in an area whose geography is confined to regions which are under the initiating actor's direct control (AD).[45] Within the ocean domain, this is commonly accomplished through the fielding of integrated air defense systems (IADs), surface-to-surface missiles (SSMs) and rockets, mines and swarming gunboats, and attack submarines, and weapons of mass destruction (WMDs). While WMDs achieve A2/AD through the guarantee of mutually assured destruction (see modern-day North Korea) and through literally rendering areas unlivable when used, weapons systems such as IADs, SSMs, gunboats, and attack submarines represent tailored solutions that counter force projection platforms which can be reasonably expected to operate in the environments they are employed in. Such systems are notably fielded by China, Russia (although only the former party fields them in an area – namely the South China sea – in which the potential to disrupt SLOCs exists), and Iran.[46] A2/AD proliferation is particularly pronounced around SLOC chokepoints such as the Suez Canal, the Bosporus, and the Strait of Hormuz. These necessitate ships' traversing chokepoints which are almost universally *physically* narrow in nature, and thus represent environments in which even nominal investments into A2/AD technologies grant actors the capability to (potentially) deny outsiders the freedom to operate in them.

This presents a threat to international flows of goods and services *in general* because it renders actors capable short-circuiting the just in time delivery systems which global supply chains rely on by delaying – if not terminating – the voyages of merchant vessels. Just in time delivery systems disincentive stockpiling ahead of time. This means that supply and demand respond to one-another in real-time, and thus require continuous bilateral feedback to maintain equilibrium. Because almost 50% of the goods which pass through the country's ports are transported through coastal shipping lanes, this renders the Dutch economy highly sensitive to shocks which disrupt the flow of goods over SLOCs. A2/AD technologies fielded around Gibraltar, the Bosporus, and the Suez Canal essentially have the capacity to cripple economically relevant hubs such as the Port of Rotterdam.

45. Andrew Krepinevich, Barry Watts, and Robert Work, "Meeting the Anti-Access and Area-Denial Challenge" (Washington, D.C.: Center for Strategic and Budgetary Assessments, 2003), 2.

46. The Iranian Navy has previously deployed a combination of relatively cheap systems such as remotely controlled suicide boats, anti-ship cruise missiles, and military speedboats in the Strait of Hormuz. To date, these systems have been utilized to (among others) sink a mock-up Nimitz-Class aircraft carrier, shadow merchant vessels, and harry U.S. Navy assets. See Mark Gunzinger and Chris Dougherty, "Outside-In: Operating from Range to Defeat Iran's Anti-Access and Area-Denial Threats" (Washington, D.C.: Center for Strategic and Budgetary Assessments, 2011), xii–xiii.; see also Franz-Stefan Gady, "In A2/AD Showcase, Iranian Navy Sinks Nimitz Carrier Mock-Up," The Diplomat, 2015, http://thediplomat.com/2015/02/in-a2ad-showcase-iranian-navy-sinks-nimitz-carrier-mock-up/. and Barbara Starr and Zachary Cohen, "US Navy Ship Fired Warning Shots at an Iranian Boat in the Persian Gulf," CNN, accessed August 18, 2017, http://www.cnn.com/2017/07/25/politics/navy-ship-iran-arabian-gulf/index.html.

Just in time supply chains can further be disrupted by piracy – particularly in the vicinity of the Horn of Africa – and (to an increasing extent) the impact that climate change related phenomena such as rising sea levels and increased storm frequency and intensity have on the operability of harbors.[47] Finally, socio-political phenomena such as domestic government policy (sanctions, protectionism, etc.) and civilian sector boycotts as well as cyberspace-based disruptions of e-commerce processes and of cargo ships' navigational instruments may disrupt the flow of goods and services.[48]

Aside from being *threatened* by several factors internationally, flows of goods and services can also *pose threats* in-and-of themselves by facilitating state failure and making inner cities unsafe. Such flows' relation to state failure is illustrated by the case of the illicit arms trade, which fuels regional instability, degrades international rule of law, and facilitates criminal violence by making weapons available to blacklisted entities.[49] These include states that are subject to UN Security Council sanctions, non-state actors such as ISIS, and criminal elements within society.[50] The continuation of negative flows also has a direct impact on Dutch communities. In addition to funneling between as many as 18,000 small-arms (mostly from the former Soviet Bloc)[51] into the country annually, the networks which constitute the Netherlands' illicit sector have exploited the country's role as an international hub to engage in human trafficking activities and to participate in the international drug trade. *Reported* instances of human trafficking indicate that at least 1321 individuals – mostly girls under 18 – were exploited by traffickers in 2015.[52] Statistics relating to the drug trade identify the Netherlands – with its authorities having seized over 30 tons of cocaine between 2009 and 2011 – as a central node within the European drug trade.[53] Aside from the direct suffering caused by the movement of these flows, they pay dividends to criminal elements, and thus contribute to degrading the safety of inner cities.

It is thus important to differentiate between positive and negative dimensions within flows of goods and services, and to recognize that maintaining flow security within this category requires not only safeguarding positive flows by addressing phenomena which threaten their continued movement, but also active management of the negative externalities they incur and the sabotage of negative flows which – in moving – constitute a threat (whether directly or indirectly) to international security.

Stakeholders

Within the flow ecosystem surrounding goods and services, a wide range of actors are of relevance. At a generalized macro level, these can roughly be filtered according to five categories. These are stakeholders involved in the production of goods and services, stakeholders which handle the logistics of propagating flows of goods and services, stakeholders which strive to disrupt flows

47. Amy Samples, Catherine Riseng, and Jim Diana, "Helping Marina and Harbor Operators Respond to Climate Change" (Michigan Sea Grant, 2014), 4.

48. Jeremy Wagstaff, "All at Sea: Global Shipping Fleet Exposed to Hacking Threat," Reuters, 2014, http://www.reuters.com/article/us-cybersecurity-shipping/all-at-sea-global-shipping-fleet-exposed-to-hacking-threat-idUSBREA3M20820140424.

49. Rachel Stohl, "The Tangled Web of Illicit Arms Trafficking" (Washington, D.C.: Center for American Progress, 2004), 21.

50. M. Zachara and Zachara, "Illegal Trade, Arms," in *Encyclopedia of Global Studies*, ed. H. K. Anheier and M. Juergensmeyer (Thousand Oaks, CA: SAGE Publications, 2012).

51. A. C. Spapens and M. Y. Bruinsma, "Smokkel van Handvuurwapens Vanuit Voormalige Oostbloklanden Naar Nederland" (Tilburg: IVA Tilburg, 2002), 3.

52. CoMensha, "Het Beeld van 2015," Jaaroverzicht (CoMensha, 2016), 9.

53. Europol, "EU Drug Markets Report: A Strategic Analysis" (The Hague: Europol, 2013), 45.

of goods and services, stakeholders charged with ensuring these flows continue, and (finally) the 'point B' stakeholders which represent the endpoint of a goods and services flow. Stakeholders which are involved in the supply chain and production of goods and services are, in layman's terms, corporations such as Apple, Spotify, and Gazprom. These assemble products and offer them to end-users. Freight *to* end users is facilitated by stakeholders which are responsible for handling the logistics associated with transporting goods and services *from* the point of production (point A) *to* the point of consumption (point B). This stakeholder category is populated by large multinationals such as Maersk and DHL, but also by harbor authorities, government officials charged with regulating which goods and services may cross borders under what circumstances, and smaller (localized) logistics services such as PostNL. Moving onto the third stakeholder category, this is populated by actors which aim to disrupt the continued flow of goods and services. These may – in the event that the flow itself can be physically disrupted – take the form of violent individuals such as pirates, but may also take the form – if the flow moves through cyberspace – of rival state actors or tech-savvy NGOs such as Anonymous. The fourth stakeholder category – situated (vis-a-vis the third) at the polar opposite of the flow spectrum – is charged with preventing flow disruption. This category is made up of government entities such as the U.S. Navy (responsible for escorting merchant vessels through, for example, the Strait of Hormuz) and the NSA, but may also include corporations which develop platforms that provide online protection for crypto service users and privately contracted militias.[54] Finally, the fifth stakeholder category is populated by end-users. These may be at-home consumers, but may also be (among other examples) corporations which import raw materials for processing.

Critical co-flows

Maintaining the current volume of flows of goods and services is contingent on the flow security of all other flow categories included in this paper. Whereas the capital flows category connects almost directly with flows in goods and services because virtually all provided goods and services require payment to be delivered, the information and people flows connect to goods and services somewhat indirectly. Here, information flows are of particular interest. This is not only because they facilitate the capital flows upon which international trade is contingent, but also because they increasingly serve to connect consumers to producers,[55] and thus play a central role in producing demand.

Table 2 Flows of goods and services

Flows of Goods and Services	
Definition	International movement of goods; provision of (physical) services to 3rd parties.
Manifestations	Trade in raw materials, trade in intermediate goods (components), trade in end products.
Relevance for NL	Generates 67% of GDP, port of Rotterdam handles up to ±70% of Dutch imports and ±40% of Dutch exports by sea; provides Dutch consumers with products which would otherwise not be available domestically; created employment in infrastructure and through trickle-down economics.
Domain(s)	**Direct**: ocean, land, and air. **Indirect**: space, cyber.

54. It should be noted that this stakeholder taxonomy may not apply to the cases of several illicit flows, as - in the case of organized crime syndicates - organization, defense, and propagation of such flows tends to be handled by a single entity.

55. Eurostat, "E-Commerce Statistics for Individuals," Eurostat - Statistics Explained, 2017, http://ec.europa.eu/eurostat/statistics-explained/index.php/E-commerce_statistics_for_individuals.

Flows of Goods and Services	
Characteristics	Physical, slow-moving, requires conscious logistics; scarce, non-replicable, subject to in-flow co-dependence due to circularity; dependent on free travel through global chokepoints.
Threats	**To**: A2/AD technologies, piracy, protectionism, climate change (also an opportunity - arctic sea routes), local unrest threatening harbors, product and material-related complications with securing supply, cyber tampering. **Associated with**: illicit flows (drugs, weapons, human trafficking, etc.) cause international instability and make inner cities unsafe; mismanagement leads to high domestic tensions (populism), and thus generates a phenomenon which may threaten the flow.
Stakeholders	Producers (senders), logistical supporters, disruptors, protectors, and end-users.
Critical co-flows	**Direct:** capital flows. **Indirect**: Information flows, people flows.

Flows of Ideas, Information, and Technology

Flow Particles

Flows of information and technology are comprised of all quaternary international trade.[56] This encompasses commodities which are most commonly associated with the knowledge-based part of the economy. These commodities can be both informational and digital and can be divided into the following sub-categories: 1) the flow of ICT goods and services; 2) the flow of knowledge in research and development (R&D); and 3) the flow of ideas. While digital equipment flows encompass they physical sense, the flows of knowledge and ideas are virtual and are enabled by digital means, word-of-mouth communication and physical exchanges. Although this category is closely intertwined with the traditional flow of goods and services, its evolution derives from the advent of the internet and digitalization.

The importance of the flow

ICT goods and services

The past decade has witnessed the advent of digitization, which has taken a predominant role in our everyday lives. Much like the steam engine, electricity and automation before them, today's digital technologies permeate every aspect of our lives. In doing so, they fundamentally alter economies and societies as a whole. Technological developments of particular note occurred in fields such as robotics, Internet of Things, autonomous driving, 3D printing, artificial intelligence, nanotechnology, biotechnology, energy storage, materials science, and quantum computing.[57] The opportunities offered by the digital revolution and the new technologies are regarded as the

56. Quaternary sector is a relatively new concept. It refers to all intellectual activity associated with innovation and consists of those industries providing information services, such as computing, ICT (information and communication technologies), consultancy (offering advice to businesses) and R&D (research, particularly in scientific fields). Some definitions also include the entertainment industry. See for example Lisch, *Measuring Service Performance. Practical Research for Better Quality*, 16.

57. Klaus Schwab, "The Fourth Industrial Revolution: What It Means and How to Respond | World Economic Forum," accessed October 4, 2017, https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/.

single most important drivers of innovation, competitiveness, and − as a consequence − economic growth.[58] According to analysis conducted by Accenture Strategy and Oxford Economics, the digital economy accounted for 22.5% ($19,159bn) of global GDP in 2015. This share is anticipated to reach 25% ($24,615bn) by 2020.[59] In addition, digitalization has a proven impact on improving the quality of life, reducing unemployment, and boosting citizens' access to public services.[60] Growing demand for − and the market share of − public cloud infrastructure services, which reach billions of people every day, demonstrates the disruptive impact of technology flows globally. Amazon Web Services (AWS) continue to dominate the cloud market with a steady 33% share, followed by a group of higher-growth chasers comprised of Google, Alibaba, Microsoft and Oracle.[61] The US-based streaming service Netflix, powered by AWS, has recorded over 104 million subscribers in 130 countries outside the US, and is illustrative of the continued success and expansion of trade in digital services.[62]

The digital economy carries great significance for Dutch prosperity.[63] In 2015, it accounted for 22.9% (€158.01bn) of Dutch GDP − a figure which is projected to reach as high as 25% (€190.4bn) by 2020.[64] The Netherlands is a world leader in ICT, and even promotes itself as 'the digital gateway of Europe'.[65] The country ranked 6th in the 2016 Network Readiness Index, which measures how well an economy is using information and communication technologies to boost well-being and competitiveness. In 2014, ICT companies contributed 4.5% of the total Dutch GDP according to the Centre of National Statistics.[66] These include international IT companies (such as Microsoft, Google, Facebook, Verizon, Cisco), companies active in the gaming industry (such as Perfect World, Guerrilla Games, Activision Blizzard and Kixeye), and homegrown companies such as (to name but a few) TomTom, WeTransfer, Booking.com, Elastic and Adyen.[67] In 2015 alone, 7,800 new ICT companies were founded in the Netherlands.[68] Aside from generating revenue, the ICT sector employs 356,000 people, or 4% of the Netherlands' working population. In the context of international trade, the Netherlands imported nearly €50bn of ICT goods (88%) and services (12%) in 2014 (4,2% increase over 2013), while it exported €33.7bn (excluding re-export), of which almost €23bn were goods, and €10.8bn ICT services.[69] In recent years, export of ICT goods and services has become increasingly important to the Dutch economy, constituting 10% of Dutch overall exports in 2015, in comparison to only 8.4% in 2010.[70] Digitalization presents opportunities

58. "Digital Transformation - Growth - European Commission," Growth, accessed November 22, 2017.

59. Mark Knickrehm, Bruno Berthon, and Paul Daugherty, "Digital Disruption: The Growth Multiplier | Accenture," 2017, https://www.accenture.com/us-en/insight-digital-disruption-growth-multiplier.

60. Karim Sabbagh et al., "Maximizing the Impact of Digitization" (Price Waterhouse Cooper (PWC), 2012).

61. Synergy Research Group, "Amazon Cloud Growth Is Hardly Hampered by the Chasing Pack | Synergy Research Group," April 2017, https://www.srgresearch.com/articles/amazon-cloud-growth-hardly-hampered-chasing-pack.

62. Mark Sweney, "Netflix Tops 100m Subscribers as It Draws Worldwide Audience," *The Guardian*, July 18, 2017, sec. Media, http://www.theguardian.com/media/2017/jul/18/netflix-tops-100m-subscribers-international-customers-sign-up.

63. The digital economy is the share of total economic output derived from a number of broad 'digital' inputs. This includes digital skills, digital equipment (hardware, software and communications equipment) and the intermediate digital goods and services used in production. Michel Rademaker et al., "Dutch Investments in ICT and Cybersecurity" (The Hague: The Hague Centre for Strategic Studies, 2016), 13.

64. Rademaker et al., 13.

65. Rademaker et al., 9.

66. Centraal Bureau voor de Statistiek, "ICT, Kennis En Economie 2017," 43.

67. IAmsterdam, "ICT Industry In the Amsterdam Metropolitan Area" (IAmsterdam, 2017).

68. Centraal Bureau voor de Statistiek, "ICT, Kennis En Economie" (Centraal Bureau voor de Statistiek, 2016), 4.

69. Centraal Bureau voor de Statistiek, "ICT, Kennis En Economie 2017," 60.

70. Centraal Bureau voor de Statistiek, 61.

to governments, companies and citizens alike. It allows governments to engage with citizens and businesses in a more convenient, transparent and efficient way and boosts corporate revenue by increasing the efficiency of enterprise processes. Insofar as it provides the civil sector with tools that allow them to interface with organizations more easily, it also contributed to streamlining the delivery of public, financial and other services.

Knowledge

Exchange of knowledge and the collaboration of individuals, enterprises and governments with one another, irrespective of geographic boundaries, is a critical driver for innovation.[71] The advent of the internet eased scientific collaboration and the flow of knowledge worldwide. Over 35% of articles published in international journals are the result of international collaboration, an increase of 10% in 15 years.[72] Internationalization of business investment in R&D constitutes another driver of technology transfers and innovation. Between 1997 and 2007 R&D investments by foreign subsidiaries in OECD countries increased by $53bn, in terms of purchasing power parity. In comparative terms, the weight of foreign R&D investments in the national R&D of OECD countries ranged from 5% (Japan) to more than 70% (Ireland).[73] Although the globalization of R&D is primarily concentrated in industrial countries, more and more multinational enterprises (MNEs) are turning their attention towards emerging economies, mainly India and China. Technology transfers from an MNE to a subsidiary increase the subsidiary's innovativeness over time. More innovative nations, in turn, tend to experience higher GDP per capita.[74] According to the OECD, different components of innovation together account for at least 50% of economic growth of developed economies.[75]

Dutch prosperity hinges on maintaining a continuing flow of innovation, based on technology and knowledge absorbed from abroad and, to a lesser extent, developed at home.[76] The Dutch public research system involves a high degree of international collaboration: around 50% of Dutch scientific articles are published with an international co-author.[77] The government promotes internalization of science, technology and innovation (STI) through the funding and programs developed by KNAW, NWO and NUFFIC. The southern area of the country is of particular interest in this regard, given its long tradition of cross-border innovation. The Eindhoven-Leuven-Aachen Triangle (ELAT), which connects hi-tech areas of the Netherlands to Belgium and Germany hosts a dense network of innovation actors involved in numerous cross-border initiatives.[78] In addition, joint strategic research partnerships were established with China and Indonesia, among other

71. Pastora Valero, "Check My Flow: How Cross-Border Data Traffic Drives Innovation," 2016, http://emear.thecisconetwork.com/site/content/lang/en/id/5977.

72. Natasha Gilbert, "Research sans Frontières," *Nature News* 471, no. 7340 (March 28, 2011): 201, https://doi.org/10.1038/471559a.

73. Blandine Laperche and Gilliane Lefebvre, "The Globalization of Research &AMP: Development in Industrial Corporations: Towards 'Reverse Innovation'? The Cases of General Electric and Renault" 2, no. 10 (2012): 53–79.

74. Cornell University, INSEAD, and World Intellectual Property Organization, "The Global Innovation Index 2017; Innovation Feeding the World" (Geneva, 2017).

75. "The Innovation Imperative | OECD READ Edition," OECD iLibrary, 2015, 19, http://www.keepeek.com/Digital-Asset-Management/oecd/science-and-technology/the-innovation-imperative_9789264239814-en.

76. OECD, "OECD Reviews of Innovation Policy: Netherlands 2014 | OECD READ Edition," OECD iLibrary, 10, accessed October 5, 2017, http://www.keepeek.com/Digital-Asset-Management/oecd/science-and-technology/oecd-reviews-of-innovation-policy-netherlands-2014_9789264213159-en.

77. OECD, 24.

78. OECD, 253.

emerging markets, and the country also participates in various international cooperative efforts, such as the European Framework Program for Research and Innovation (Horizon 2020).[79] In light of the expected skills shortages in science and engineering, the country also depends on the inflow of foreign talent. Around one third of research staff at Dutch universities are foreign-born, and an action plan to attract and retain students with skills relevant to innovation is in place. The presence of large multinationals, with impressive technological capabilities and performance, also contributes to Dutch innovation potential and, by extension, to the country's economic prosperity. Philips, ASML, Shell, DSM, NXP, Unilever, Océ and AkzoNobel constitute eight of the country's largest private R&D investors, and account for more than one third of total business expenditure on R&D in the Netherlands.[80] Owing to the presence of these large, globally networked R&D spenders, the Netherlands also exhibits positive trends with regard to patenting activity. Dutch companies filed 37,983 patents in 2015 - an increase of 4,394 when compared to 2013's 33,589.[81] As a consequence, the Netherlands currently ranks third in the 2017 Global Innovation Index (GII), following Switzerland and Sweden.[82] To maintain its position as one of the leading knowledge economies globally, protecting uninterrupted exchange of knowledge and academic exchange is key.

Ideas

The free flow of ideas, opinions and information is essential to the functioning of a liberal democratic order. It provides the foundation for open dialogue, promotes good governance, and helps to build the societal and political consensus necessary to bring about reforms. Freedom of the media and protection of journalists is a cornerstone of the Dutch democratic system. Media have traditionally played a key role in diffusing ideas and information and in enabling social participation. The advent of the internet and social media have had 'game-changing' implications (both positive and negative) for politics by increasing the speed at which ideas travel, extending their geographical reach, and by transforming citizens into 'netizens'.[83]

Flow Domains and Critical Hubs

Domains

Flow domains are dependent on whether the transported item is physical (tangible) or virtual (intangible). Because the international flow of intangible objects such as ideas and knowledge is increasingly digitized, this subcategory flows primarily through the cyber domain. As the movement of data through cyberspace is dependent on a wide array of physical infrastructure, the flow of information and technology can be understood as occurring (by proxy) within the environments where the aforementioned infrastructure is situated. At the local level, data transfer is largely dependent on data-beaming satellites, EM (radio) waves which originate from handheld

79. OECD, 257.

80. Jasper Deuten, "R&D Goes Global: Policy Implications for the Netherlands as a Knowledge Region in a Global Perspective" (The Hague: Rathenau Instituut, 2017), 34.

81. WIPO, "WIPO Statistical Country Profiles," 2015, http://www.wipo.int/ipstats/en/statistics/country_profile/profile.jsp?code=NL.

82. Cornell University, INSEAD, and World Intellectual Property Organization, "The Global Innovation Index 2017; Innovation Feeding the World."

83. Niall Ferguson, "The False Prophecy of Hyperconnection," *Foreign Affairs*, August 15, 2017, https://www.foreignaffairs.com/articles/2017-08-15/false-prophecy-hyperconnection.

devices, and physical ground-based assets such as telephone lines. These are respectively space, air, and land-based. At the international level, approximately 99% of the data traffic in this area is carried by sea-based fiber cables, maintained by companies such as Facebook and Google.[84] As a result, although a small percentage of international data transfers rely on the data beaming satellites which are also relevant at the local level, information flows at the international level travel predominantly through the sea domain. The remaining vestiges of these flows – which may take the form of physical goods or human interaction – flow through the same domains as the flows of people, goods and services, and thus traverse ocean, land, and air as they move between points A and B.

With regards to hubs which are instrumental to ensuring a continuation of the flow of information and technology, these vary between 'tangible' and 'intangible' goods. In the case of intangible flows, global fragmentation of world ISPs (internet service providers) means that the hubs within this subcategory can generally be classified as ISP data centers and world internet exchanges such as the Amsterdam Internet Exchange. Both play vital roles in facilitating the world's information flows. This is because ISPs carry flows over infrastructure which – often for security reasons – does not relay information outside of the ISP network. As a result, information which is designated for a location *outside* of the ISP network needs to flow through a location which allows it to communicate with 3rd party ISP networks. ISP data centers and internet exchanges collectively facilitate this process by ordering data generated within the ISP by destination and by providing 'safe' environments for data transfer between ISPs respectively. With regards to 'tangible' goods, these – in the event that they do not take the form of crypto services – are dependent on the same hubs (airports, harbors, post offices, etc.) as are flows of goods, services, and people.

Characteristics

Characteristics of the flows of information and technology are dependent on the domains through which they move. Overall, they are distinct from other flow categories in terms of velocity, scope and systems impact and can be characterized by blurring the lines between the physical, digital and biological spheres. They evolve at an exponential rather than linear pace, and have the potential to disrupt existing industry structures, value chains as well as political systems. Today's information travels at an unprecedented speed: data movement has been reduced to a fraction of seconds. The velocity of ideas depends on whether they flow through digital means or word-of-mouth communication. Assets that constitute the physical sub-flow within this category (i.e. hardware or communication equipment) traverse by air, land and/or sea domains and their velocity is limited by the form of transport employed. While the flow volume of physical assets may be limited by transport capacity, costs and by resource scarcity, intangible assets in the forms of ideas and knowledge can be distributed in an unlimited volume. At the international level, flows of information are highly centralized: much of the world's communication infrastructure is run by the Silicon Valley - a situation that can be characterized as 'internet imperialism'.[85]

84. Meghan Neal, "Let's Be Real, Sharks Aren't Eating Google's Undersea Internet Cables," Motherboard, August 14, 2014, https://motherboard.vice.com/en_us/article/pgazmb/lets-be-real-sharks-arent-eating-googles-undersea-internet-cables.

85. Evgeny Morozov, "Who's the True Enemy of Internet Freedom - China, Russia, or the US?," *The Guardian*, January 4, 2015, sec. Opinion, http://www.theguardian.com/commentisfree/2015/jan/04/internet-freedom-china-russia-us-google-microsoft-digital-sovereignty.

Threats

Threats to the flows of information and technology originate mainly in the cyber domain, and are primarily directed from abroad.[86] The rise in digitalization increases the risk of cyber threats, primarily threats of cybercrime and cyberespionage. It is estimated that that in 2014 alone, cybercrime and cyber espionage caused €400bn in damages worldwide.[87] The estimated loss incurred by the Netherlands constituted 1.5% of its national GDP, or about €10bn per year.[88] Due to the high costs of cybercrime and the proliferation of offensive state cyber capabilities, the potential risk of cyber incidents for the Netherlands is likely to increase further. This can damage the confidentiality, availability and integrity of information, thereby affecting decision-making and reducing trust in ICT systems.

The lack of adequate protection of intellectual property rights – through patents and copyright – threatens the flows of ICT technology and knowledge in particular. The general respect for and enforcement of intellectual property rights varies from country to country. Some trading nations, such as Brazil or China for example, have shown reluctance to enforce, or even create, laws for the protection of intellectual property rights in the past.[89] As a consequence, foreign companies may choose not to bring their ideas or products to such economic environments. Digital threat barriers and restrictions can also hinder free flows of information and technology. Countries around the world have started engaging in new forms of protectionism to restrict the flow of data across borders. These include policies such as data-residency requirements or forced technology transfers, which may inhibit business operations and ultimately hinder innovation.[90]

Flow environments may also be threatened. Jamming, both intentional and unintentional, constitutes a major threat to wireless communications. A jamming attack can effectively block the communication on a wireless channel, disrupt its operation, cause performance issues, or even damage control systems. In addition to jamming, the work of communication satellites is in constant peril due to potential collisions with defunct satellites and debris orbiting the Earth. Development of advanced anti-satellite capabilities by state actors has the potential of not only limiting (or even preventing) the use of space assets by other states, but might also culminate in an orbital arms race and – in the worst-case scenario – lead to large-scale warfare within the space domain. Such advanced capabilities include the ability to 'overhear' communication traffic, collect civilian and (possibly) sensitive military information, and to disable and destroy other satellites (kamikaze tactics).[91] Given the increasing degree to which outer space is being weaponized, space security is increasingly regarded as a military priority and an area of strategic concern, particularly among the G7 economies. Undersea cables, which transport 99% of international data, can be disrupted by ship anchors, trawlers or fishing-related incidents. Damage may also result from natural disasters such as earthquakes, underwater landslides, or tidal currents dragging a cable over the rocky

86. Although the majority of cyber-attacks originate from external sources, the 'insider threat' should not be underestimated.

87. Ministry of Economic Affairs, "Digital Agenda for the Netherlands: Innovation, Trust, Acceleration" (The Hague: Ministry of Economic Affairs, 2016), 24.

88. Deloitte, "Cyber Value at Risk in the Netherlands" (The Netherlands: Deloitte, 2016).

89. D Slifer, "Intellectual Property Rights: The Last Barrier to International Free Trade | Illinois Business Law Journal - University of Illinois at Urbana-Champaign," 2009, https://publish.illinois.edu/illinoisblj/2009/10/10/intellectual-property-rights-the-last-barrier-to-international-free-trade/.

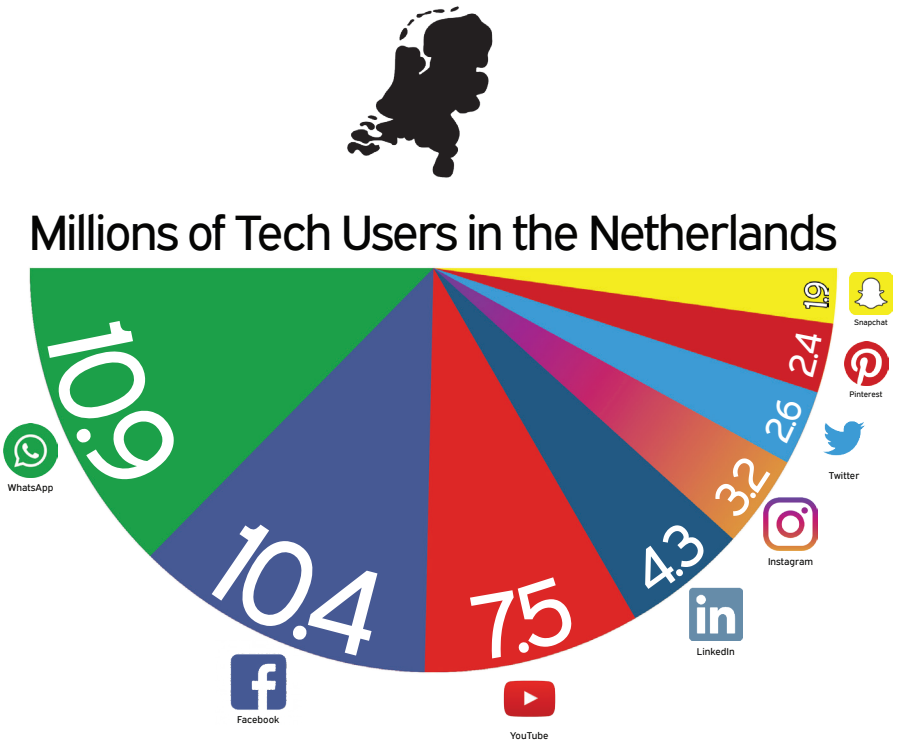
90. Cross-border data flows enable flows across all industries.

91. Jim Sciutto and Jennifer Rizzo CNN, "War in Space: Kamikazes, Kidnapper Satellites, Lasers," CNN, accessed October 5, 2017, http://www.cnn.com/2016/11/29/politics/space-war-lasers-satellites-russia-china/index.html.

surface.[92] Fish, including sharks, have also been identified as causes of cable failures.[93] To fend off shark attacks, Google cables now feature a Kevlar-like protective layer.[94]

In a digital age, the free flow of information grants governments and businesses alike access to a wide array of data about individual citizens or consumers. As such, free flow of information can be threatened by government surveillance and investigatory activities, which can infringe on personal privacy and data security. The legal battle between FBI and Apple over whether the company should grant investigators access to the iPhone belonging to a dead ISIS terrorist[95], or the NSA eavesdropping on American citizens are illustrative of this inherent tension – or a 'trade-off' – between national security and civil liberties.[96] A 'security first' approach in the context of digital technologies will likely infringe on the privacy of individual citizens, and should – given the degree to which its citizens make use of American-owned social media platforms – be of particular concern to Dutch policymakers (Figure 4).

Figure 4 Dutch use of American social media platforms (millions of users) 2016[97]



92. International Cable Protection Committee Ltd, "About Submarine Telecommunications Cables" (United Kingdom: International Cable Protection Committee, October 2011).

93. Lionel Carter et al., "Submarine Cables and the Oceans: Connecting the World" (United Kingdom: United Nations Environment Programme, 2009).

94. Brandon Butler, "Google Wraps Its Trans-Pacific Fiber Cables in Kevlar to Prevent against Shark Attacks," Network World, August 13, 2014, https://www.networkworld.com/article/2464035/cloud-computing/cloud-computing-google-wraps-its-trans-pacific-fiber-cables-in-kevlar-to-prevent-against-shark.html.

95. Danny Yadron, Spencer Ackerman, and Sam Thielman, "Inside the FBI's Encryption Battle with Apple," *The Guardian*, February 18, 2016, sec. Technology, http://www.theguardian.com/technology/2016/feb/17/inside-the-fbis-encryption-battle-with-apple.

96. Ferguson, "The False Prophecy of Hyperconnection."

97. "Social Media in 2017: The Latest Statistics," *BuzzAcademy* (blog), March 13, 2017, https://www.buzzcapture.com/academy/en/social-media-usage-in-2017/.

Aside from being threatened by outside factors, flows of information and technology can also pose threats in-and-of themselves. Several governments have actively sought to weaponize such flows – and the flow of ideas in particular – by integrating them into their military doctrines. Notable examples of this include the Russian Federation's 'Gerasimov Doctrine' and China's 'Three Warfares,' which acknowledge the need for war to be waged on multiple fronts – the 'information' front included – simultaneously,[98] and which incorporate operational elements that are specifically geared towards employing 'grey area' measures with the goal of sowing discord from within.[99] Beyond their immediate negative side effects – initiatives such as Russia's well-documented misinformation campaign (enabled by the free flow of ideas and expression) have likely contributed to a rise of populist and nationalist political forces throughout Europe, and pose a growing danger to international democratic order[100] – also stem from deep-seeded ideological differences between counties such as the Netherlands (which subscribe to the notion of a liberal world order) and countries such as the Russian Federation (which have a vested interest in propagating large-scale illiberalism). Radical groups such as the Islamic State rely on websites, social networks, and content-sharing sites such as YouTube or Facebook to recruit supporters.

In addition, flows of information and technology contain the potential to disrupt labor markets and bring about greater inequality. First, AI and automation can eventually substitute labor across the entire economy, replacing tens of millions of jobs. Second, they create economic inequality between 'netizens', or the end users, and the providers of intellectual and physical capital – the innovators, shareholders, and investors. This trend is perhaps most visible in Silicon Valley, from which the world's tech giants (Apple, Microsoft, Amazon, Google, Facebook) have succeeded in capitalizing on the financial benefits of a networked world.[101]

Stakeholders

A wide range of actors are relevant within a digital ecosystem of information and technology. With regards to the flows of ICT goods and services, these can be generally divided into the following four main categories. The first category represents the end users, or the 'point B' stakeholders, and consists of 'netizens', governments and industries that benefit from new technologies and digitalization. The second category consists of providers, which represent the 'point A' stakeholders. This category constitutes the largest beneficiary of these flows' continued movement, and presides over the capacity to exert considerable influence over them. Because of their ownership of critical flow infrastructure (networks, data storage, computers), large 'Silicon Valley' corporations dictate the speed at, volume with which, and direction in which these flows can travel. The second group is also responsible for logistics and internet transit. The third stakeholder group is populated by actors who aim to disrupt the continued flows of information and technology. Cybercriminals are considered the biggest threat actors, accounting for the majority of the costs and attacks in the

98. See Valery Gerasimov, "The Value of Silence Is in the Foresight: New Challenges Demand Rethinking the Forms and Methods of Carrying out Combat Operations," *Military Review*, no. January-February (2016): 27.

99. Keir Giles, "Russia's 'New' Tools for Confronting the West: Continuity and Innovation in Moscow's Exercise of Power," Research Paper (Chatham House, 2016), 9.

100. Arch Puddington and Tyler Roylance, "Freedom in the World 2017," January 24, 2017, https://freedomhouse.org/report/freedom-world/freedom-world-2017.

101. Ferguson, "The False Prophecy of Hyperconnection."

cyber domain.[102] In addition to individual attackers, the past decade has witnessed the proliferation of offensive capabilities by state actors. As well as potentially causing grave harm in the cyber domain, state actors can hinder the flow of information and technology by imposing protectionist rules on either trade or data exchanges, or by a lack of adequate protection and enforcement of intellectual property rights. The fourth stakeholder group pertains to the flows of knowledge and ideas and is populated by all individuals who act as carriers of knowledge and ideas. The fifth stakeholder group comprises of actors who bear responsibility for protecting unhindered flows of information and technology. Governments, companies and individual citizens, who have become dependent on the provision of digital services, all have a role to play in ensuring and promoting their own cyber security. International organizations such as WTO and WIPO have a role to play in establishing uniform intellectual property law across differing continents and in re-educating those countries that currently do not value intellectual property rights the way they should.

Critical co-flows

This category is intertwined with the traditional flow of goods and services, people flows and flows of financial capital. Flows of traditional goods and services increasingly depend on uninterrupted flows of data and digital technologies. ICT products may depend on delivery of raw materials and metals to function. The same applies to critical infrastructure, satellites and fiber cables. Flows of people are important with regard to the exchange of ideas, international mobility of researchers, as well as to bridge the skills gap in ICT sector. Finally, this flow category depends on uninterrupted flows of financial capital for both R&D and trade in ICT goods and services.

Table 3 Flows of ideas, information, and technology

Flows of Ideas, Information, and Technology	
Definition	The flow of technology (ICT goods and services); the flow of knowledge in research and development (R&D); and the flow of ideas.
Manifestations	Trade in ICT goods and services; exchange of ideas, knowledge and intellectual property.
Relevance for NL	NL: one of the leading ICT countries in the world, 'digital gateway to Europe', leader in innovation policy.
Domain(s)	Space (satellite communication), Sea (fiber cables), Land (cable termination stations and terrestrial cables), Air (radio traffic and EM-spectrum), cyber.
Characteristics	Velocity, scope and systems impact; highly centralized at the international level.
Threats	**To:** cybercrime and cyberespionage, ICT counterfeit, lack of IPR protection and enforcement, jamming, possible collisions with defunct satellites and debris orbiting the Earth, natural disasters, deep sea creatures, anti-satellite capabilities developed by other states, spread of fake news and extreme opinions. **Associated with:** labor market disruption (by AI and automation), economic inequality, individual privacy and data security.

102. Little is known about their motivations and tools due to three factors: first, the threat landscape is increasingly complex, with blurred boundaries between cybercrime, cyber espionage and cyber-attacks. The second central issue characteristic of the cyber domain is the problem of attribution. Third, reporting has been inconsistent due to a lack of commonly agreed-upon definitions.

Flows of Ideas, Information, and Technology	
Stakeholders	Point A stakeholders: innovators, shareholders and investors. Point B stakeholders (end-users): netizens, governments and enterprises Cybercriminals: individuals and states with offensive cyber capabilities Society as a whole: mobile population carrying knowledge and ideas Actors of resilience: governments, companies, individual citizens, international organizations such as WTO and WIPO.
Critical co-flows	Traditional flow of goods and services. Flows of people. Flows of (financial) capital.

Capital Flows

Flow Particles

Capital flows may take the form of exchange based interactions in which goods and services are traded for currency, but may equally present as investments, loans or grants including foreign direct investments, portfolio equity (stocks), foreign debts and bonds, foreign assets, and remittances.[103] Because B2B (business to business) and C2B (customer to business) exchange-based flows of capital have largely been addressed within the goods and services and quaternary market section, these are not discussed at length within this section. This is not only to avoid redundancy, but also because the in-flow taxonomy presented within this section focuses on the workings of the underlying mechanisms which facilitate the exchange-based movement of capital.

The importance of the flow

Global capital flows benefit economies worldwide by facilitating the availability of capital for local economic activity. In giving companies and consumers alike access to foreign capital, it pays off from an international welfare perspective by fostering competition and specialization according to competitive advantage. The influx of capital (whether through bank loans, exchange-based corporate profits, or cash injection through the stock market) into an economy facilitates the development and the widespread adoption of new technologies and products. Though the mechanisms through which these flows generate profit vary, the underlying benefits associated with their movement are self-evident: they ensure capital is available for expenditure, and thus propagate their own continued movement. Capital flows may also transpose into foreign aid in the form of corporate philanthropy, IGO or state-sanctioned funding programs, and worker remittances.[104] Global capital flows have reached unprecedented high volumes fostering ever deeper global links between capital holders and receivers. The international stock market had a gross value of $99.67tn (165% of global GDP)[105] in 2015. Global foreign direct investment (FDI) increased from $25tn (46% of world GDP) in 2007

103. Susan Lund et al., "The New Dynamics of Financial Globalization" (McKinsey & Company, 2017). "International Capital Flows: The Concise Encyclopedia of Economics | Library of Economics and Liberty," 2008, http://www.econlib.org/library/Enc/InternationalCapitalFlows.html.

104. World Bank, "Personal Remittances, Received (Current US$)," World Bank, 2017, https://data.worldbank.org/indicator/BX.TRF.PWKR.CD.DT.

105. World Bank, "Stocks Traded, Total Value (% of GDP)," World Bank, 2017, https://data.worldbank.org/indicator/CM.MKT.TRAD.GD.ZS?view=chart.

to $41tn (57% of world GDP) in 2016.[106] Cross border loans and bonds as measured by global debt reached $217tn (327% of global GDP) in 2017.[107] Though the volume of some cross-border capital flows – notably the provision of loans within the banking sector – have been reduced by as much as 45% ($7.3tn) since the 2008 financial crisis,[108] increased stability within global FDI markets constitutes a 'shift' in capital flow movement which is likely to improve their overall integrity in the near future.[109] Global currency trade amounted to over $5.1tn per day in April 2016.[110] Governments accumulate foreign currency denominated assets to be able to stabilize the value of their national currencies and the competitiveness of their export industries. Foreign assets were valued at $132tn (183% of world GDP) in 2016,[111] and accounted for almost 100% of some countries' (notably Japan's) GDP.[112] Meanwhile, the net value of official development assistance (including philanthropy) sunk to $152bn (down from a 2015 value of $161bn) in 2016,[113] with the value of personal remittances in the same year being valued at $536bn.[114]

From the Netherlands' perspective, the uninterrupted flow of capital is important for several reasons. First, with a 2016 GDP of $770bn - making it the world's 18th largest economy - the Netherlands respectively ranked 5th ($91.9bn) and 3rd ($113bn) in international FDI inflows and outflows in 2016.[115] The value of the country's inwards FDI stocks exceeded $7.83bn (102% of the national GDP) in 2016, while the value of outwards stocks exceeded $126bn (164% of the national GDP).[116] These statistics respectively place the Netherlands 7th and 5th worldwide, and – because up to 54% of inward flows are allocated towards the country's finance and insurance sector[117] – contributed directly to generating profits, creating employment opportunities within the banking sector, and raising the country's GDP. The Netherlands' FDI relationships (both incoming and outgoing) are relatively, and link it to virtually all of the world's regions (South Asia being the notable exception – see Figures 5, 6, and 7). The Dutch pension fund the *ABP* generated €12.4bn in net value between 2010 and 2015 through its investment portfolio.[118] The Dutch economy's interaction with the international banking sector (whether through corporate bonds, public bonds, or foreign cross border lending) had a gross value of $38,6bn in 2016,[119] and contributes to maintaining the sizeable volume of its foreign

106. Lund et al., "The New Dynamics of Financial Globalization," 39.

107. For a clearer overview of world debt, see the dataset launched in conjunction with World Bank Group, "International Debt Statistics 2017" (Washington, D.C.: World Bank Group, 2017).

108. Lund et al., "The New Dynamics of Financial Globalization."

109. Lund et al., 53.

110. Bank for International Settlements, "Press Release: Global FX Trading Averages $5.1 Trillion a Day in April 2016; Spot Trading Falls While FX Swaps Rise," September 1, 2016, 5, http://www.bis.org/press/p160901a.htm.

111. IMF, "Balance of Payments Manual" (International Monetary Fund, n.d.).

112. Lund et al., "The New Dynamics of Financial Globalization," 6.

113. World Bank, "Net Official Development Assistance and Official Aid Received (Current US$)§," World Bank, 2017, https://data.worldbank.org/indicator/DT.ODA.ALLD.CD.

114. World Bank, "Personal Remittances, Received (Current US$)."

115. UNCTAD, "World Investment Report 2017," UNITED NATIONS PUBLICATION (Geneva: United Nations, 2017). See also OECD, "OECD Economic Surveys NETHERLANDS Overview" (OECD, March 2016), http://www.oecd.org/eco/surveys/Netherlands-2016-overview.pdf.

116. OECD, "FDI In Figures" (Geneva: OECD, 2016).

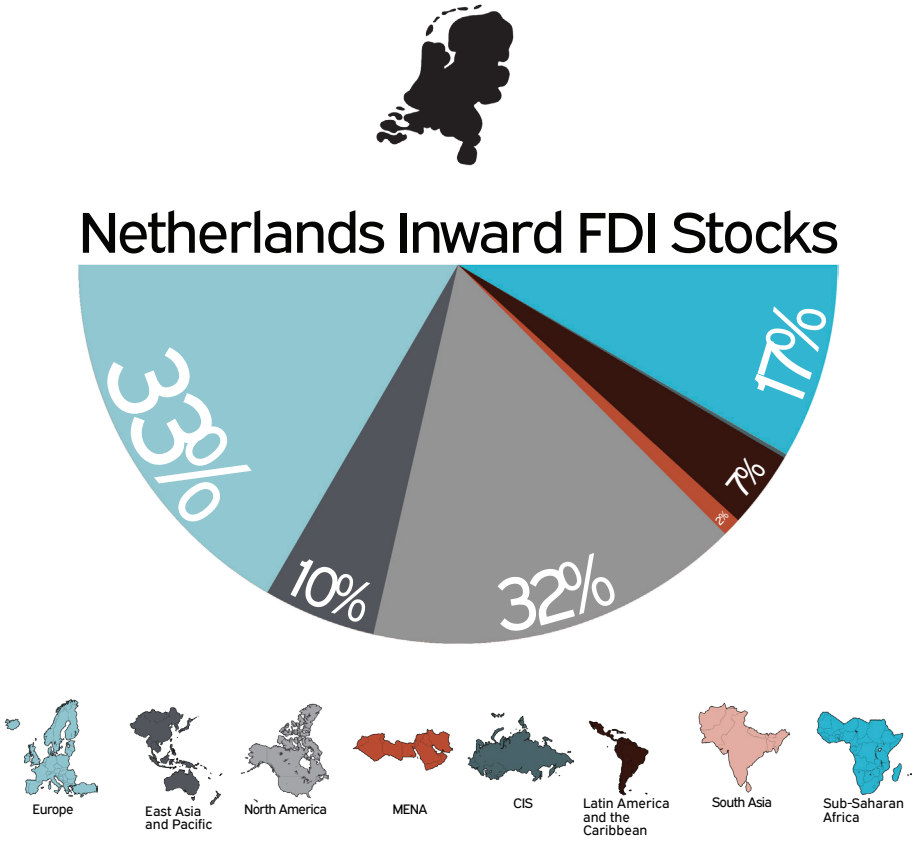
117. OECD, "Foreign Direct Investment (FDI) - FDI Stocks - OECD Data," OECD, 2017, http://data.oecd.org/fdi/fdi-stocks.htm.

118. Leen Preesman, "Asset Allocation: The Dutch Top Five," Investments & Pensions Europe, 2015, https://www.ipe.com/pensions/pensions-in/netherlands/asset-allocation-the-dutch-top-five/10009578.fullarticle.

119. Centraal Bureau voor de Statistiek, "ICT, Kennis En Economie 2017."

assets ($2.69tn - 349% of GDP - in 2016).[120] The country also remains an important actor within the international stock market. The Amsterdam Stock Exchange commands considerable volume, and (in amounting to a net value of over $474bn) was worth about 54% of the country's GDP in 2014.[121] As transactions on the stock market are perpetrated (in part) by millions of individual-level micro transactions, this speaks volumes both to the degree of domestic and foreign investors engagement in stock exchanges which trade in Dutch companies. With regards to capital flows' contribution to Dutch access to goods and services, the Netherlands ranks 28th on the MIT's Observatory of Economic Complexity Index, and imports goods – including 'keystone' technologies such as LCD screens – from 210 foreign countries and territories.[122] The Netherlands also provided approximately $4.9bn (0,6% of GDP) in foreign aid in 2016,[123] and received roughly $200mn worth of remittances.[124]

Figure 5 Regional breakdown of inbound Dutch FDI stocks (2016)[125]



120. Centraal Bureau voor de Statistiek.
121. World Bank, "Stocks Traded, Total Value (% of GDP)."
122. The Observatory of Economic Complexity, "OEC - Netherlands (NLD) Exports, Imports, and Trade Partners."
123. OECD, "Seventeenth Report on G20 Investment Measures" (G20 Investment Measures: OECD, 2017).
124. Trading Economics, "Netherlands Remittances | 1992-2017," Trading Economics, 2017, tradingeconomics.com/netherlands/remittances.
125. Data adapted from OECD, "Foreign Direct Investment (FDI) - FDI Stocks - OECD Data."

Figure 6 Regional breakdown of outbound Dutch FDI stocks (2016)[126]

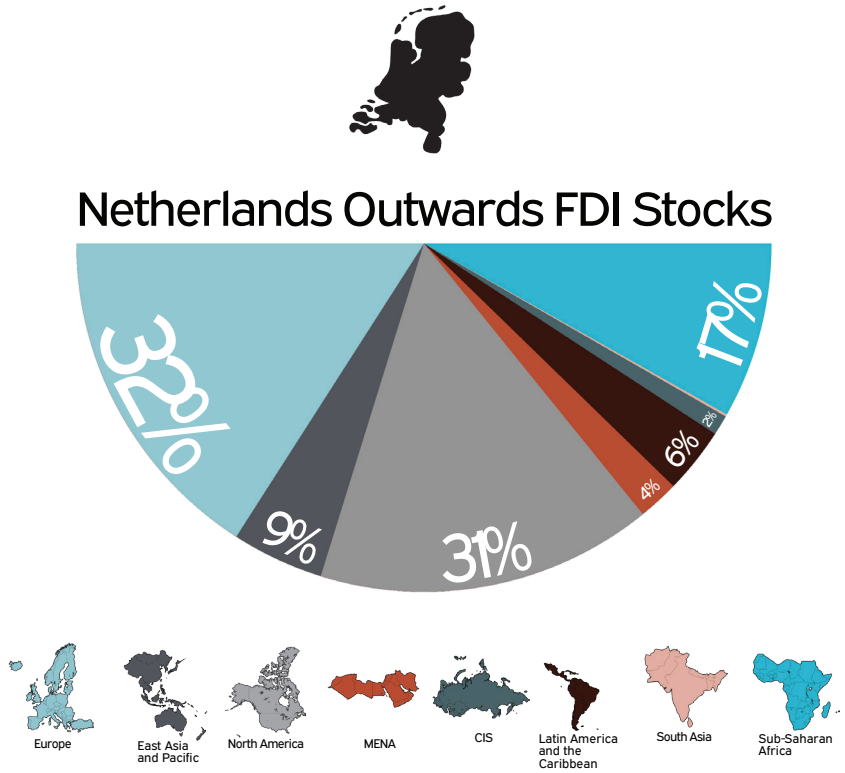
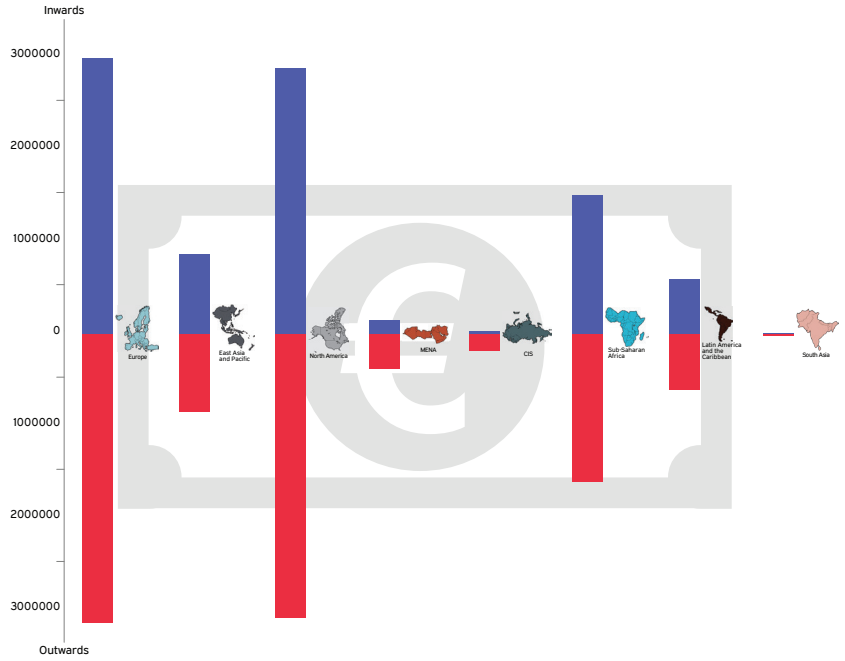


Figure 7 Comparative absolute regional values of Dutch FDI in-and-outbound stock (2016)[127]



126. Data adapted from OECD.
127. Data adapted from OECD.

Flow domains and critical hubs

Domains

Today, financial capital can take the form of anything from cash handovers to direct bank transfers and – as interfaces such as Samsung Pay, Apple Pay and ABN AMRO's Tikkie push to integrate them with social media platforms – text messages.[128] Within the European consumer market – in which, in select countries, up to 91% of individuals make regular use online banking as their primary form of payment – the combination of a relatively high amount of disposable income, widespread access to smartphones, and the prevalence of e-shopping (a development which is facilitated by innovation within the goods and services sector) have made the phenomenon particularly pronounced. This shift toward electronic cash transfers (read: cash flows which take the form of information flows) at the individual level echoes the *modus operandi* of the macro-level financial sector, which has long propagated large financial transactions – including the purchase of publicly traded stocks, the provision of FDI, the cross-border transfer of loans, and the purchase of bonds – through electronic rather than physical means. The free flow of information is also increasingly relevant for informing the actions of actors which participate in these flows. Though a small percentage of state foreign reserves take the form of gold (and – in the unlikely event that they move at all – are thus dependent on physical transportation through the sea, land, and air domains), the growing importance of information flows – which provide actors with actionable information, transmit intent across continents, and facilitate the transfer of large sums through wire transfers – renders capital flows increasingly dependent on cyberspace. This increases the importance of the ocean and space domains, and (by extension) serves to further elevate the importance of infrastructure such as the ocean cables, internet exchanges (the AMS-IX included), and data-beaming satellites which transport them.

With regards to hubs which are relevant for the continued movement of capital flows, these can be generally divided into hubs from which capital originates and hubs which facilitate the logistics of its flows. Logistical issues associated with capital flows can be roughly divided into issues associated with registering human *intent* to propagate them and issues associated with transporting finance (information) once its transfer has been greenlighted by a capital holder. Starting with hubs involved with logistics surrounding transportation, these take the form of – as is also the case with information flows at large – internet exchanges, data beaming satellites, and ISP data centers. In the case of the (very few) capital flows which take a physical form, the relevant hubs are the world's airports and harbors. Moving on to hubs which are critical to registering human *intent*, these largely take the form of institutions (public sector) and organizations (private sector). Flows in publicly traded (private sector) stocks depend on the world's stock exchanges, but also on firms which provide capital holders with prodding (and expertise) necessary to incentivize their participation. The transfer of loans and the purchasing of bonds are subject to the checks and balances which are institutionalized by central banks. This phenomenon ties in closely with the second relevant hub category. Because the movement of capital flows – more than any other flow category – is dependent on human intent, it is also dependent on clusters of currency-holders which (due to the volume of capital which they hold) are capable of transposing intent into action. These can be

128. Sean O'Kane, "iOS 11 Lets You Send and Receive Money via iMessage with Apple Pay," The Verge, 2017, 11, https://www.theverge.com/2017/6/5/15731034/apple-pay-iphone-payments-venmo-update-announced-wwdc-2017.

roughly divided into public sector (national government funds), private (hedge funds, banks, etc.), and supranational entities (World Bank, IMF, etc.). Capital holders play a role in facilitating both the flow of physical and digital currencies by employing several mechanisms whose ultimate outcome manifests in increases in disposable income (and, by extension, increases in expenditure) on the part of consumers.

Characteristics

Several characteristics serve to differentiate capital flows from the flows of goods and services and flows of information with which they share (literal) bandwidth. These derive from structural factors surrounding the flow's place in society rather than from limitations of its environment, and can be defined as follows. First, the particles which make up capital flows are finite. This is because, within the context of the international economy, national currencies are partially valued on the basis of their relative scarcity. Though national banks can increase money supply by printing additional money, they rarely do so because it drives the value of the currency down relative to other currencies by increasing the volume (reducing the scarcity) of currency in active international circulation. This reduces consumers' spending potential outside the country, increases of the price of internationally imported goods and services domestically, and may (in extreme cases) lead to scenarios in which investors flee a national currency en-masse. Capital flows' finite nature ties in closely with the second characteristic they derive from structural factors: they are non-replicable. To conceptualize this, it helps to remember that – on the rare occasion that a national bank does print more money – it is injecting new (not previously existing) bills into the economy. This form of replication constitutes an actively employed, supply-side policy initiative, and thus clearly differentiates capital flow replication from information flows' ability to replicate infinitely between nodes. Capital flow particles' ability to exist in both physical and digital domains – but never in both simultaneously – constitutes a third characteristic which is unique to the flow, and limits the velocity with which it (as an individual unit) can spread throughout society. An individual Euro can exist either in cyberspace (as a €1 on a bank account) or as a physical coin. The act of withdrawing a Euro from a bank account by definition removes that Euro from the digital domain, just as returning a Euro to a bank removes it (from the perspective of the owner) from the accessible physical domain. Capital flows are also unique because they are the only flow whose movement is dependent on a human domain. Essentially: because the particles which make up capital flows (unlike, for example, gold) have no intrinsic value, their functioning – and, by extension, their continued flow – is dependent on the maintenance of individual-level trust that numbers on a bank account or plastic bills can be exchanged for tangible goods and services. In addition to these unique flow characteristics, capital flows additionally preside over several standard (domain-based) characteristics. These include digital funds' ability to (barring procedural constraints) transfer between actors instantaneously, physical capital's dependence on external forms of physical propulsion to traverse environments, and the flow category at large's dependence on human initiative to be mobile at all.

Threats

Factors which threaten the continued movement of capital can be loosely divided into four categories. These are protectionist policies, system failure, human interference with the functional capacity of hubs and domains, and the advent of cryptocurrencies. With regards to challenges associated with protectionist policies, these have (in extremely general terms) the potential to

disrupt global capital flows by ushering in tax schemes which disincentive capital investment, by stirring up mutual animosity (lack of trust) between countries, and by reducing the volume of international trade as a whole. The rate of adoption vis-a-vis such measures has increased in recent years, and has been linked to reduced macro-level FDI inflows in 2016.[129] Moving on to market-level engagement in risky investment initiatives, this relates strongly to structurally ingrained moral risk and individual-level opportunism, which can both trigger system failure.[130] Crises such as the 2008 housing market erode public trust in the hubs which facilitate the flow of capital, and undermine trust in the value of money. As such, they may lead to bank runs and reduced engagement with stock exchanges. These respectively hamper capital flows by reducing the capital available to capital holding hubs (which may negatively impact their ability to invest or offer loans) and by reducing the volume of capital which flows into corporate R&D funds. Pivoting towards a hub-centric view of threats to capital flows, there are concerns regarding the ability of the world's stock exchanges and central banks to withstand cyberattacks. Examples of such attacks are widespread, with events such as Iranian hackers' targeting of banks such as JP Morgan Chase and Russia's alleged tampering with Ukrainian banks presenting as particularly topical examples.[131]

The final threat to capital flows derives from the advent of cryptocurrencies, which have the potential to destabilize real-world currencies and to undermine central authorities' ability to utilize capital flows in policymaking. Though standards such as Bitcoin preside (due to the accountability enforced through their Blockchain architecture) over a wide range of attractive qualities and are arguably poised to replace current capital flows mechanisms in the near future, they command – at a value of approximately $41bn in total – a relatively small share of financial market value.[132] With regards to their potential to erode state capacity to utilize capital flows in policymaking, this derives from the fact that cryptocurrencies (unlike national currencies) are not centralized around hubs – instead favoring an approach in which they exist in constantly updated device-based networks. This limits the ability of outsiders to enact coercive economic policies and cut off sources of funding of such groups. Cryptocurrencies additionally offer their users almost complete anonymity. This circumvents authorities' ability to employ financial monitoring techniques as a tool in the preemption of crises. Their finite nature (Bitcoin – much like gold – exists in limited amount) additionally combines with their mode of extraction (Bitcoin must be 'mined' by computers which solve mathematical equations that become more difficult as the currency becomes more common) to render them immune to value adjustment through monetary policy, which renders their value extremely volatile. This is further exacerbated by the fact that cryptocurrency 'exchanges' – unlike the currencies themselves, which (due to their Blockchain architecture) do not rely on any form of hub infrastructure – can be shut down (as is currently occurring in China) by national actors.[133]

129. FDI inflows reduced to $1.75tn in 2016; at least 10 bilateral investment treaties (BITs) were terminated in the same year. See OECD, "Foreign Direct Investment (FDI) - FDI Stocks - OECD Data."

130. Kevin Dowd, "Moral Hazard and the Financial Crisis," CRIS Discussion Paper Series (Nottingham: Centre for Risk & Insurance Studies, 2008).

131. See American Banker, "U.S. Charges Iranian Hackers in Wall Street Cyber-Attacks," American Banker, 2016, https://www.americanbanker.com/news/us-charges-iranian-hackers-in-wall-street-cyber-attacks; see also Lizzie Dearden, "An Unprecedented Cyber Attack Just Took out Major Banks, Government and Airport Computers in Ukraine," The Independent, June 27, 2017, http://www.independent.co.uk/news/world/europe/ukraine-cyber-attack-hackers-national-bank-state-power-company-airport-rozenko-pavlo-cabinet-a7810471.html.

132. Sue Chang, "How Big Is Bitcoin, Really? This Chart Puts It All in Perspective," MarketWatch, 2017, http://www.marketwatch.com/story/how-big-is-bitcoin-really-this-chart-puts-it-all-in-perspective-2017-06-21.

133. Thuy Ong, "China Tightens Cryptocurrency Ban with New Directive - The Verge," The Verge, 2017, https://www.theverge.com/2017/9/18/16326078/chinese-regulators-ban-cryptocurrency-platforms-bitcoin.

In addition to being threatened by several phenomena, the movement of capital may also present a security threat for several reasons. The first relates to the fact that these flows have facilitated an unprecedented degree of integration within the international banking system. This has led not only to greater international interdependence (which is positive from a liberal International Relations perspective), but has also increased international vulnerability because it exacerbates the impact of financial crises (as illustrated by the wide-reaching impact of the 2008 Recession). The second relates to these flows' role in propagating the movement of negative goods and services. The marketplaces hosted on the dark web – a 'negative' flow domain which is born of the combination of illicit information and capital flows – serve to institutionalize the world's illicit arms trade, drug transactions, and human trafficking operations (the Netherlands-specific negative impacts of which are outlined under the goods and services section).

Stakeholders

Several stakeholder categories are of relevance within the capital flow category. At the generalized macro-level, a rough distinction can be drawn between capital-holding stakeholders, stakeholders which facilitate human logistics, stakeholders which facilitate practical logistics, and capital receiving stakeholders. The capital holding stakeholder category is populated by actors which have the capacity to contribute to capital flows by spending disposable income, and thus incorporates everything from middle class citizens to banks and hedge funds. These respectively contribute to propagating capital flows by engaging in consumerism and engaging in transactions on the stock market, and by engaging in large-scale investment initiatives (whether through FDI, aid provision, or bond purchasing). The transactions propagated by these actors are facilitated by logistics-specialized stakeholders, which may specialize in either logistics associated with incentivizing human (capital holder) engagement with capital flows or logistics associated with ensuring sanctioned capital flows reach their intended destination. Actors which specialize in incentivizing capital holder engagement with capital flows include banks (enforce checks and balances which attempt to verify intent before transactions are transmitted), stock brokers (provide capital holders with the expertise and interface necessary to interact with the stock market), and (to a lesser extent) government regulators which contribute to creating the structural conditions necessary to incentivize such engagement in the first place. Moving on the stakeholders which ensure that sanctioned capital flows reach their destinations, relevant actors include banks, ISP providers, and cyber security personnel which are charged with ensuring that the transmission of information through cyberspace remains viable. Finally, capital-receiving stakeholders include – depending on the type of capital flows – investors (banks, private citizens, etc.), corporations, in-need individuals (finance through aid), and governments. These respectively derive capital from their engagement with capital flows through returns on investments, stock market surges and profits made from the provision of goods and services, aid provision, and taxation, and are universally actors which – by spending the capital they earn – have the potential of contributing to the continued movement of capital flows.

Critical co-flows

The continued movement of capital is predominantly dependent on the continued flow of information. This is partially because information flows inform stakeholder behavior vis-a-vis capital flows, and partially because capital flows almost exclusively take the form of internet-

based wire transfers (e-banking). This also renders them dependent on human (trust-based) flows, as anonymous internet-based transactions by definition cannot deliver goods at the moment of payment, and thus require one party to provide funds on the basis of good faith. Simultaneously, the capital flows which accompany international commerce are indirectly dependent on the continued supply of goods, and are thus tied closely to flows of goods and services. Such flows also occasionally serve to transport capital; for example, gold – a common investment commodity – takes physical form, and (when transported) must traverse the same hubs and domains as flows of goods and services in-large.

Table 4 Capital flows

Capital Flows	
Definition	International movement of monetary capital.
Manifestations	FDI flows, stock transactions, provision of loans, bond transactions, accumulation of foreign assets, financial transfers relating to commerce in goods and services.
Relevance for NL	FDI inward flow is 102% of GDP; outward flow is 164%; €12.4bn in net value generated by ABP; over $474bn in transactions over the Amsterdam stock exchange; provided access to 210 foreign markets in 2015.
Domain(s)	Cyber, Sea, Land, Human.
Characteristics	Capable of near-instantaneous transfers; finite & non-replicable; trust-based (human).
Threats	To: system failure, human interference, protectionist policies, advent of cryptocurrencies, erosion of trust. From: Banking sector integration spreads local system failure, role in propagating negative goods and services, cryptocurrencies hamstring state actors.
Stakeholders	Capital holders (private, public); (anti)logistical actors; capital-receivers; regulators.
Critical co-flows	Information flows, flows of goods and services.

Flows of People

Flow Particles

Flows of people constitute the movement of people across borders. This category comprises of tourism, labor flows and non-labor related migration flows (asylum seekers, refugees and internally displaced persons). Tourism and labor make up positive flows: foreign tourism spending brings revenue and boosts employment while inflow of skilled labor adds economic value by boosting productivity, knowledge and innovation potential. The impact of refugee flows on a host economy remains to be seen and depends on the success of their labor market integration, the acceptance of the host population, and the flexibility of the receiving economy to change its output mix. Altogether, tourists, immigrants and refugees may enrich intellectual, social and cultural life, bring diversity of values, and pave the way to a more tolerant, inclusive and resilient society. In contrast, uncontrolled migration flows, group animosity between migrants and the host population, the spread of pathogens through global travel - with a potential to cause pandemics - and 'brain drain' produce negative effects which warrant active mitigation.

The importance of the flow

Tourism

The flow of tourism has recorded an uninterrupted growth for seven consecutive years since the aftermath of the 2009 global economic and financial crisis. In 2016, international tourist arrivals reached a total of 1,235 million, which constitutes a rise of 3.9% - or 46 million - relative to 2015.[134] The robust performance of this sector contributes to economic growth and job creation worldwide. In 2016, travel and tourism generated $7.6tn in GDP (10.2% of global GDP), making this sector's GDP contribution larger than that of banking, mining, agriculture, automotive and chemical manufacturing.[135] With regards to employment, in 2016 travel and tourism directly sustained 108.7 million jobs worldwide. When both direct and indirect impacts are considered, in 2016 the sector generated 9.6% of global employment. World Travel and Tourism Council (WTTC) projects the global travel and tourism to grow 4.0% per annum (compound annual growth).[136]

With regards to the sector's relevance at the national level, tourism (both domestic and foreign) constitutes an important part of the Dutch economy. In 2016, its value totaled €75.7bn. In terms of value added, the tourism sector accounted for €24.8bn in 2016, or a 3.9% share of Dutch GDP.[137] This sub-flow consists of inbound (foreign), outbound and domestic tourism. Inbound tourism is an increasingly significant source of income for the Netherlands. International visitor arrivals reached 15 million in 2015, resulting in 37,3 million overnight stays in the Netherlands.[138] A large share of foreign tourism spending is generated by the booking of accommodation and travel via Dutch companies, which contributes to their turnover. In comparison to revenue generated by foreign tourism (€21bn), domestic tourism accounted for the largest share of revenue generated by this sector, totaling €51.4bn in 2016.[139] In addition, the tourism sector generated 5.5% of all employment, representing 389 thousand full-time jobs in 2016.[140]

Labor

Labor flows, which comprise both skilled and unskilled migration, have been on the rise over the past decades and are expected to increase even further in the future. According to the McKinsey

134. UNWTO, "World Tourism Organization UNWTO | Specialized Agency of the United Nations," accessed October 6, 2017, http://www2.unwto.org/.

135. WTTC, "Benchmarking Travel & Tourism," WTTC, accessed October 6, 2017, https://www.wttc.org:443/research/economic-research/benchmark-reports/.

136. WTTC.

137. Statistics Netherlands, "Tourism Sector Continues to Grow," webpagina, August 2017, https://www.cbs.nl/en-gb/news/2017/34/tourism-sector-continues-to-grow.

138. Statistics Netherlands, "CBS StatLine - Overnight Accommodation; Guests, Country of Residence, Type, Region," October 31, 2017, http://statline.cbs.nl/Statweb/publication/?VW=T&DM=SLEN&PA=82059ENG&D1=a&D2=0&D3=0-2&D4=0&D5=16,33,50,67&HD=160601-1450&HDR=G3,G4&STB=G1,T,G2.

139. Statistics Netherlands, "CBS StatLine - Tourist Expenditure; National Accounts," August 21, 2017, http://statline.cbs.nl/Statweb/publication/?DM=SLEN&PA=82671ENG&D1=a&D2=a&VW=T.

140. Statistics Netherlands.

Global Institute (MGI),[141] more than 90% of the world's 247 million cross-border migrants moved voluntary, primarily for economic reasons.[142] The remaining 10% are comprised of asylum seekers and refugees. Migrant workers contribute to development and growth of the host economy, while countries of origin greatly benefit from their remittances and the skills acquired during their migration experience. According to MGI's estimates, migrants contributed 9.4% of global GDP in 2015, or around $6.7tn. This value is estimated to be $3tn more than they would have produced in their countries of origin.[143] In addition, migrants of all skill levels enrich the workforce, allowing for a more finely graded specialization that raises living standards as well as average productivity. Diverse workforces are likely to be more productive, especially in industries where success depends on specific knowledge, such as finance, computing, and health care.[144] Migration also helps to deal with labor shortages in low- and mid-skilled industries, such as agriculture or mining, and in remote locations where attracting native workers has proven difficult. In light of slowing population growth in Europe - due to decades of falling birth rates - labor market experts forecast future labor shortages, and single out labor inflows and refugee integration as a possible solution. In fact, according to Eurostat, the region's population rose in 2016 solely due to immigration.[145]

In international comparisons, the Netherlands has been successful in attracting and retaining foreign talent. Free movement of EU citizens constitutes the major source of labor inflow for the Netherlands. By the end of 2015, there were 855 thousand migrants registered in the Netherlands from other EU member states and candidate member states.[146] The share of non-EU labor migrants remained below the European OECD average. Although the overall skill level is high in the Netherlands, technological progress has led to a rising demand for more complex skills, creating a skills gap that will need to be addressed. Labor shortages are limited to specific occupations and sectors. The business sector suffers most, followed by ICT.[147] For 2016, the National Employee Insurance Agency (UWV) predicted around 40,000 vacancies in the information and communication sector and a 5% growth in ICT job vacancies.[148] At the moment, however, there is an increasing shortage of ICT professionals, with more than 50% of the enterprises in this sector facing challenges filling these vacancies.[149] Overall, future demand for skilled workers is expected

141. Estimates provided by McKinsey Global Institute and International Labour Organization (ILO) differ. According to ILO (based on 2013 data), there are 150 million migrant workers world-wide. Source: Department of Statistics, "ILO Global Estimates on Migrant Workers: Results and Methadology" (International Labor Organization, 2015).

142. The remaining 10% are comprised of asylum seekers and refugees. The remaining 10% are comprised of asylum seekers and refugees. See Jonathan Woetzel et al., "Global Migration's Impact and Opportunity | McKinsey & Company," November 2016, http://www.mckinsey.com/global-themes/employment-and-growth/global-migrations-impact-and-opportunity.

143. Woetzel et al.

144. The Economist, "Needed but Not Wanted: Economic Migrants Are Seen as a Threat to Jobs and the Welfare State. The Reality Is More Complex" (The Economist, September 29, 2016), https://www.economist.com/news/special-report/21707835-economic-migrants-are-seen-threat-jobs-and-welfare-state-reality-more.

145. The Economist, "Why Europe Needs More Migrants: Without Them the Continent's Population Will Start to Shrink," July 12, 2017, https://www.economist.com/blogs/graphicdetail/2017/07/daily-chart-6.

146. Statistics Netherlands, "More Eastern Europeans Working in the Netherlands," webpagina, accessed October 6, 2017, http://www.cbs.nl/en-gb/news/2017/05/more-eastern-europeans-working-in-the-netherlands.

147. Statistics Netherlands, "Staffing Deficits Impact Private Sector," webpagina, accessed October 9, 2017, http://www.cbs.nl/en-gb/news/2017/33/staffing-deficits-impact-private-sector.

148. Ministry of Economic Affairs, "Digital Agenda for the Netherlands: Innovation, Trust, Acceleration," 11.

149. Ministry of Economic Affairs, 11.

to exceed domestic supply over the coming decade.[150] Maintaining an unhindered flow of skilled migrants is important to not only address current labor shortages, but also to strengthen the position of the Netherlands as a knowledge based economy.

Non-labor related migration

Non-labor flows comprise asylum seekers, refugees and internally displaced persons, whose movement is forced by conflict, persecution, violence or human rights violations. According to the United Nations Refugee Agency (UNHCR), the world is facing the highest number of displaced persons ever recorded, numbering over 65.5 million, which surpasses even World War II levels.[151] Among them are nearly 22.5 million refugees and 2.8 million asylum seekers.[152] Between 2013 and 2016, around 4.4 million people applied for asylum in 44 industrialized countries, driven mainly by greater geopolitical instability in the Middle East.[153] In contrast to voluntary migrants, the integration of refugees typically requires more time and effort, as many are troubled by the trauma which led them to flee their countries of origin in the first place.[154] The costs of their integration tend to be higher, too. The impact of refugee flows on GDP per capita remains to be seen, and will likely depend on the rate at which such individuals are able to successfully integrate into the labor markets of the receiving countries (partially an artifact of the effectiveness of related policies).[155] In the case of the Netherlands, asylum requests surged in 2015, almost doubling relative to 2014 levels (58.9 thousand in 2015 in comparison to 29.9 thousand applications in 2014). In 2015, refugee participation rate in the labor market was around 45%, which is much lower than participation rates of the host-country population.[156] Moreover, refugees have the lowest incomes among the various background groups and their jobs involve fewer hours of work.[157] Given the increase in domestic public spending on newly arrived migrants – such as investment in additional dwellings, for example – economic contribution of refugees remains marginal. Enhancing language training, providing assistance in the recognition of foreign diplomas, and developing skills relevant for the Dutch labor market will help the Netherlands reap the economic benefits of refugee flows in the future.[158]

The regional breakdown of people flows to the Netherlands is further explored in Figures 8 and 9.

150. United Nations High Commissioner for Refugees, "Global Trends: Forced Displacement in 2016," UNHCR, 2016, http://www.unhcr.org/statistics/unhcrstats/5943e8a34/global-trends-forced-displacement-2016.html.

151. United Nations High Commissioner for Refugees.

152. United Nations High Commissioner for Refugees.

153. Robbie Gramer, "Watch: The Global Flow of Asylum-Seekers In One Interactive Map," *Foreign Policy* (blog), March 15, 2017, https://foreignpolicy.com/2017/03/15/how-many-asylum-seekers-refugees-are-in-the-world-interactive-map-infographic-global-migration-immigration/.

154. OECD, "OECD Economic Surveys NETHERLANDS Overview," 18.

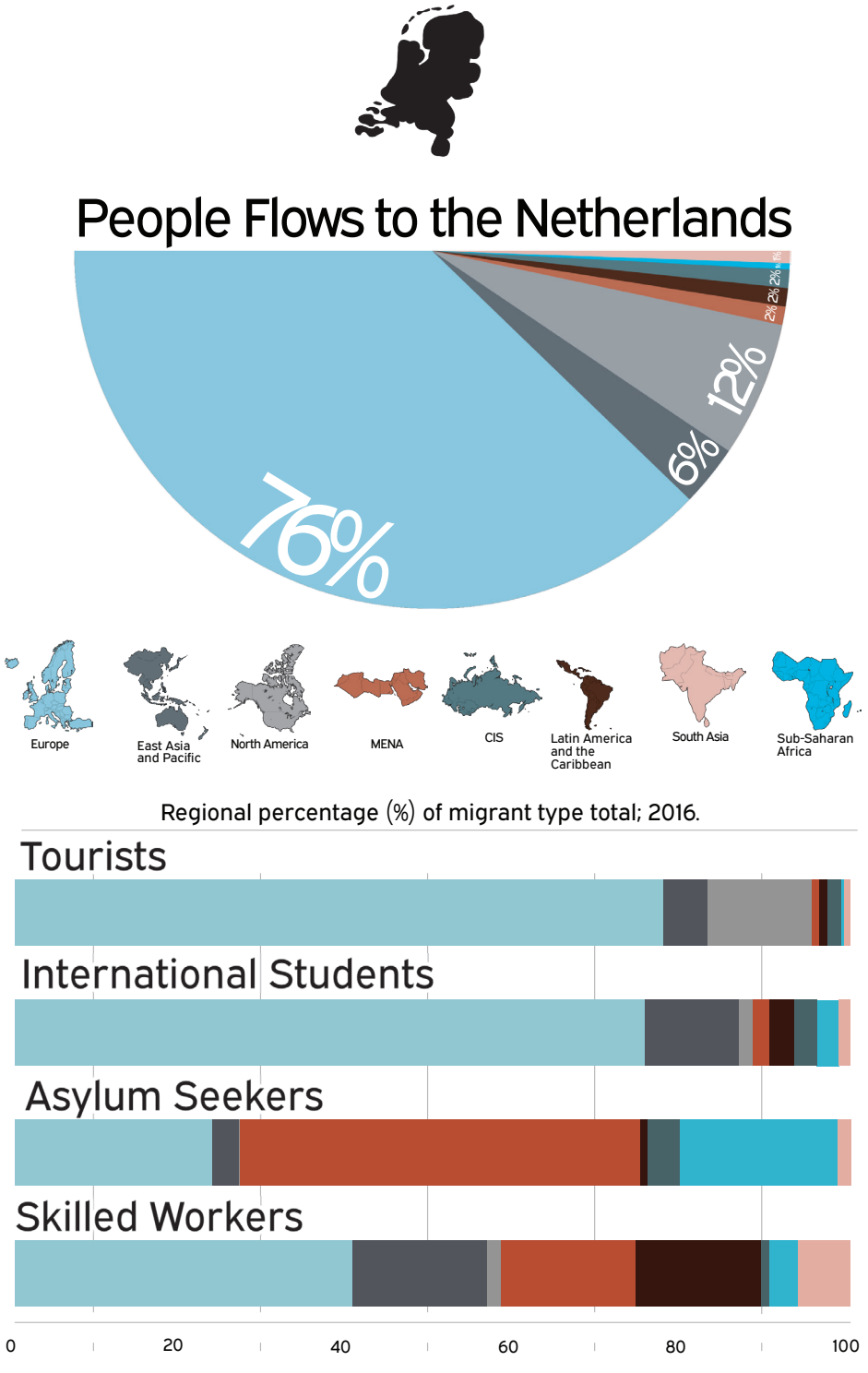
155. OECD, 18.

156. OECD, 19.

157. Statistics Netherlands, "Annual Report on Integration 2016 Summary" (The Hague: Statistics Netherlands, 2016).

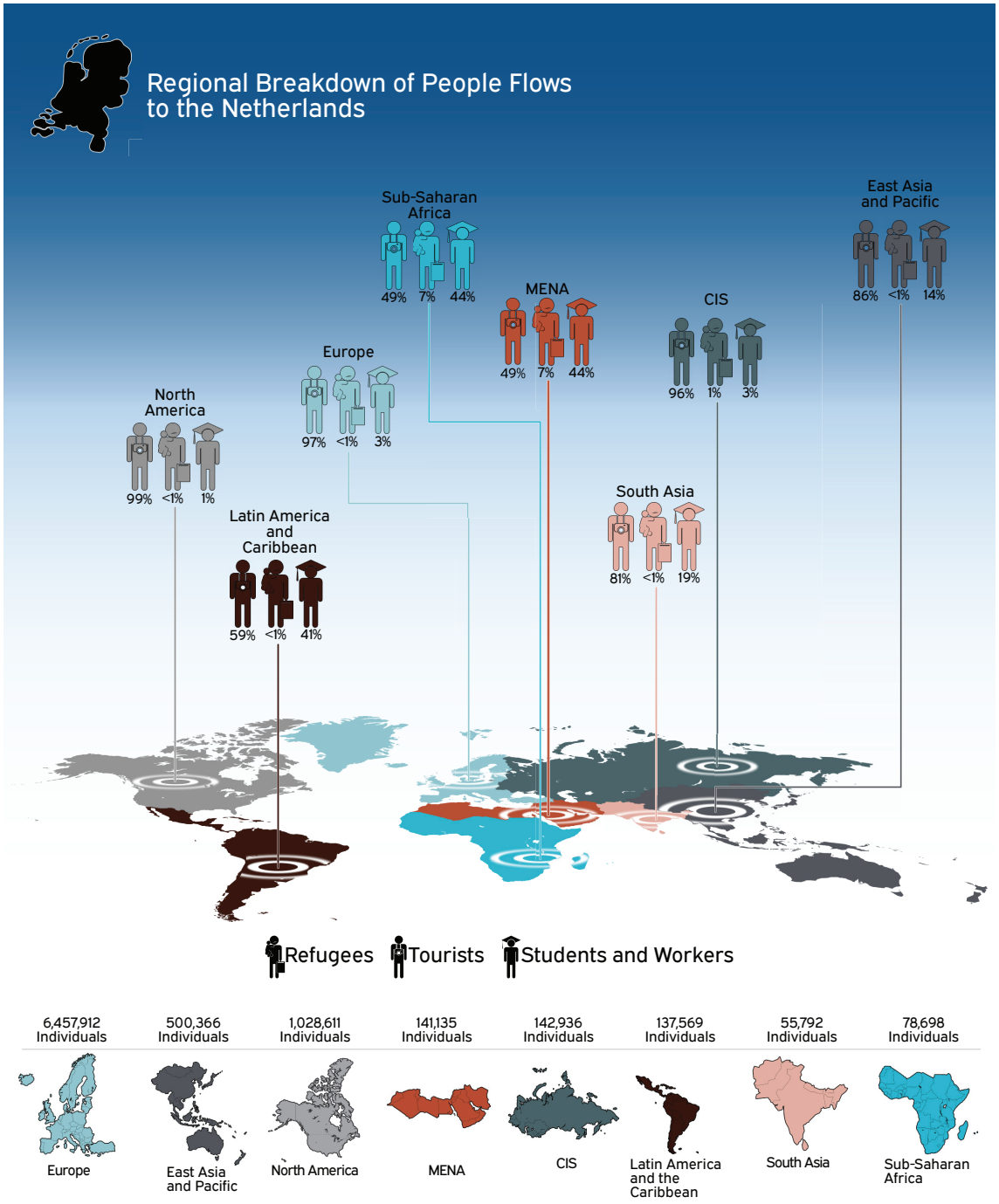
158. OECD, "OECD Economic Surveys NETHERLANDS Overview," 19.

Figure 8 Regional breakdown of aggregate people flows to the Netherlands[159]



159. See "UIS Statistics," accessed November 28, 2017, http://data.uis.unesco.org/#. for data relating to international students. Data relating to Asylum Seekers adapted from "Database - Eurostat," accessed November 28, 2017, http://ec.europa.eu/eurostat/data/database.; data relating to tourism adapted from Netherlands, "Tourism Sector Continues to Grow."; and data relating to skilled workers adapted from H Brucker, S Capuano, and A Marfouk, "IAB Brain-Drain Data | IAB," 2013, http://www.iab.de/en/daten/iab-brain-drain-data.aspx.

Figure 9 Regional breakdown of people flows by flow type (2016)[160]



160. See "UIS Statistics." for data relating to international students. Data relating to Asylum Seekers adapted from "Database - Eurostat."; data relating to tourism adapted from Netherlands, "Tourism Sector Continues to Grow."; and data relating to skilled workers adapted from Brucker, Capuano, and Marfouk, "IAB Brain-Drain Data | IAB."

Flow Domains and Critical Hubs

Domains

The movement of people occurs by means of air, land or sea. The choice of domain is most often defined by the cost of transport, disposable personal income, and possible legal checks at the points of entry. Tourism is most often associated with transport by air, which is subject to both stricter border and customs checks and higher costs. This includes regular commercial flights and charter flights. Due to factors such as lower oil prices and increased competition between airlines, air fares have been falling, making air travel more affordable for different income groups. In 2016, IATA recorded a $44 fall in average return fares and a record number of 3.7 billion passengers.[161] Labor flows, which comprise skilled and unskilled migration, occur by means of air or land, depending on disposable personal income. While highly-skilled migrants are more likely to travel by air and have their travel expenses reimbursed, low-skill migrants often travel in groups by land. Transport carriers within the land domain include trains, cars, buses and minibuses. Refugees most often travel by a combination of irregular land and sea routes. They cross borders by foot, making long treks or walking on railway lines. Crossing the sea route - most often the Mediterranean or the Aegean seas - in boats and inflatable rafts constitutes the most perilous domain of transportation. According to the IOM Missing Migrants Monitor, 64% of migrant fatalities (2,654 out of 4,147) recorded worldwide in 2017 occurred on the Mediterranean Sea route.[162] Victims of human trafficking are most often transported by cars (owned by the trafficking or a member of a criminal group), buses, or minibuses (operated by international transport companies). Travelling by air occurs mainly in the cases of trans-continental trafficking.[163]

Hubs which are instrumental in ensuring the continued flow of people are land, air and sea points of entry. These include seaports, airports, and road and rail crossings. Every legal point of entry also acts as a checkpoint, which subjects individuals to a variety of security procedures and measures. From the point of view of the Netherlands, Amsterdam Schiphol airport acts as the main hub enabling the flow of people. In 2016 alone, Schiphol recorded almost 479,000 air movements and handled 63,6 million passengers.[164]

Characteristics

Flows of people are asymmetric, constituting the reason why governments put measures in place to restrict or 'manage' the movement of people across borders. They are temporary or reciprocal, reflecting the global integration of educational, economic and labor markets. Temporary movements include flows of international students, medical tourists, temporary and seasonal workers, as well as individuals with dual or multiple citizenship and right of residence.[165] These

161. IATA, "IATA - Another Strong Year for Air Travel Demand in 2016," February 2, 2017, http://www.iata.org/pressroom/pr/Pages/2017-02-02-01.aspx.

162. International Organization for Migration, "Missing Migrants Project," November 20, 2017, https://missingmigrants.iom.int/.

163. Adelina Tamas, "Routs and Flows of Human Trafficking," December 6, 2016.

164. Schiphol group, "Facts and Figures | 2016 Annual Report | Schiphol," 2016, http://www.annualreportschiphol.com/about-us.

165. BD Gushulak, J Weekers, and DW MacPherson, "Migrants and Emerging Public Health Issues in a Globalized World: Threats, Risks and Challenges, an Evidence-Based Framework," *Emerging Health Threats Journal* 2 (March 31, 2010): 3, https://doi.org/10.3134/ehtj.09.010.

flows can be both voluntary and forced, regular and irregular. Flows of people face limits in terms of geography, resources and legal constraints. The flow velocity of people is limited by the form of transport chosen to move from point A to point B. Another important characteristic which is related to the flows of people is that by being physical, they are subject to physical barriers. These barriers can be natural (mountains, swamps, deserts) or man-made (separation barrier) and include immigration detention centers which can change the flow direction by facilitating the deportation of foreign individuals back to their countries of origin.

Threats to the flows of people

A number of factors restrict the free flow of people across borders. While numerous natural and human-caused disasters can significantly impact the flow of tourists, the threat of terrorism is of major concern for many governments with regard to ensuring the continuity of travel and tourism. This includes attacks on (Western) tourists, tourism-related services such as aviation and transport, as well as cities and popular tourist destinations.[166] In addition to hitting the industries that make travel possible, fear of terrorist violence deters potential tourists from traveling, and encourages states to impose physical and legal barriers that also impact workers and refugees. In order to 'manage' the movement of people across borders, various quantitative/numerical restrictions have been imposed at the state level. The travel ban that has been recently imposed by the Trump administration on foreign nationals from certain countries serves as an illustrative example. Security checks, racial and ethnic profiling by law enforcement agencies, or other discriminatory measures can restrict free movement indirectly by rendering it uncomfortable or unnecessarily long.

Labor and refugee flows may also be restricted by the 'threat factor', or public anxiety. Albeit needed, economic migrants are often seen as a threat to jobs and the welfare state. In both the US and Britain, for example, immigration of low-skilled workers has become an increasingly contentious political issue. In the US, the main concern is that migrants hold down the wages of native workers. In Britain, the debate is whether migrants put additional pressure on housing, schools, public health services and transport systems.[167] This constitutes a tangible resource-drain for native onlookers, and breeds political polarization that can be exploited by hybrid warfare-savvy actors to exacerbate negative externalities.[168] This dynamic will persist as long as the population of the host country perceives migrants as a threat to their living standards and livelihoods, and requires governments to carefully consider whether they preside over the resources necessary (whether monetary, infrastructural, systemic) to successfully integrate migrant populations in a positive way. In addition to public anxiety, flows of refugees can also be restricted by physical barriers. These barriers can be natural (mountains, swamps, deserts) or man-made, such as border fences in Hungary to keep migrants out, separation walls akin to the one planned for the US-Mexico border, or immigration detention centers which facilitate the deportation of foreign individuals back to their countries of origin.

166. David Baker, "The Effects of Terrorism on the Travel and Tourism Industry" 2, no. 1 (2014).

167. The Economist, "Needed but Not Wanted: Economic Migrants Are Seen as a Threat to Jobs and the Welfare State. The Reality Is More Complex."

168. The impact of such polarization is illustrated by the election of Donald Trump, the anti-talking points of UKIP's BREXIT 'Leave' campaign in Britain, and the rhetoric relied upon by right-wing politicians in (among others) Poland and Hungary.

The propagation of people flows also has an adverse effect on the environment. Just like all other sectors of the economy, the tourism industry exerts pressures on the environment due to (among others) the consumption of energy and water and the production of waste.[169] In the Netherlands, tourism accounts for 7% of net domestic energy consumption and 10% of total tap water consumption.[170] In addition, the sector accounts for a significant contribution to greenhouse gas emissions: between 2010-2015, emissions grew by approximately 11%, primarily due to tourism-related increases in demand for air-based travel.[171]

People flows can also pose threats in-and-of themselves. Brain drain constitutes an unintended consequence of labor flows. The people who move are often the brightest and best, so their country of origin may suffer a brain drain as a consequence. According to the IMF, between 1990 and 2012, almost 20 million people relocated from central, eastern and south-eastern Europe to richer countries in Western Europe. This east-to-west migration accelerated further after the 2004 EU enlargement. IMF researchers estimate that the aforementioned 'exodus' lowered cumulative population growth in labor-sending countries by eight percentage points.[172] The Dutch economy benefits from the 'brain gain', and this trend has been positive since 1995. According to Nuffic, as many as 25% of international students remain in the Netherlands after graduation, boosting the economy by €1.5bn annually.[173] The Netherlands suffers from brain drain to Canada, which remains the top destination chosen by the highly-skilled migrants emigrating from the Netherlands. In 2015, 81,192 highly-educated Dutch nationals resided in Canada.[174]

The free movement of people can also be abused by terrorist and criminal networks to further their political and economic gains. Although there is no evidence that migration leads to increased terrorist activity, overly-restrictive migration policies or ones that violate human rights may create conditions which are conducive to terrorism.[175] As density of people flows increases, so too does the volume of human trafficking, smuggling and forced labor. After illicit drugs and arms trafficking, human trafficking has grown to constitute the world's third most profitable form of organized crime with annual profits as high as $36bn per year.[176] Women constitute the majority (up to 60%) of all victims globally, and women and girls together make up 75% of all victims of human trafficking.[177] In addition, illicit trade in drugs, medicine and tobacco oftentimes occurs in parallel with illicit movement of people. According to Europol, the Netherlands constitutes a major European hub for

169. Netherlands, "Tourism Sector Continues to Grow."

170. Statistics Netherlands, "Environmental-Economic Impact of Tourism Sector Studied," webpagina, June 6, 2017, http://www.cbs.nl/en-gb/news/2017/22/environmental-economic-impact-of-tourism-sector-studied.

171. Netherlands, "Environmental-Economic Impact of Tourism Sector Studied."

172. The Economist, "Needed but Not Wanted: Economic Migrants Are Seen as a Threat to Jobs and the Welfare State. The Reality Is More Complex."

173. Laura van Gelder, "Record Number of International Students in the Netherlands," *Univers* (blog), March 30, 2017, https://universonline.nl/2017/03/30/record-number-international-students-netherlands.

174. Brucker, Capuano, and Marfouk, "IAB Brain-Drain Data | IAB."

175. OHCHR, "OHCHR | Refugees and Terrorism: 'No Evidence of Risk' – New Report by UN Expert on Counter-Terrorism," 2016, http://www.ohchr.org/EN/NewsEvents/Pages/DisplayNews.aspx?NewsID=20734.

176. United Nations News Service United Nations News Service, "UN News - Human Trafficking Has No Place in Modern World, General Assembly President Says," UN News Service Section, July 14, 2014, http://www.un.org/apps/news/story.asp?NewsID=48271#.WddBozCxVPZ.

177. United Nations News Service.

drug production (MDMA, Amphetamines), and trafficking (Cannabis, Opium).[178] The Netherlands also ranks among the top five EU countries in terms of absolute numbers of registered victims of human trafficking. In 2015, this number totaled 1,321.[179]

The overall mobility of people constitutes one of the underlying factors in the emergence and reemergence of diseases of international public health importance. These public health risks are most often related to transmissible pathogens, but can also be influenced by global processes such as trade, transportation, environment and climate change, and civil security.[180] Rapid or high-volume international movements can link zones of disease emergence to non-endemic or low-prevalence areas. Common examples of infectious diseases recorded in countries that receive migrant populations include tuberculosis and hepatitis B. Other infectious disease outbreaks seen in recent years include the severe acute respiratory syndrome (SARS, 2003), influenza A/H1N1 (2009 pandemic), avian influenza A(H7N9), Ebola and the Zika virus.[181] Apart from infectious diseases, sustained migration between disparate health environments can also result in chronic non-infectious diseases.

Stakeholders

A wide range of stakeholders are involved in the free movement of people. Governments are the key actors governing/managing migration flows and are also the key actors to fight irregular migration. Governments are in a position to implement measures such as quantitative/numerical restrictions on the inflows of people, as a means to manage the flow of people across borders. Another group of stakeholders is populated by the law enforcement agencies that implement decisions taken at the government level. Authorized visa agents and border and customs guards are involved in transboundary flows of people. The third group of stakeholders comprises of admissions officers and recruiters, who are on the demand side of labor flows, and who influence the flow of knowledge and skills across borders. The fourth group of stakeholders is populated by negative actors, such as terrorists and criminals, who abuse freedom of movement to further their political and/or economic agendas. Individuals who move from point A to point B are stakeholders in themselves, as carriers of skills and knowledge in a positive sense, and as carriers of pathogens and extremist ideologies in a negative sense.

Critical co-flows

The free movement of people is contingent on the flow security of goods, services, information, technology and capital. Increased connectivity simplified visa procedures and travel arrangements in many countries. Exchange rate fluctuations and drops in oil and other commodities' prices increase disposable income and makes travel more affordable. Flows of capital enable migrants to make use of banks and financial services to foster the development of their country of origin by means of remittances.

178. European Monitoring Centre for Drugs and Drug Addiction and Europol, "EU Drug Markets Report: In-Depth Analysis" (Luxembourg: EMCDDA-Europol Joint publications, 2016).

179. Ministerie van Veiligheid en Justitie, "'Aandacht voor mensenhandel neemt af,'" webpagina, September 30, 2016, https://www.nationaalrapporteur.nl/actueel/2016/aandacht-voor-mensenhandel-neemt-af.aspx.

180. Gushulak, Weekers, and MacPherson, "Migrants and Emerging Public Health Issues in a Globalized World," 1.

181. Lawrence Gostin and Ana Ayala, "Global Health Security in an Era of Explosive Pandemic Potential" (Georgetown University Law Center, 2017), http://scholarship.law.georgetown.edu/cgi/viewcontent.cgi?article=2967&context=facpub.

Table 5 Flows of people

Flows of People	
Definition	The movement of people across border.
Manifestations	Tourism, labor flows and non-labor related migration flows (asylum seekers, refugees and internally displaced persons)
Relevance for NL	Tourism generates revenue and boosts employment. Flows of skilled migrants addresses current (and future) labor shortages and strengthens the position of the Netherlands as a knowledge based economy.
Domain(s)	Air, Land, Sea
Characteristics	Asymmetric, temporary, both voluntary and forced, regular and irregular, slow-moving, subject to natural and man-made barriers.
Threats	**To**: Terrorism, health concerns, crime or natural disasters at tourist destination; quantitative restrictions and quotas imposed at the state level; public anxiety of the host population, physical barriers (both natural and man-made). **Associated with**: terrorism and criminal activity (human trafficking, smuggling, forced labor), emergence and reemergence of infectious diseases, environmental pressures, pressures on public spending and services, political polarization, brain drain.
Stakeholders	Governments, law enforcement agencies, NGOs, admissions officers and recruiters, terrorists and criminals, migrants themselves.
Critical co-flows	Free movement of goods and services, information and technology, and capital.

Environmental Flows

Flow Particles

Environmental flows are made up of particles whose movement is key to human life on earth. These include clean air, clean water, biologically diverse environments (ecosystem flows), arable farmland, and 'productive' global commons. A key take-away that can be applied to all the flows in the environmental category is that they are self-sustaining as long as an equilibrium exists between the system's particle uptake mechanisms and the particles themselves. Though many of these 'particles' do not 'flow' in the traditional sense of the word – a plot of arable land cannot move from point A to point B – they may indirectly wax, wane, relocate, or even cease to exist as the impact of negative environmental flows renders their current mode of existence untenable.

The importance of the flow

The relevance of positive environmental flows is difficult to overstate, as they are a key component of human life on earth. The negative impacts associated with malfunctions in this area are well documented, and range from minor nuisances such as a lengthening of the 'mosquito season' to major reductions in life expectancy, increased number of forest fires, and the collapse of entire ecosystems. The relevance of clean air flows stems largely from the fact that exposure to polluted air has a non-negligible negative impact on life expectancy and work productivity.[182] In 2005, the

182. World Bank, "Life Expectancy at Birth, Total (Years)."

effects of inner-city air pollution on human welfare − which range from reduced life expectancy to reduced working productivity and depression − were estimated to be in excess of $100bn (5.9% of the country's historic GDP level).[183] Later estimates place the global death toll associated with this type of pollution at as high as 12.6 million per year.[184] As over 54% of people live in cities (projected to increase to 60% by 2030)[185] − arguably the environment in which humans are most impacted by air pollution − studies such as these reinforce the notion that ensuring that the quality of world air flows is not further degraded by pollution constitutes an economic no-brainer. The impacts of water pollution more-or-less mirror the impacts of air pollution. Water pollution can take several forms (human excreta, toxins, bacteria), and is associated with several well-established negative externalities: it reduces life expectancy, increases the societal diseases burden, and complicates the process of growing crops by contaminating soil.[186] Though trends regarding progress in the area of the clean drinking water provision are positive at the macro level − more than 5.2 billion people (approximately 71% of the world population) had access to safely managed drinking water in 2015[187] − gains have not been equally distributed. Only about 50% of African countries succeed in providing their citizens with a reliable variant of the aforementioned service.[188] Global water supply is also impacted by other flows within the environmental category, with Carbon flows (and the global warming they exacerbate) having a particularly pronounced impact as measured through water stress statistics.[189] Carbon flows are increasingly propagated by human activities − including the combustion of carbon-based fuels and deforestation − and have been reliably linked to increasing world temperatures.[190] These respectively contribute to the buildup of CO_2 in the earth's atmosphere by producing it as a result of energy generation and removing carbon-absorption mechanisms (photosynthesizing bodies) from the carbon cycle. When disrupted in this manner, carbon flows contribute to raising global temperatures by trapping radiant heat from the sun within the earth's atmosphere.[191] As a result, 2016 − at 0.99 degrees Celsius warmer than the 20th-century mean − was the third consecutive year to set a new record for world temperatures,[192] with particularly high temperature increases being recorded in the world's polar regions.[193] Aside from having exacerbated global water stress, this trend has contributed to accelerating the process

183. See Kira Matus et al., "Health Damages from Air Pollution in China" (Cambridge, MA: Massachusetts Institute of Technology, 2011), 18.

184. World Health Organization, "WHO | An Estimated 12.6 Million Deaths Each Year Are Attributable to Unhealthy Environments," WHO, 2016, http://www.who.int/mediacentre/news/releases/2016/deaths-attributable-to-unhealthy-environments/en/.

185. United Nations, "The World's Cities in 2016 - Data Booklet" (Geneva: United Nations, 2016), ii.

186. World Health Organization, *Guidelines for Drinking-Water Quality: Recommendations* (Geneva: World Health Organization, 2004), xvi.

187. World Health Organization and Unicef, "Progress on Drinking Water, Sanitation and Hygiene: 2017 Update and SDG Baselines" (Switzerland: United Nations, 2017), 3.

188. World Health Organization and Unicef, "Progress on Drinking Water, Sanitation and Hygiene: 2017 Update and SDG Baselines."

189. See Francis Gassert et al., "Aqueduct Country and River Basin Rankings" (Washington, D.C.: World Resource Institute, 2013), 5.

190. See for example Martin Leduc, H. Damon Mattews, and Ramón de Elía, "Regional Estimates of the Transient Climate Response to Cumulative CO2 Emissions," *Nature Climate Change*, 2016, 3.

191. See S. Solomon et al., "Climate Change 2007: The Physical Science Basis," Working Paper, Fourth Assessment Report of the Intergovernmental Panel on Climate Change (Cambridge University Press, 2007).

192. Karen Northon, "NASA, NOAA Data Show 2016 Warmest Year on Record Globally," Text, NASA, January 18, 2017, http://www.nasa.gov/press-release/nasa-noaa-data-show-2016-warmest-year-on-record-globally.

193. Temperature increases in the Arctic register as up-to 4 degrees higher than the world average in 2004. See Arctic Climate Assessment, *Arctic Cimate Assessment* (Cambridge University Press, 2004).

of desertification, which has rendered previously arable land barren, has transformed drinking water into a scarce commodity, and has given rise to the climate refugee and fanned the flames of sectarian conflict.[194] It has also (in general) been linked to an increase in natural disasters, the damages of which are estimated to amount to over $520bn annually.[195] The relevance of ecosystem flows derives largely from the fact that human societies remain dependent on the healthy functioning of natural ecosystems to generate income and to secure sustenance. Human activities – long-line fishing, deep ocean mining, and deforestation included – may be largely propagated by the increased demand generated by 21st century population growth, but – given current rates of vertebrate population losses – are effectively amounting to the cause of a sixth extinction event.[196] As lifeforms within ecosystems are – by definition – dependent on one-another's presence to ensure that a flow of life is maintained, such events have potentially far-reaching (and likely not-yet manifested) impacts on the viability of ecosystems as a whole,[197] and are likely to exacerbate global food scarcity in the future.[198]

As environmental flows (and the malfunctioning thereof) almost universally give rise to negative trends, the Netherlands has a vested interest in maintaining the integrity of all the flows outlined in the previous paragraph. That said, two environmental sub-flows – namely those relating to carbon and ecosystems – are of particular relevance because (as they are disrupted) they directly impact the country by raising the sea level and by reducing economic opportunities respectively. Because about one third of the Netherlands' land mass is situated below sea level,[199] global warming's heating of the arctic is of particular concern to the Netherlands. This is because such heating has caused ice formations (including glaciers and floating sea ice) to melt in such volume that the resulting water deposits have raised ocean levels by an annual average of 3.4mm between 1992 and 2010.[200] This development – in requiring aggressive investment into the construction of dikes,[201] safeguarding against diseases such as dengue fever, and extensive revisions of infrastructure and housing isolation – will likely require over $140bn in investments by 2050.[202] Natural disasters brought on by climate change (see hurricane Irma) have (very recently) also ravaged the Dutch

194. See Michael Klare, "Time Is Running Out to Avert Climate Wars," *War Is Boring* (blog), 2015, https://warisboring.com/time-to-avert-climate-wars-is-running-out/.

195. World Bank, "Natural Disasters Force 26 Million People into Poverty and Cost $520bn in Losses Every Year, New World Bank Analysis Finds," Text/HTML, World Bank, 2016, http://www.worldbank.org/en/news/press-release/2016/11/14/natural-disasters-force-26-million-people-into-poverty-and-cost-520bn-in-losses-every-year-new-world-bank-analysis-finds.

196. See Gerardo Ceballos, Paul R. Ehrlich, and Rodolfo Dirzo, "Biological Annihilation via the Ongoing Sixth Mass Extinction Signaled by Vertebrate Population Losses and Declines," *PNAS* 114, no. 30 (2017).; see also Gerardo Ceballos et al., "Accelerated Modern Human–induced Species Losses: Entering the Sixth Mass Extinction," *Science Advances* 1, no. 5 (2015): 2015.

197. Navjot S. Sodhi and Barry W. Brook, "Causes and Consequences of Species Extinctions," *The Princeton Guide to Ecology* 1 (2009): 19.

198. See for example: Ian Johnston, "Overfishing Driving Dozens of Species into Extinction Threatening African Food Crisis, Warn Experts," The Independent, 2017, http://www.independent.co.uk/environment/overfishing-species-extinction-african-food-crisis-threat-iucn-warning-niger-angola-mauritania-a7534901.html.

199. The lowest point in the Netherlands is 22 feet (6.7 meters) below sea level. See Jan M, "Is the Netherlands below Sea Level?," *Netherlands Tourism* (blog), December 1, 2013, http://www.netherlands-tourism.com/netherlands-sea-level/.

200. R. S. Nerem et al., "Estimating Mean Sea Level Change from the TOPEX and Jason Altimeter Missions," *Marine Geodesy* 33, no. 1 (2010): 446.

201. Costs associated with maintaining systems relating to water management were in excess of $7bn in 2010, and are expected to rise to between $8 and 9bn by 2020. See Rijksoverheid, "Bestuurts Askkoord Water" (Rijksoverheid, 2011), 5.

202. See Ministry of Infrastructure and the Environment, "Climate Agenda: Resilient, Prosperous and Green" (The Hague: Ministry of Infrastructure and the Environment, 2014), 14.

constituent country Sint Maarten, incurring over $2.5bn in damages in the process.[203] The relevance of ecosystem flows derives from the Netherlands' burgeoning fishing industry. In 2012, this brought in approximately $775mn, and provided direct employment to over 6000 people.[204] These numbers are relatively minute when compared to the Dutch GDP and/or the size of the Dutch working population, but are nonetheless worth considering. This is because the fishing industry interacts with an environment (namely ocean) which is particularly vulnerable to the negative externalities brought on by human activity, and thus provides an illustrative example for trends in ecosystem flows as a whole. With regards to clean air-and-water flows, the Netherlands – which is increasingly transitioning towards a knowledge economy - produces relatively little in the way of industrial waste, and has (partially due to limited environmental regulation and advanced water purification infrastructure) been able to maintain relatively good performance vis-a-vis metrics in this area. This is not to say that these flows carry no relevance: developments over the world may yet exacerbate them to a degree that they begin to constitute a pressing matter for The Hague. At current, however, they are relatively less pressing than their carbon-and-ecosystem counterparts.

Flow domains and critical hubs

Domains

Domains within the environmental category are relatively complex when compared to the other flow categories included in this report. Starting with the most complex flow within this category (namely carbon flows), these − in moving through the carbon cycle − travel through land, air, and ocean domains. As the building block of life, carbon can be either captured in organic matter − in which case it binds with other atoms to form complex molecules, and is largely land-or-ocean-based − or can be accumulated (typically in gaseous CO_2 form) in the earth's oceans (ocean domain) by photosynthesizing algae or in the upper atmosphere (air domain) as a result of emissions.[205] Moving on the flow of clean water, this (once again) depends on a combination of land, air, and ocean-based mechanisms,[206] with pollution thereof deriving largely from land-based human activities (i.e. industrial processes). While clean air flows follow a model which is similar to clean water flows (pollution is land-based but the elements which pollute it may be derived from − and released by − various domain categories), ecosystem flows present (once again) as a relatively complex case. This is because ecosystem flows across domains are dependent on one another. Just as the depletion of herring stocks has a negative impact on ecosystem flows in its native (ocean) domain by damaging (among others) Bluefin Tuna stocks, it also impacts on the survival rate of the sea birds which hunt herring and thus (indirectly) of the land-based predators which feed on them.

With regards to critical hubs within the environmental flow category, these are loosely conceptualized as those ecosystems and environments which play a key role in propagating some form of (in)balance within the included flow categories. Here, we distinguish between positive

203. Jean Mentens, "2.5 Billion Dollars Estimated for St. Maarten Recovery," Caribisch Netwerk, 2017, http://caribbeannetwork.ntr.nl/2017/09/13/2-5-billion-dollars-estimated-for-st-maarten-recovery/.

204. European Commission, "The Netherlands - Overview" (European Maratime and Fisheries Fund, 2014).

205. For an overview of the mechanisms which capture CO_2 capture, see Holli Riebeek, "The Ocean's Carbon Balance : Feature Articles," Text.Article, July 1, 2008, https://earthobservatory.nasa.gov/Features/OceanCarbon/.

206. USGS, "The Water Cycle Summary, USGS Water Science School."

and negative hubs, which respectively contribute *to* and take away *from* a flow system's ability to regulate particle circulation. Starting with carbon flows, the world's forests - and the Amazon rainforest in particular - constitute relevant positive hubs, and are commonly referred to as the 'lungs of the earth' due to their capacity to remove CO_2 from the air.[207] Negative hubs in this category are defined as polluting countries. As of 2015, the top three offenders in this area are China (29.51%), the United States (14.34%), and the European Union (9.62%).[208] With regards to flows of clean water, the provision of this resource is partially dependent on national infrastructure. It is additionally dependent (under natural circumstances) on the continuous replenishment of freshwater mountain glaciers, which (in slowly melting during summer months) ensures that rivers don't dry out. Negative hubs in the category are almost impossible to discern, partially because the world's nations almost universally participate in questionable behavior (including the dumping of plastic, sewage, and industrial waste) into naturally occurring bodies of water. Finally, hubs within ecosystem flows are − as is also the case with clean water − difficult to discern. Animal species are (almost by definition) widely dispersed, and the flow of the ecological particles which connect them is rarely dependent on *one* hub as much as it is on a multitude of interlocking (and co-dependent) small ones. In much the same way, negative hubs are difficult to discern because these differ by the ecosystem, domain, industry, and even species in question.

Characteristics

Several characteristics set apart environmental flows from the other flow categories discussed in this paper. These include these flows' mode of propagation, their international (non-localized) nature, and their dependence on flow particle balance. With regards to these flows' mode of propagation, environmental flows differ from their goods and services, capital, people, and information-based counterparts in that the processes which facilitate their movement are passive rather than active. The 'cycles' which transport environmental flows through flow environments exist outside of human interference, and − far from being bolstered by them − are often negatively impacted by human activities. This ties in with environmental flows' dependence on flow particle balance. Because environmental flows are unique in their dependence on a cyclical (multidimensional) process continuation in which the maintenance of an equilibrium between flow particles and particle absorption mechanisms is key, they exhibit a high degree of in-flow co-dependence. This renders environmental flow networks as a whole vulnerable to human interference, and combines with their international nature to make them extremely fragile. Environmental flows are additionally characterized by their finite nature (or, in the event of animal stocks, limited to a species-specific rate of production and maturation rate) and by in-flow non-fungibility. The latter characteristic is particularly true of ecosystem flows, which − due to individual species' development of niche roles within their ecosystems (see for example bees and flower pollination) − means that few (and most often: *no*) other native species can replace their contribution to the overall system.

207. Brienen et al., "Long-Term Decline of the Amazon Carbon Sink," *Nature* 519 (2015): 344–48.

208. See J. G. J. Olivier et al., "Trends in Global CO2 Emissions: 2016 Report" (The Hague: European Commission, Joint Research Centre (JRC), Directorate C - Energy, Transport and Climate; PBL Netherlands Environmental Assessment Agency, 2016).

Threats

Threats to the continued functioning of environmental flows can almost universally be tied to human activities, which have a tendency of disrupting the equilibrium – whether by overloading the system or by depleting its resources – necessary to ensure their continued movement. Because references to specifically threatening activities – including deforestation and the combustion of carbon-based fuels for carbon flows, the dumping of waste and the effect of rising of global temperatures on water flows, the effect of industrial and transport-based emissions on air flows, and (in combination with all these) the effects of unsustainable hunting practices on ecosystem flows – have been referred to throughout the environmental flows category, this threats section will outline trends in human society which problematize initiatives to halt them. Here, issues such as a lack of ability (or interest) to collectively accept short-term losses in exchange for long-term gains, free riding and/or noncompliance with international agreements, and general ignorance (or, in many cases, downright lack of willingness to accept) vis-a-vis the impact that human activities have on environmental flows are of particular relevance. Starting with the phenomenon of lack of ability (or willingness) to accept short-term losses, misbehavior in this area presents at both the state and individual levels. At the state level, such behavior derives (at least partially) from a combination of lack of willingness to harm economic prospects (both actual and - in the event of free riding - relative to other states), the investment necessary to enact best practices, and the lobbying efforts of well-represented interest groups. At the individual level, relevant input factors include lack of information, unwillingness to enact lifestyle changes (major as well as minor), and – in the event that lack of information *isn't* a limiting factor – insufficient capacity vis-a-vis ability to organize the collective action which has the potential of leading to policy change. Moving on to problems associated with free riding and noncompliance, these relate to the fact that the public goods produced by one actor's adoption of best practices manifest internationally (even in communities which do not contribute to delivering them). This incentivizes third parties to circumvent their responsibilities, and thus harms the ability of the system-at-large to move forward. Much as is the case with lack of willingness to accept concessions, the problems of free riding and/or noncompliance recur within both the state and individual levels. The problem's manifestation at the state level relates to 'cheating' on international agreements while its manifestation at the individual level relates to the fact that public goods are taken for granted in daily lives, and are (as a result) difficult causes to organize collective action around.

Moving on to the threats associated with the continued flow of environmental particles, a cause for concern in this area stems mainly from the negative externalities associated with these flows' inability to maintain equilibrium rather than their continued movement. Within the carbon, water and air, and ecosystem flow categories, the failure of equilibrium within these flows respectively raise world temperatures, reduce life expectancy, work productivity, and the output capacity of farmlands, and contribute to extinction events. These (in turn) are linked to a wide range of phenomena whose negative impact is more tangible. Both scenarios are associated with negative externalities. Specifically, CO_2 absorbed in the ocean causes surface stratification, and kills off the phytoplankton which contributes to the ocean's ability to play a role in the carbon cycle in the first place. This reduced the ocean's uptake capacity, and increases CO_2 concentration in the atmosphere domain, which accelerates global warming. Captured carbon is (as previously outlined) released mainly by human activities, and can even exacerbate its own rate of release. An example of this

presents in the world's tundra, which is releasing copious amounts of methane (another greenhouse gas) as increased global temperatures cause permafrost – which previously acted as a carbon-capturing mechanism – to melt.[209] Global warming doesn't only cause large-scale economic harm by causing ocean levels to rise, it also (among others) amplifies the destructive force of storms such as hurricane Irma by increasing ocean temperatures,[210] propagates the large-scale desertification which is currently taking place in Africa (thus indirectly fueling civil war and creating climate refugees),[211] and increases the occurrence of forest fires.[212] This ties in with threats associated with malfunctioning air and water flows, which – as previously outlined – are exacerbated by climate change, and are key in ensuring that farmland remains arable and in preventing economic loss associated with increased disease burden and reduced life expectancy. With regards to ecosystem flows, human activities often have systemic effects whose impacts manifest far beyond the dimensional scope with which they are immediately associated. These activities may present in the form of unsustainable hunting practices, but also in the form of the introduction of non-naturally-occurring elements. These respectively contribute to extinction events by breaking ecosystem equilibrium and by impacting balance within ecosystems in unforeseen ways. As an example, the BP oil spill was found to have disrupted Bluefin Tuna spawning areas and to have caused several life-threatening birth deficiencies.[213] These events don't only damage biodiversity, they also reduce ecosystems' capability to produce economic gains in the long term, and thus contribute to marginalizing human communities which depend on them.

Stakeholders

Within the environmental flow category, relevant stakeholders can be roughly divided into categories which capture civilians, regulators, polluters, and pioneers. The civilian category is arguably the most impacted by negative environmental externalities, and can be further divided into engaged and unengaged sub-factions. Collective action vis-a-vis environmental issues is partially problematized by this group's large size (organizing coherent movements grows more difficult as the number of participants increases) and partially by the fact that a large majority of individuals within this collective are largely unaware of the problems these phenomena entail for them. This is likely to change in the near future (particularly in the area of climate change), as the negative externalities associated with these flows' malfunctioning are set to begin manifesting themselves in more tangible (read: invasive) ways. The 'regulators' category is mainly populated by governments and IGOs, and typically presides over the tools (whether economic or otherwise) of conceptualizing, enacting, and enforcing regulations which incentivize and/or force the adoption of best practices at both the corporate and societal levels. This group's ability to contribute to

209. Henry Fountain, "Alaska's Permafrost Is Thawing," *The New York Times*, August 23, 2017, sec. Climate, https://www.nytimes.com/interactive/2017/08/23/climate/alaska-permafrost-thawing.html.

210. Wayne Drash, "Yes, Climate Change Made Harvey and Irma Worse," CNN, 2017, http://www.cnn.com/2017/09/15/us/climate-change-hurricanes-harvey-and-irma/index.html.

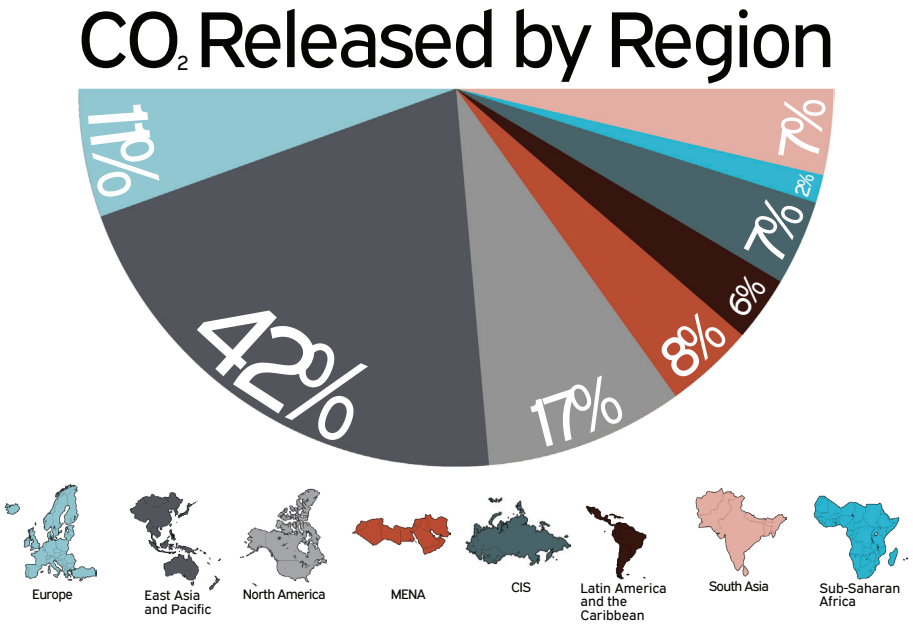
211. 1 degree of global warming reduces (due to the desertification of arable farmland) the growth rate of exports from developing countries by between 2 and 5.7%. See Pete Smith et al., "Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems (SR2)," International Panel on Climate Change (United Nations, 2017), 9.

212. See M.D. Flannigan, B.J. Stocks, and B.M. Wotton, "Climate Change and Forest Fires," *Science of The Total Environment* 262, no. 3 (2000): 221–29.

213. Stanford University, "Deepwater Horizon Oil Spill Impacted Bluefin Tuna Spawning Habitat in Gulf of Mexico, Stanford and NOAA Researchers Find," Stanford News, September 30, 2016, http://news.stanford.edu/2016/09/30/deepwater-horizon-oil-spill-impacted-bluefin-tuna-spawning-habitat-gulf-mexico/.

the delivery of public goods within the environmental category is often hamstrung by the actions of polluters. These exist at the state level as well as at the corporate level, and routinely engage in efforts – whether in the form of disinformation campaigns, well-funded lobbying efforts, or noncompliance – which maintain a status quo in which environmental flows continue to be short circuited. At the state level, notable actors include LDCs which (partially due to the capital investments required to construct renewables) remain highly dependent on carbon-based fuels for economic growth and latecomers to the industrialization process (for example: China – see the East Asia and Pacific region's CO_2 release in Figure 10) which rely on carbon to fuel their economies. The corporate level is populated by companies such as Royal Dutch Shell and Koch Industries. Finally, several 'pioneer' actors - including corporations such as Elon Musk's Tesla - have cropped up in recent years. These have had limited (but measurable) success, and typically engage in initiatives which aim to market various types of environmentally friendly technologies to the civilian sector. This helps to alleviate the stigma associated with discussions surrounding environmental issues by inserting objects which encapsulate the benefits of environmentally-conscious living practices directly into people's lives, and thus contributes to checking the influence of major polluters.

Figure 10 Regional carbon release (thousands of metric tons) 2014[214]



Critical co-flows

Due to their intimate interaction with almost all (minus cyber) flow domains, environmental flows are impacted by flows of goods and services, capital flows, and flows of people. Capital flows have an impact because individual-level pursuit of their continued movement incentivizes behavior which harms equilibrium within environmental flows. This dynamic is similar to the one present in flows of goods and services, whose flow particles which are commodified versions of particles within carbon (oil, LNG, etc.) and ecosystem (trade in rhino horns, animal meat, etc.) flows. People flows

214. Data adapted from Olivier et al., "Trends in Global CO2 Emissions: 2016 Report."

are of lesser relevance, but - in requiring transportation and the erection of infrastructure - are associated with considerable volumes of waste and emissions, and are thus typically propagated at the expense of environmental flows at large.

Table 6 Environmental flows

Environmental Flows	
Definition	The movement of particles which are key to sustaining human life on earth.
Manifestations	Movement of carbon within carbon cycle; water cycle; movement of (clean) air and airborne pollutants; ecosystem lifecycles.
Relevance for NL	Global warming requires significant investment into dikes, disease prevention, and infrastructure; overfishing threatens the livelihood of Dutch fishermen; tropical storms impact Dutch constituent countries, and require financial relief.
Domain(s)	Air, land, sea.
Characteristics	Finite, non-fungible, internationally dispersed and internationally impactful, can be disrupted at the local level, take on form of global public goods, high degree of in-flow co-dependence.
Threats	To: human activities, including long-line fishing, energy extraction & consumption, industrial waste-dumping. Systemic (societal) unwillingness to adopt best practices also relevant. From: global warming (rising sea levels, amplification of storm severity), reduction of life expectancy, increase of disease burden, desertification, recession of arable land, creation of climate refugees, propagation of extinction events.
Stakeholders	Civilians, government regulators, polluters (state, nonstate), 'pioneer' actors.
Critical co-flows	Goods and services, capital, flows of people.

CHAPTER 4: IMPLICATIONS FOR DUTCH SECURITY AND DEFENSE POLICIES

Flow security recently was elevated by the Defense Document of early 2017 as one of three 'strategic challenges' by the Dutch Ministry of Defense. Flow security now stands on par with the two more familiar challenges of 'staying secure' (in reference to the territorial defense of Dutch and NATO territory) and of 'bringing security' (in reference to peace support and crisis management operations geared towards promoting global stability and maintaining the international order). While these more familiar challenges undoubtedly remain important, their relevance is – in the age of interconnectedness – complemented by the need to ensure the integrity of global flows that are critical to Dutch national security and prosperity. These flows are under siege by actors which have concluded that modern societies are vulnerable to disruptions of the flows which sustain them and, accordingly, have adopted hybrid strategies. The Russian Federation's Gerasimov Doctrine, geared as it is towards 'cross-domain coercion', is a clear case in point. It involves Russia deploying a variety of direct and indirect national instruments of influence towards disrupting flows that run through nodes which are geographically far-removed from it. More generally, from high-seas piracy to cyber-crime, the fragmentation of the internet, and the increased sophistication of national cross domain coercive means, the integrity of global flows is under pressure. The Netherlands and its allies are – at the time of writing – neither sufficiently equipped nor sufficiently prepared to meet all of these challenges head-on.

This study set out to answer four questions relating to the adoption of flow security as a separate strategic challenge by the Dutch Ministry of Defense. First, what does the term flow security refer to? Second, why is flow security important? Third, what makes flow security distinct from the other two strategic challenges both in terms of risks and threats and in terms of the security and defense responses these require? And finally, what implications – future as well as current – does it hold for Dutch defense and security policies and the roles, tasks and capabilities of the Dutch Defense Organization?

In the previous chapters, we have addressed the first two questions. To briefly recapitulate, we established that flow security deals with securing the integrity of flows of goods and services, information, ideas, and technology, capital, people and the environment through both the physical and digital domains. It is a topical subject for the Netherlands because Dutch prosperity depends heavily on the continuity of these flows, not only those in and out of the country, but also globally, given the interconnectedness of flow systems. Because of this, the protection of commodities, movement of capital, critical environmental resources, and the cyber domain at large should therefore feature as an important component of Dutch security and defense policies. This chapter addresses the third and fourth questions, and concludes that the Netherlands should adopt neither a fully open nor a fully closed model, but one that balances between the two by encapsulating elements from both.

What Makes Flow Security Different?

The analysis of the critical flows offered in the preceding chapters highlighted first and foremost the complex nature of modern flow networks which traverse multiple domains, run along extended multiple-input supply chains, and interact with a multitude of actors before delivering their flow particles. Multiple critical hubs are situated along these chains, often in-between points of origin and destination for the various flows. Some (such as harbors and airports) are co-located, and serve multiple flows simultaneously. Major hubs include ports and airports, narrow sea passes, critical energy infrastructure nodes, internet traffic exchanges, internet service providers, financial clearing houses, and major satellite systems which are used for navigation, communication and earth observation. The five critical flows – goods, capital, information, technology and ideas, people, and the environment – feature a high degree of co-dependence, not only because they interact with one-another (e.g., capital for goods), but also because they traverse (and affect) multiple connected domains. This makes them vulnerable to ripple effects in which disruptions in one domain also affect another. The flow domains typically comprise a patchwork of multiple jurisdictions in which a variety of public and private stakeholders – each with different responsibilities and competences – are involved. Political and functional geographies thus intersect but do not always align. When combined, these characteristics frame flow security as a distinctive challenge, that requires the following responses:

Flow security is about safeguarding the overall integrity of flow systems. Flow security is about securing systems rather than individual parts. The impacts of localized flow disruptions can be mitigated by ensuring that the disruption of a single node does not stall the entire flow system's continued functionality. The delay of a limited number of airplanes is an everyday occurrence. A ground stop of a particular airport is more than a mere nuisance, but still not a real problem from a security perspective. Only when airspaces or regions are shut down completely are entire industries suddenly at risk. Similarly, whereas the hijacking of one vessel constitutes an incident, it becomes a major problem when dozens of ships are hijacked or delayed. When maritime choke points cannot be safely navigated, it risks putting a serious strain on global trade. Isolated banking card fraud harms individuals and puts a small dent in the results of financial service companies, but is manageable. Large-scale banking Trojans, however, or even the *perception* that on-line banking cannot be trusted, can threaten the financial service industry at large, and can bring national economies to a standstill. Moreover, the various flow systems are inextricably intertwined. A case in point is an internet order (information flow) for which payment is provided through PayPal (financial/information flow) and which is delivered by DHL (physical flow). Flow security is about securing the integrity of this multi-flow system in its entirety (what is called a 'system of systems). That must be done in such a way that negative flows are stopped while positive flows are stimulated, even if both types typically flow through similar channels and domains. This means that the ability of differentiating between positive and negative flows (and the ability to isolate one from the effects of sabotaging another) is of increasing importance.

The importance of the integrity of the flow system in its entirety implies that **flow security must address the various elements of the flow systems**. These include the nodes and the perimeters, channels and domains, and the flow particles themselves. Securing the nodes and perimeters is nothing new. Perimeter protection through border defense is, after all, part and parcel of

traditional statecraft and is an area in which security clearly meets and overlaps with the other two strategic challenges ('staying secure' and 'bringing security'). The use of mine sweeping capabilities to keep SLOCs open, or of cyber defense capabilities to protect critical internet exchange servers are as much part of 'staying secure' at home or of 'bringing security' abroad as they are of 'flow security'. What is largely unique to flow security – and therefore sets it apart as a distinct challenge – is the fact that it involves **securing the flow particles themselves** by developing a **systems approach** to **geostrategic planning**. In the case of information, this involves, in practical terms, the use of sophisticated encryption algorithms and ensuring the integrity of digital communication channels. It may also extend to controlling incoming and outgoing traffic through the erection of firewalls. Similar tenets can be applied within the realm of flows of goods and services. Increased use of RFID chips can contribute to securing permanent access control of (sealed) sea containers. The development of more sophisticated screening processes (by customs officers at the originating as well as the destination harbor) can contribute to preempting attacks on critical infrastructure. The combination of increased use of Vessel Protection Detachments and area surveillance systems (particularly in piracy-prone waters) can contribute to in-transit security, and the protection of off-shore oil and gas production platforms and pipelines against (for example) terrorist threats can contribute to securing critical flows during their production phases. It is expected that distributed ledger technology (of which block chain is currently the best-known incarnation) will play a major role in securing the flow of all sorts of physical and virtual assets as they travel from their points of origin to their final destinations.[215] Any (defense) organization that takes flow security seriously should therefore be fully aware of the rapid developments in distributed ledger technology, and, where appropriate, invest in particular capabilities and applications in this technology domain as well.

The emphasis on the integrity of the flow system in its entirety calls for the implementation of **security measures at the level of the overall architecture of the flow system**. As a recent Finnish study concluded: "[…] the security-of-supply perspective should be integrated 'by design' in every policy field, and not only in the work of different security sector actors."[216] A flow system security approach draws on security principles that have been developed – and continue to be developed – in cyber security and information architecture protection.[217] It first relies on network analysis to assess critical vulnerabilities, including co-dependencies and the weakest links within the system. It then builds on these insights to design a flow system security approach based on a set of general principles which include diversity and redundancy, robustness and resilience, layered segmentation, critical node protection, and adaptive response. Building *diversity* as an integral part into the design of a flow security system reduces the system's vulnerability to disruption from threats, dangers and natural hazards. Diversity can be achieved by (for example) sourcing one resource from several points of origin, as is currently the case with Dutch energy imports. *Redundancy* is somewhat similar to diversity, as it furthers the security of flow systems by ensuring that there is no single point of

215. Distributed ledger technology is expected to improve the transparency of supply chains of a wide variety of products and services, ranging from diamonds to financial transactions, from Amazon and Alibaba deliveries to information transfers, and from contracts to nuclear export controls. For more information, see Aaron Arnold, "Nuclear Nonproliferation and Blockchain," Bulletin of the Atomic Scientists, October 19, 2017, https://thebulletin.org/blockchain-new-aid-nuclear-export-controls11204.

216. Mika Aaltola et al., "Towards the Geopolitics of Flows: Implications for Finland" (The Finnish Institute of International Affairs, 2014).

217. See for instance chapter 4 of Robert H. Anderson et al., "Securing the U.S. Defense Information Infrastructure" (Washington, D.C.: RAND Corporation, 1999), as well as the recent recommendations for public cyber policies that essentially rely on similar principles in Daniel M. Gerstein, "Strategies for Defending U.S. Government Networks in Cyberspace" (Washington, D.C.: RAND Corporation, 2015).

failure that renders the system vulnerable to disruption. Concrete examples include the stockpiling of *redundant* (beyond expected requirements) energy resources, the operational maintenance of unused, alternative-energy-based power plants, and the use of multiple harbors in the import of critical resources. *Robustness and resilience* refers to the ability to withstand attacks on the one hand, and the ability to veer back and quickly begin functioning on the other. *Critical node protection* refers to the prioritization of the protection of critical nodes in the overall system, based on constant vulnerability analysis. *Layered segmentation* entails making the functioning of vital system components independent from one another, so that the entire system cannot be brought down if one of the components fails. Finally, because flow systems are continuously changing, a systems approach to flow security requires *adaptive responses* that dynamically adjust to changes in the systems and the risk that these systems face. The precise application of these general principles will vary from flow system to flow system.

Finally, an effective flow security approach needs to address the 'responsibility gap' associated with the governance of modern flow systems. This responsibility gap manifests itself in two different ways. First, many **flow domains are in the most part located within global commons**. Traditional commons (notably the high seas) host the sea lines of communication that facilitate over 90% of global trade as well as the communication cables and energy pipelines that traverse international waters. The upper atmosphere and space act as mediums for both global air traffic and for the satellite networks that provide important communication, navigation and earth observation services within the public as well as the private sectors. The internet (essentially a network of networks) relies on infrastructure which is owned by a diverse array of internationally dispersed public and private actors. The internet is important to the continued existence of the 'infosphere' (the sum total of shared ideas, concepts, memes and information of all sorts) that substantiates and defines human culture – including the freedom to utilize that sphere. These global commons are at best weakly governed through international organizations and agreements, and at worst bereft of governance altogether. Security of these global commons is typically provided, if at all, by individual states (e.g. the US on the basis of its military primacy) or by coalitions (for instance in anti-piracy missions), with or without the tacit or explicit consent of the international community. The second responsibility gap derives from the fact that most **flow systems have a multitude of stakeholders, but no clear 'owners'** which can credibly assume responsibility for ensuring the integrity and security of systems as a whole. The design of flow system security at the architectural level requires the alignment of many different stakeholders, and is generally complicated by the absence of a single trusted party or a small set of cooperating parties which can pioneer norms and standards.

This implies that **securing flow systems requires active engagement with a wide and diverse range of national and international actors and of arrangements.** The required **security ecosystem** is typically wider and more diverse than it is in other strategic challenges, and is subject to more ad-hoc arrangements between unfamiliar stakeholders. Cooperation between state and non-state actors is of particular importance. Examples of non-state actors with a stake in flow security include shipping companies and private security companies that provide Vessel Protection Detachments; private companies that own and operate critical ICT infrastructure; public and commercial organizations that supply the physical backbone of the Internet (and much of the content as well); white hat hackers that assist both governments and businesses in protecting cyber flows; and financial institutions which monitor and prevent capital flows that contribute to the illegal arms trade.

The Implications of Flow Security for Dutch Security and Defense Policies

The adoption of flow security as a distinct strategic challenge has a range of implications for the roles, tasks and capabilities of not just the Dutch Defense Organization, but of the Dutch government as a whole. Chief among these is the conclusion that security in the context of the intricate cross-domain character of flow systems requires the operationalization of a whole of government approach. Debates within NATO, EU and in many European capitals on how to respond to hybrid threats highlight the fact that many Western countries are struggling to devise effective integrated approaches to multi-domain security challenges. The lack of adequate analytical monitoring capacity on the one hand, and the absence of an authoritative agency that can cut through siloed responses on the other hand, hamstring efforts to orchestrate effective responses across various state power instruments in the diplomatic, informational, military, economic and legislative spheres. This problem is present within both the international and national contexts, and often bridges the two.

In the recent report to the Dutch government on defense policy of the Scientific Council for Government Policy, five out of twelve final recommendations display a clear connection to a whole of government approach to countering hybrid threats.[218] A key recommendation is the establishment of a National Security Council (NSC) chaired by the prime minister, who is the designated official to coordinate the coherence between policies and to ensure their implementation. In the Dutch governmental structure and culture – in which a prime minister is the *primus inter pares* rather – a NSC would likely take the shape of a networked NSC-like *function*. This function would simultaneously build on and strengthen existing interdepartmental consultation and coordination instead of establishing another organizational *structure*. In practical terms, one potential option would be to merge the two cabinet subcommittees *Ministeriële Commissie Veiligheid* (Ministerial Commission Security) and *Raad voor de Inlichtingen- en Veiligheidsdiensten* (Council for the Intelligence and Security Services). The mandate for the new body would empower it to act on a comprehensive range of both 'hard' and 'soft' security issues. Analytical support can be provided by an existing network of agencies and knowledge institutes that reside both in- and outside of government.

At various other levels, many of the tenets of Dutch foreign and security policy remain valid when applied within the context of flow security. The promotion of an international liberal legal order can be conducive to flow security and can be complemented, rather than substituted, where appropriate. The more recent accentuation of the security of supply of critical materials including energy ties in closely with the principles of diversity and redundancy: broadening the portfolio of sources and transport modalities renders the provision of services resilient to shocks which disrupt the flow of critical supplies. In some cases, strategic stockpiling might be required as an antidote to hiccups in 'just-in-time'-supply chains. In the broader framework of the economic interest of the Netherlands, a policy of reducing monolithic dependencies within the public sector is also in order. Such an initiative is ideally suited to be pursued through the Dutch Ministry of Foreign Affairs, and would ideally be geared towards incentivising corporations to participate in a wide range of global innovation and production networks. To streamline this process, Dutch government

218. See Wetenschappelijke Raad voor het Regeringsbeleid, "Veiligheid in Een Wereld van Verbindingen: Een Strategische Visie Op Het Defensiebeleid."

agencies – including but not limited to the MIVD, AIVD, and NCTV – should strive to establish feedback loops through which concerns relating to companies' dependence on non-diversified import venues can be aired, particularly with those which are classified as being vital to Dutch critical infrastructure. Similarly, intelligence and information sharing with partners to deal with the risks posed by transnational terrorism, illicit flows, is also part of a flow security agenda. Finally, addressing migration flows from other regions calls for a combination of containment, building local alternatives and controlling the remaining flows, which is also part of existing policy.

The Implications of Flow Security for the Dutch Defense Organization

Flow security also brings with it an assortment of implications for the Dutch Defense Organization. The most fundamental of these implications relates to its role in the provision of security. Around the mid-twentieth century, ministries of War were renamed ministries of Defense across the West. This development was emblematic of more widely changing perspectives on war as a legitimate instrument in interstate relations. More than a mere cosmetic change, however, this rebranding also resulted from the merger under this 'joined' entity of different armed services. The merger came in response to the changing character of contemporary conflict which required both greater inter-service collaboration and better political-military coordination. Some seven decades later, the current geostrategic environment has changed again: flow security as well as other complex, hybrid security challenges, bring with them new demands that require ministries of defense to evolve and adapt further.

With 'national' and 'international', 'soft' and 'hard' security challenges overlapping and sometimes fusing, a host of actors become stakeholder in these challenges. This inevitably means that responses to these challenges require the contributions of many of these parties – state actors, international organizations, NGOs, corporations and societal groups.[219] Increasingly, the notion of a security ecosystem is used to describe the interaction of all these actors that need to balance their particular interests with the common interest of the validity and stability of the (flow) system as a whole. At the level of flow systems, overall security responsibility emerges – often more implicitly than explicitly – from the interplay of such an ecosystem of many different stakeholders. None of these actors may or will claim overall responsibility, but all have a role to play. This role is not hierarchical in that it is not about taking control and telling others what to do. Instead, it is about facilitating. It involves acting as adviser, standard setter, facilitator, supervisor, and sometimes even de-facto regulatory power in environments where no single actor has the incentive or the mandate to do so. Ministries of defense and armed forces constitute influential entities, even when their role as operators is quite limited, because they typically preside over the assets, the unity of command, and the political backing necessary to nudge, stimulate and support other parties into changing their behavior. This is similar – although in most aspects far more complicated – from a shift that firefighters made a long time ago; modern firefighters spend more time and effort preventing fires than they do fighting and actually quenching blazes. Their new tasks include improving and reviewing fire safety measures, educating people, identifying critical gaps, assessing and monitoring risks, and promoting (fire) safety by design in new buildings and urban development.

219. This development has been described by HCSS in multiple publications over the past few years. See for example Willem Oosterveld, Stephan De Spiegeleire, and Frank Bekkers, "Better Together" (The Hague: The Hague Centre for Strategic Studies, 2016).

Is the Dutch defense organization willing and able to expand its role and position in the wider 'security ecosystem' along these lines, and in particular in the flow security ecosystems discussed here? In his opening speech of the Future Force Conference 2015, former CDS General Middendorp introduced the term 'custodian' of security to mark such a role and position.[220] He clearly saw the need for the Dutch Defense Organization – and defense organizations in general − to move in that direction. But whether the organization is capable of transposing Tom Middendorp's vision into reality remains to be seen. Such a transformation would push the Dutch Ministry of Defense beyond its comfort zone, and would require it to communicate and collaborate with unfamiliar partners and parties, to develop new structures and doctrines, to cultivate new skills, and to adapt to flexible decision-making processes also in environments where the power to act does *not* fall under command and control structures. To be able to fulfil a role of an 'attractor' in a network that, without having much or any formal control, still brings a sense of purpose and direction to the (eco)system, the organization must become an 'adaptive force'. The jury is still out – and will likely remain so for years to come – with regards to whether such a transformation is feasible, especially because it would require the blessing of multiple stakeholders both within the organization itself and by other stakeholders. Let's assume that, indeed, the Dutch Defense Organization, as well as the defense organizations of a number of like-minded nations, are able to step up their role as 'custodians' of flow security. What then are the tasks and challenges that come with that role?

At the highest level, flow security as a (distinct) strategic challenge means that the **geostrategic environment** needs to be analyzed and understood from a **flow security prism**. This will involve mapping and monitoring global value chains, recognizing interdependencies in and across flow chains, identifying critical vulnerabilities along these chains, and amassing strategic stockpiles geared towards mitigating them accordingly. This process is best facilitated by a global mindset not out of enlightened altruism, but because – in a 'flowing' world – a sophisticated understanding of self-interest requires awareness of the fact that national security is procedurally delivered (and eroded) by means of a multitude of international inputs. Given its **intelligence assets** and associated organizational, doctrinal and procedural frameworks, the Ministry of Defense can provide a substantial part of the backbone of a **government-wide anticipation function** for analyzing and monitoring (flow) security risks and threats, and can include the Ministry of Foreign Affairs (as previously outlined) in facilitating the process of ensuring that vital stockpiles are sourced in an expedited fashion.[221] This anticipation function, in turn, constitutes an essential building block of a comprehensive, **whole-of-government approach to security**, which would benefit significantly from the establishment of the **aforementioned National Security Council.** It also necessitates the implementation of a legal framework under which intelligence agencies can execute flow security monitoring activities subject to appropriate democratic checks and balances. This necessitates the implementation of a **legal framework** under which **intelligence agencies** can execute cyber flow security monitoring subject to **appropriate democratic checks and balances**. A case in point presents in forthcoming Dutch Telecom/ICT regulation, which will mandate telecom providers to report changes in ownership to the Ministry of Economic Affairs, and will empower various agencies (the AIVD included) to conduct in-depth analyses of incoming shareholders.[222]

220. Tom Middendorp. *Volledige Openingsspeech CDS Op Future Force Conference (Engels)*, 2015. https://www.youtube.com/watch?v=ZAt5gmgR1rI.

221. The General Intelligence Service (the AIVD) would be another important contributor.

222. Claartje Bulten et al., "Vitale Vennootschappen in Veilige Handen" (Nijmegen: Radboud University, 2017).

Flow security also necessitates investment in **monitoring technologies** that can identify and track **flow particles** at the **micro-level**. Like ship and airplane transponders used in naval shipping and aviation, this will be of great value in monitoring sensitive materials, tracking human trafficking, or identifying the presence of malware in cyberspace. The Royal Netherland's Marechaussee's participation in the *seamless flow* program for the border passage at Schiphol serves as a promising example in these regards. As mentioned, the advent of digital ledger technologies is expected to play a vital role. The Ministry of Defense's relatively robust knowledge and innovation base can and should be put to work in the area of technology assessment, concept development, and experimentation relating to this field, and should aim to integrate digital ledger technologies with the military sensor platforms and intelligence assets, including those in space and cyber space, which currently afford it a valuable niche capability.[223]

Increased capability vis-à-vis the tracking of negative flow particles and the identification of flow disruptions should ideally be paired with increased capacity to react accordingly. This requires the Dutch Defense Organization to **recognize the increasing importance of its role as a 'flow security contributor'**. The Dutch Defense Organization has a critical role to play in applying band aids to flow systems as disruptions arise. Because flow disruptions can present in ad-hoc fashion which – as was recently the case in the Dutch country St. Maarten – may require the involvement of the armed forces, this requires increased commitment (financial or otherwise) to maintaining the readiness of deployment systems such as the C-130 Hercules. More generally, it requires rendering the Dutch armed forces more flexible vis-à-vis operations in noncombat situations, and benefits from initiatives to adapt existing systems for use in disaster relief situations.

In addition to identifying and geographically locating negative flow elements, the ability to **target** individual flow particles with **greater precision** so as not to interrupt the positive flow is also a must. This is where the combined weapon and sensor platforms of the armed forces are particularly – and uniquely – useful. These assets may require specific add-ons, not currently in the inventory, and/or new operational concepts, doctrines and procedures, to be able to better deal with flow security challenges. One important example is the ability to act in an environment with advanced A2/AD capabilities in the hands of (potential) adversaries; and in particular to incapacitate these capabilities. The Netherlands would be well served in improving its capacity to counter the A2/AD capabilities of opponents. A specific **counter-A2/AD capability** particularly relevant for the Netherlands is a robust mine countermeasure capability. The development of sea mines constitutes a relatively cheap and easy proposition, and provides parties with a method through which the flow of ships to and from Rotterdam port can be brought to a standstill. NATO has acknowledged countermine capability as an alliance-wide gap. New technology renders cost-effective unmanned and modular solutions possible. From a Dutch perspective on flow security, investments in advanced maritime countermine capabilities are therefore appropriate. But countering **A2/AD capabilities** to offset the A2/AD capabilities of opponents will require greater investment in a much wider range of deterrent, defensive, but also offensive counter A2/AD capabilities across the different services of the armed forces. These include greater emphasis on stealth technology, investment in anti-submarine warfare capabilities and deployable command and control naval and land assets, reinforcing fire support capabilities, and strengthening and expanding means for electronic warfare.

223. The Dutch Ministry of Defense has experimented with launching its own micro-satellites in orbit.

Furthermore, the resilience of the flows themselves are critical. This can be increased by **improving the resilience and robustness** of the individual flow particles but also by using **flow design principles** in the architecture of the flow system. This includes building diversity and redundancy into the system, segmentation, the protection of critical nodes and the ability to respond adaptively. Having ample experience in the protection of (high value) targets, the Ministry of Defense may well act as advisor, in particular to public and private owners, operators and users of vital infrastructure.

Finally, flow security involves engaging new, sometimes **unlikely**, partners in **flexible coalitions** of the **able and willing** across a wide range of domains in order to strengthen the resilience of the flow system and/or counter eminent threats. The collection of information, the adoption of standards, and even the protection of physical and virtual flows requires close cooperation with a mix of private and public partners. The MoD and the armed forces can advise, facilitate and support some of these partners in their contribution to the overall security effort. This is not unlike the security assistance function the Ministry of Defense already performs to state actors, but will also apply to non-state actors – analogous to 'firefighters' evolving into 'fire safety advisers'.

Given the daunting nature of the challenge at hand, it is not surprising that Dutch security and defense organizations are insufficiently prepared to ward off the myriad of risks associated with flow security. Prudent policymakers therefore take flow security seriously and prepare accordingly. We hope that this study contributes to that end.

BIBLIOGRAPHY

Aaltola, Mika, Juha Kapyla, Harri Mikkola, and Timo Behr. "Towards the Geopolitics of Flows: Implications for Finland." The Finnish Institute of International Affairs, 2014.

American Banker. "U.S. Charges Iranian Hackers in Wall Street Cyber-Attacks." American Banker, 2016. https://www.americanbanker.com/news/us-charges-iranian-hackers-in-wall-street-cyber-attacks.

Anderson, Robert H., Phillip M. Feldman, Scott Gerwehr, Brian Houghton, Richard Mesic, John Pinder, Jeff Rothernberg, and James Chiesa. "Securing the U.S. Defense Information Infrastructure." Washington, D.C.: RAND Corporation, 19990.

Arctic Climate Assessment. *Arctic Cimate Assessment*. Cambridge University Press, 2004.

Arnold, Aaron. "Nuclear Nonproliferation and Blockchain." Bulletin of the Atomic Scientists, October 19, 2017. https://thebulletin.org/blockchain-new-aid-nuclear-export-controls11204.

Baker, David. "The Effects of Terrorism on the Travel and Tourism Industry" 2, no. 1 (2014).

Bank for International Settlements. "Press Release: Global FX Trading Averages $5.1 Trillion a Day in April 2016; Spot Trading Falls While FX Swaps Rise," September 1, 2016. http://www.bis.org/press/p160901a.htm.

Bekkers, Frank, Joris van Esch, Maarten Gehem, Rem Korteweg, Stephan De Spiegeleire, Tim Sweijs, and Peter Wijninga. "De Toekomst in Alle Staten." The Hague: The Hague Centre for Strategic Studies, 2013.

Betz, David J. "Webs, Walls, and Wars." *Global Crime* 17, no. 3–4 (October 1, 2016): 296–313. https://doi.org/10.1080/17440572.2016.1179631.

Brattberg, Erik, and Daniel S. Hamilton, eds. *Global Flow Security: A New Security Agenda for the Transatlantic Community in 2030*. Washington, D.C.: Center for Transatlantic Relations, 2014.

Brienen et al. "Long-Term Decline of the Amazon Carbon Sink." *Nature* 519 (2015): 344–48.

Brucker, H, S Capuano, and A Marfouk. "IAB Brain-Drain Data | IAB," 2013. http://www.iab.de/en/daten/iab-brain-drain-data.aspx.

Bulten, Claartje, Bas de Jong, Evert-Jan Breuking, and Alex Jettinghoff. "Vitale Vennootschappen in Veilige Handen." Nijmegen: Radboud University, 2017.

Butler, Brandon. "Google Wraps Its Trans-Pacific Fiber Cables in Kevlar to Prevent against Shark Attacks." Network World, August 13, 2014. https://www.networkworld.com/article/2464035/cloud-computing/cloud-computing-google-wraps-its-trans-pacific-fiber-cables-in-kevlar-to-prevent-against-shark.html.

Carter, Lionel, Douglas Burnett, Stephen Drew, Graham Marle, Lonnie Hagadorn, Deborah Bartlett-McNeil, and Nigel Irvine. "Submarine Cables and the Oceans: Connecting the World." United Kingdom: United Nations Environment Programme, 2009.

Ceballos, Gerardo, Paul R. Ehrlich, Anthony D. Barnosky, Andrés García, Robert M. Pringle, and Todd M. Palmer. "Accelerated Modern Human–induced Species Losses: Entering the Sixth Mass Extinction." *Science Advances* 1, no. 5 (2015): 2015.

Ceballos, Gerardo, Paul R. Ehrlich, and Rodolfo Dirzo. "Biological Annihilation via the Ongoing Sixth Mass Extinction Signaled by Vertebrate Population Losses and Declines." *PNAS* 114, no. 30 (2017).

Centraal Bureau voor de Statistiek. "Fact Sheet Port of Rotterdam 2014." Centraal Bureau voor de Statistiek, 2015.

———. "ICT, Kennis En Economie." Centraal Bureau voor de Statistiek, 2016.

———. "ICT, Kennis En Economie 2017." Centraal Bureau voor de Statistiek, 2017.

———. "Transport and Mobility 2106." The Hague: Statistics Netherlands, 2016.

Chang, Sue. "How Big Is Bitcoin, Really? This Chart Puts It All in Perspective." MarketWatch, 2017. http://www.marketwatch.com/story/how-big-is-bitcoin-really-this-chart-puts-it-all-in-perspective-2017-06-21.

CNN, Jim Sciutto and Jennifer Rizzo. "War in Space: Kamikazes, Kidnapper Satellites, Lasers." CNN. Accessed October 5, 2017. http://www.cnn.com/2016/11/29/politics/space-war-lasers-satellites-russia-china/index.html.

CoMensha. "Het Beeld van 2015." Jaaroverzicht. CoMensha, 2016.

Cornell University, INSEAD, and World Intellectual Property Organization. "The Global Innovation Index 2017; Innovation Feeding the World." Geneva, 2017.

"Database - Eurostat." Accessed November 28, 2017. http://ec.europa.eu/eurostat/data/database.

De Spiegeleire, Stephan, Clarissa Skinner, and Tim Sweijs. *The Rise of Populist Sovereignism: What It Is, Where It Comes from and What It Means for International Security and Defense*. HCSS, 2017. https://hcss.nl/report/rise-populist-sovereignism-what-it-where-it-comes-and-what-it-means-international-security.

De Spiegeleire, Stephan, and Tim Sweijs. *StratMon 2016-2017: Volatility and Friction in the Age of Disintermediation*. The Hague: The Hague Centre for Strategic Studies, 2017.

Dearden, Lizzie. "An Unprecedented Cyber Attack Just Took out Major Banks, Government and Airport Computers in Ukraine." The Independent, June 27, 2017. http://www.independent.co.uk/news/world/europe/ukraine-cyber-attack-hackers-national-bank-state-power-company-airport-rozenko-pavlo-cabinet-a7810471.html.

Deloitte. "Cyber Value at Risk in the Netherlands." The Netherlands: Deloitte, 2016.

Department of Statistics. "ILO Global Estimates on Migrant Workers: Results and Methadology." International Labor Organization, 2015.

Deuten, Jasper. "R&D Goes Global: Policy Implications for the Netherlands as a Knowledge Region in a Global Perspective." The Hague: Rathenau Instituut, 2017.

"Digital Transformation - Growth - European Commission." Growth. Accessed November 22, 2017.

Dowd, Kevin. "Moral Hazard and the Financial Crisis." CRIS Discussion Paper Series. Nottingham: Centre for Risk & Insurance Studies, 2008.

Drash, Wayne. "Yes, Climate Change Made Harvey and Irma Worse." CNN, 2017. http://www.cnn.com/2017/09/15/us/climate-change-hurricanes-harvey-and-irma/index.html.

European Commission. "The Netherlands - Overview." European Maratime and Fisheries Fund, 2014.

European Monitoring Centre for Drugs and Drug Addiction and Europol. "EU Drug Markets Report: In-Depth Analysis." Luxembourg: EMCDDA-Europol Joint publications, 2016.

Europol. “EU Drug Markets Report: A Strategic Analysis.” The Hague: Europol, 2013.

Eurostat. “E-Commerce Statistics for Individuals.” Eurostat - Statistics Explained, 2017. http://ec.europa.eu/eurostat/statistics-explained/index.php/E-commerce_statistics_for_individuals.

Ferguson, Niall. “The False Prophecy of Hyperconnection.” *Foreign Affairs*, August 15, 2017. https://www.foreignaffairs.com/articles/2017-08-15/false-prophecy-hyperconnection.

Flannigan, M.D., B.J. Stocks, and B.M. Wotton. “Climate Change and Forest Fires.” *Science of The Total Environment* 262, no. 3 (2000): 221–29.

Fountain, Henry. “Alaska’s Permafrost Is Thawing.” *The New York Times*, August 23, 2017, sec. Climate. https://www.nytimes.com/interactive/2017/08/23/climate/alaska-permafrost-thawing.html.

Gady, Franz-Stefan. “In A2/AD Showcase, Iranian Navy Sinks Nimitz Carrier Mock-Up.” The Diplomat, 2015. http://thediplomat.com/2015/02/in-a2ad-showcase-iranian-navy-sinks-nimitz-carrier-mock-up/.

Gassert, Francis, Paul Reig, Tianyi Luo, and Andrew Maddocks. “Aqueduct Country and River Basin Rankings.” Washington, D.C.: World Resource Institute, 2013.

Gat, Azar. *War in Human Civilization*. 1 edition. Oxford: Oxford University Press, 2008.

Gelder, Laura van. “Record Number of International Students in the Netherlands.” *Univers* (blog), March 30, 2017. https://universonline.nl/2017/03/30/record-number-international-students-netherlands.

Gerasimov, Valery. “The Value of Silence Is in the Foresight: New Challenges Demand Rethinking the Forms and Methods of Carrying out Combat Operations.” *Military Review*, no. January-February (2016): 23–29.

Gerstein, Daniel M. “Strategies for Defending U.S. Government Networks in Cyberspace.” Washington, D.C.: RAND Corporation, 2015.

Ghemawat, Pankaj, and Steven Altman. “DHL GLobal Connectedness Index 2016: The State of Globalization in an Age of Ambiguity.” Deutsche Post DHL Group, 2017.

Gilbert, Natasha. “Research sans Frontières.” *Nature News* 471, no. 7340 (March 28, 2011): 559–559. https://doi.org/10.1038/471559a.

Giles, Keir. “Russia’s ‘New’ Tools for Confronting the West: Continuity and Innovation in Moscow’s Exercise of Power.” Research Paper. Chatham House, 2016.

Gostin, Lawrence, and Ana Ayala. “Global Health Security in an Era of Explosive Pandemic Potential.” Georgetown University Law Center, 2017. http://scholarship.law.georgetown.edu/cgi/viewcontent.cgi?article=2967&context=facpub.

Gramer, Robbie. “Watch: The Global Flow of Asylum-Seekers In One Interactive Map.” *Foreign Policy* (blog), March 15, 2017. https://foreignpolicy.com/2017/03/15/how-many-asylum-seekers-refugees-are-in-the-world-interactive-map-infographic-global-migration-immigration/.

Gunzinger, Mark, and Chris Dougherty. “Outside-In: Operating from Range to Defeat Iran’s Anti-Access and Area-Denial Threats.” Washington, D.C.: Center for Strategic and Budgetary Assessments, 2011.

Gushulak, BD, J Weekers, and DW MacPherson. “Migrants and Emerging Public Health Issues in a Globalized World: Threats, Risks and Challenges, an Evidence-Based Framework.” *Emerging Health Threats Journal* 2 (March 31, 2010). https://doi.org/10.3134/ehtj.09.010.

Harrison, John Arthur. "The Nitrogen Cycle | Earth Science." Visionlearning, 2003. https://www.visionlearning.com/en/library/Earth-Science/6/The-Nitrogen-Cycle/98.

Hassner, Ron E., and Jason Wittenberg. "Barriers to Entry: Who Builds Fortified Boundaries and Why? | International Security | MIT Press Journals." *International Security* 40, no. 1 (Summer 2015). http://www.mitpressjournals.org/doi/full/10.1162/ISEC_a_00206.

Hennis-Plasschaert, Jeanine. "Houvast in Een Onzekere Wereld." The Hague, Netherlands: Ministry of Defence, February 2017.

IAmsterdam. "ICT Industry In the Amsterdam Metropolitan Area." IAmsterdam, 2017.

IATA. "IATA - Another Strong Year for Air Travel Demand in 2016," February 2, 2017. http://www.iata.org/pressroom/pr/Pages/2017-02-02-01.aspx.

IMF. "Balance of Payments Manual." International Monetary Fund, n.d.

International Cable Protection Committee Ltd. "About Submarine Telecommunications Cables." United Kingdom: International Cable Protection Committee, October 2011.

"International Capital Flows: The Concise Encyclopedia of Economics | Library of Economics and Liberty," 2008. http://www.econlib.org/library/Enc/InternationalCapitalFlows.html.

International Organization for Migration. "Missing Migrants Project," November 20, 2017. https://missingmigrants.iom.int/.

Johnston, Ian. "Overfishing Driving Dozens of Species into Extinction Threatening African Food Crisis, Warn Experts." The Independent, 2017. http://www.independent.co.uk/environment/overfishing-species-extinction-african-food-crisis-threat-iucn-warning-niger-angola-mauritania-a7534901.html.

Justitie, Ministerie van Veiligheid en. "'Aandacht voor mensenhandel neemt af.'" Webpagina, September 30, 2016. https://www.nationaalrapporteur.nl/actueel/2016/aandacht-voor-mensenhandel-neemt-af.aspx.

Khanna, Parag. *Connectography: Mapping the Future of Global Civilization*. Random House Publishing Group, 2016.

Klare, Michael. "Militarizing Homeland Security in the Climate-Change Era." *War Is Boring* (blog), 2017. http://warisboring.com/militarizing-homeland-security-in-the-climate-change-era/.

———. "Time Is Running Out to Avert Climate Wars." *War Is Boring* (blog), 2015. https://warisboring.com/time-to-avert-climate-wars-is-running-out/.

Knickrehm, Mark, Bruno Berthon, and Paul Daugherty. "Digital Disruption: The Growth Multiplier | Accenture," 2017. https://www.accenture.com/us-en/insight-digital-disruption-growth-multiplier.

Koenders, Albert. "Beleidsbrief Internationale Veiligheid – Turbulente Tijden in Een Instabiele Omgeving." Ministry of Foreign Affairs, 2014.

Krepinevich, Andrew, Barry Watts, and Robert Work. "Meeting the Anti-Access and Area-Denial Challenge." Washington, D.C.: Center for Strategic and Budgetary Assessments, 2003.

Laperche, Blandine, and Gilliane Lefebvre. "The Globalization of Research &AMP: Development in Industrial Corporations: Towards 'Reverse Innovation'? The Cases of General Electric and Renault" 2, no. 10 (2012): 53–79.

Leduc, Martin, H. Damon Mattews, and Ramón de Elía. "Regional Estimates of the Transient Climate Response to Cumulative CO2 Emissions." *Nature Climate Change*, 2016.

Lisch, Ralf. *Measuring Service Performance. Practical Research for Better Quality*. England: Gower Publishing Ltd, 2014.

Loungani, Prakash, Saurabh Mishra, Chris Papageorgiou, and Ke Wang. "World Trade in Services: Evidence from A New Dataset." IMF Working Paper. International Monetary Fund, 2017.

Lund, Susan, Eckart Windhagen, James Manyika, Philipp Härle, Jonathan Woetzel, and Diana Goldshtein. "The New Dynamics of Financial Globalization." McKinsey & Company, 2017.

M, Jan. "Is the Netherlands below Sea Level?" *Netherlands Tourism* (blog), December 1, 2013. http://www.netherlands-tourism.com/netherlands-sea-level/.

Manyika, James, Jacques Bughij, Susan Lund, Olivia Nottebohm, David Poulter, Sebastian Jauch, and Sree Ramaswamy. "Global Flows in a Digital Age: How Trade, Finannance, People, and Data Connect the World Economy." McKinsey Global Institute, 2014.

Manyika, James, Susan Lund, Jacques Bughin, Jonathan Woetzel, Kalin Stamenov, and Dhruv Dhingra. "Digital Globalization: The New Era of Global Flows | McKinsey & Company." McKinsey Global Institute, March 2016. http://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/digital-globalization-the-new-era-of-global-flows.

Matus, Kira, Kyung-Min Nam, Noelle E. Selin, Lok N. Lamsal, John M. Reilly, and Sergey Paltsev. "Health Damages from Air Pollution in China." Cambridge, MA: Massachusetts Institute of Technology, 2011.

Mentens, Jean. "2.5 Billion Dollars Estimated for St. Maarten Recovery." Caribisch Netwerk, 2017. http://caribbeannetwork.ntr.nl/2017/09/13/2-5-billion-dollars-estimated-for-st-maarten-recovery/.

Minasians, Christopher. "Where Are Apple Products Made? How Much Does the IPhone Cost to Make?" Macworld, 2017. http://www.macworld.co.uk/feature/apple/where-are-apple-products-made-3633832/.

Ministry of Defence. "Strategie Nationale Veiligheid." Ministry of Defence, 2007.

Ministry of Economic Affairs. "Digital Agenda for the Netherlands: Innovation, Trust, Acceleration." The Hague: Ministry of Economic Affairs, 2016.

Ministry of Foreign Affairs. "A Secure Netherlands in a Secure World." Ministry of Foreign Affairs, 2013.

Ministry of Infrastructure and the Environment. "Climate Agenda: Resilient, Prosperous and Green." The Hague: Ministry of Infrastructure and the Environment, 2014.

Morozov, Evgeny. "Who's the True Enemy of Internet Freedom - China, Russia, or the US?" *The Guardian*, January 4, 2015, sec. Opinion. http://www.theguardian.com/commentisfree/2015/jan/04/internet-freedom-china-russia-us-google-microsoft-digital-sovereignty.

Morris, Ian. *Why the West Rules--for Now: The Patterns of History, and What They Reveal About the Future*. Reprint edition. London: Picador, 2011.

Neal, Meghan. "Let's Be Real, Sharks Aren't Eating Google's Undersea Internet Cables." Motherboard, August 14, 2014. https://motherboard.vice.com/en_us/article/pgazmb/lets-be-real-sharks-arent-eating-googles-undersea-internet-cables.

Nerem, R. S., D. Chambers, C. Choe, and G. T. Mitchum. "Estimating Mean Sea Level Change from the TOPEX and Jason Altimeter Missions." *Marine Geodesy* 33, no. 1 (2010): 435–46.

Netherlands, Statistics. “Environmental-Economic Impact of Tourism Sector Studied.” Webpagina, June 6, 2017. http://www.cbs.nl/en-gb/news/2017/22/environmental-economic-impact-of-tourism-sector-studied.

———. “More Eastern Europeans Working in the Netherlands.” Webpagina. Accessed October 6, 2017. http://www.cbs.nl/en-gb/news/2017/05/more-eastern-europeans-working-in-the-netherlands.

———. “Tourism Sector Continues to Grow.” Webpagina, August 2017. https://www.cbs.nl/en-gb/news/2017/34/tourism-sector-continues-to-grow.

———. “Transport of Goods in the Netherlands Hits New Record.” Webpagina, September 22, 2016. http://www.cbs.nl/en-gb/news/2016/25/transport-of-goods-in-the-netherlands-hits-new-record.

Northon, Karen. “NASA, NOAA Data Show 2016 Warmest Year on Record Globally.” Text. NASA, January 18, 2017. http://www.nasa.gov/press-release/nasa-noaa-data-show-2016-warmest-year-on-record-globally.

OECD. “FDI In Figures.” Geneva: OECD, 2016.

———. “Foreign Direct Investment (FDI) - FDI Stocks - OECD Data.” OECD, 2017. http://data.oecd.org/fdi/fdi-stocks.htm.

———. “OECD Economic Surveys NETHERLANDS Overview.” OECD, March 2016. http://www.oecd.org/eco/surveys/Netherlands-2016-overview.pdf.

———. “OECD Reviews of Innovation Policy: Netherlands 2014 | OECD READ Edition.” OECD iLibrary. Accessed October 5, 2017. http://www.keepeek.com/Digital-Asset-Management/oecd/science-and-technology/oecd-reviews-of-innovation-policy-netherlands-2014_9789264213159-en.

———. “Seventeenth Report on G20 Investment Measures.” G20 Investment Measures: OECD, 2017.

OHCHR. “OHCHR | Refugees and Terrorism: ‘No Evidence of Risk’ – New Report by UN Expert on Counter-Terrorism,” 2016. http://www.ohchr.org/EN/NewsEvents/Pages/DisplayNews.aspx?NewsID=20734.

O’Kane, Sean. “IOS 11 Lets You Send and Receive Money via IMessage with Apple Pay.” The Verge, 2017. https://www.theverge.com/2017/6/5/15731034/apple-pay-iphone-payments-venmo-update-announced-wwdc-2017.

Olivier, J. G. J., G. Janssens-Maenhout, M. Muntean, and J.A.H.W. Peters. “Trends in Global CO2 Emissions: 2016 Report.” The Hague: European Commission, Joint Research Centre (JRC), Directorate C - Energy, Transport and Climate; PBL Netherlands Environmental Assessment Agency, 2016.

Ong, Thuy. “China Tightens Cryptocurrency Ban with New Directive - The Verge.” The Verge, 2017. https://www.theverge.com/2017/9/18/16326078/chinese-regulators-ban-cryptocurrency-platforms-bitcoin.

Oosterveld, Willem, Stephan De Spiegeleire, and Frank Bekkers. “Better Together.” The Hague: The Hague Centre for Strategic Studies, 2016.

Preesman, Leen. “Asset Allocation: The Dutch Top Five.” Investments & Pensions Europe, 2015. https://www.ipe.com/pensions/pensions-in/netherlands/asset-allocation-the-dutch-top-five/10009578.fullarticle.

Puddington, Arch, and Tyler Roylance. “Freedom in the World 2017,” January 24, 2017. https://freedomhouse.org/report/freedom-world/freedom-world-2017.

Rademaker, Michel, Louk Faesen, Koen van Lieshout, and Mercedes Abdalla. “Dutch Investments in ICT and Cybersecurity.” The Hague: The Hague Centre for Strategic Studies, 2016.

Ramo, Joshua Cooper. *The Seventh Sense: Power, Fortune, and Survival in the Age of Networks*. Unabridged edition. Little, Brown & Company, 2016.

“Review of Maritime Transport 2016.” Review of Maritime Transport. Geneva: UNCTAD, 2016.

Riebeek, Holli. “The Carbon Cycle : Feature Articles,” June 16, 2011. https://earthobservatory.nasa.gov/Features/CarbonCycle/page4.php.

———. “The Ocean’s Carbon Balance : Feature Articles.” Text. Article, July 1, 2008. https://earthobservatory.nasa.gov/Features/OceanCarbon/.

Rijksoverheid. “Bestuurts Askkoord Water.” Rijksoverheid, 2011.

Rodrigue, J.-P., C. Comtois, and B. Slack. *The Geography of Transport Systems*. New York: Routledge, 2017. https://people.hofstra.edu/geotrans/.

Sabbagh, Karim, Bahjat El-Darwiche, Roman Friedrich, and Milind Singh. “Maximizing the Impact of Digitization.” Price Waterhouse Cooper (PWC), 2012.

Samples, Amy, Catherine Riseng, and Jim Diana. “Helping Marina and Harbor Operators Respond to Climate Change.” Michigan Sea Grant, 2014.

Schiphol group. “Facts and Figures | 2016 Annual Report | Schiphol,” 2016. http://www.annualreportschiphol.com/about-us.

Schwab, Klaus. “The Fourth Industrial Revolution: What It Means and How to Respond | World Economic Forum.” Accessed October 4, 2017. https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/.

Slaughter, Anne-Marie. “How to Succeed in the Networked World.” *Foreign Affairs*, October 4, 2016. https://www.foreignaffairs.com/articles/world/2016-10-04/how-succeed-networked-world.

Slifer, D. “Intellectual Property Rights: The Last Barrier to International Free Trade | Illinois Business Law Journal - University of Illinois at Urbana-Champaign,” 2009. https://publish.illinois.edu/illinoisblj/2009/10/10/intellectual-property-rights-the-last-barrier-to-international-free-trade/.

Smith, Pete, Mark Howden, Thelma Krug, Valérie Masson-Delmotte, Cheikh Mbow, Hans-Otto Pörtner, Andy Reisinger, Josep Canadell, and Phillip O’Brien. “Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems (SR2).” International Panel on Climate Change. United Nations, 2017.

“Social Media in 2017: The Latest Statistics.” *BuzzAcademy* (blog), March 13, 2017. https://www.buzzcapture.com/academy/en/social-media-usage-in-2017/.

Sodhi, Navjot S., and Barry W. Brook. “Causes and Consequences of Species Extinctions.” *The Princeton Guide to Ecology* 1 (2009): 514–20.

Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averty, M. Tignor, and H. L. Miller. “Climate Change 2007: The Physical Science Basis.” Working Paper. Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, 2007.

Spapens, A. C., and M. Y. Bruinsma. "Smokkel van Handvuurwapens Vanuit Voormalige Oostbloklanden Naar Nederland." Tilburg: IVA Tilburg, 2002.

Stanford University. "Deepwater Horizon Oil Spill Impacted Bluefin Tuna Spawning Habitat in Gulf of Mexico, Stanford and NOAA Researchers Find." Stanford News, September 30, 2016. http://news.stanford.edu/2016/09/30/deepwater-horizon-oil-spill-impacted-bluefin-tuna-spawning-habitat-gulf-mexico/.

Starr, Barbara, and Zachary Cohen. "US Navy Ship Fired Warning Shots at an Iranian Boat in the Persian Gulf." CNN. Accessed August 18, 2017. http://www.cnn.com/2017/07/25/politics/navy-ship-iran-arabian-gulf/index.html.

Statistics Netherlands. "Annual Report on Integration 2016 Summary." The Hague: Statistics Netherlands, 2016.

———. "CBS StatLine - Overnight Accommodation; Guests, Country of Residence, Type, Region," October 31, 2017. http://statline.cbs.nl/Statweb/publication/?VW=T&DM=SLEN&PA=82059ENG&D1=a&D2=0&D3=0-2&D4=0&D5=16,33,50,67&HD=160601-1450&HDR=G3,G4&STB=G1,T,G2.

———. "CBS StatLine - Tourist Expenditure; National Accounts," August 21, 2017. http://statline.cbs.nl/Statweb/publication/?DM=SLEN&PA=82671ENG&D1=a&D2=a&VW=T.

Stohl, Rachel. "The Tangled Web of Illicit Arms Trafficking." Washington, D.C.: Center for American Progress, 2004.

Sweney, Mark. "Netflix Tops 100m Subscribers as It Draws Worldwide Audience." *The Guardian*, July 18, 2017, sec. Media. http://www.theguardian.com/media/2017/jul/18/netflix-tops-100m-subscribers-international-customers-sign-up.

Synergy Research Group. "Amazon Cloud Growth Is Hardly Hampered by the Chasing Pack | Synergy Research Group," April 2017. https://www.srgresearch.com/articles/amazon-cloud-growth-hardly-hampered-chasing-pack.

Tamas, Adelina. "Routs and Flows of Human Trafficking." December 6, 2016.

The Economist. "Needed but Not Wanted: Economic Migrants Are Seen as a Threat to Jobs and the Welfare State. The Reality Is More Complex." The Economist, September 29, 2016. https://www.economist.com/news/special-report/21707835-economic-migrants-are-seen-threat-jobs-and-welfare-state-reality-more.

———. "Why Europe Needs More Migrants: Without Them the Continent's Population Will Start to Shrink," July 12, 2017. https://www.economist.com/blogs/graphicdetail/2017/07/daily-chart-6.

"The Innovation Imperative | OECD READ Edition." OECD iLibrary, 2015. http://www.keepeek.com/Digital-Asset-Management/oecd/science-and-technology/the-innovation-imperative_9789264239814-en.

The Observatory of Economic Complexity. "OEC - Netherlands (NLD) Exports, Imports, and Trade Partners." OEC, 2017. http://atlas.media.mit.edu/en/profile/country/nld/.

Trading Economics. "Netherlands Remittances | 1992-2017." Trading Economics, 2017. tradingeconomics.com/netherlands/remittances.

"UIS Statistics." Accessed November 28, 2017. http://data.uis.unesco.org/#.

UNCTAD. "World Investment Report 2017." UNITED NATIONS PUBLICATION. Geneva: United Nations, 2017.

"Unctad.Org | 80% of Trade Takes Place in 'Value Chains' Linked to Transnational Corporations, UNCTAD Report Says." Accessed October 5, 2017. http://unctad.org/en/pages/PressRelease.aspx?OriginalVersionID=113.

United Nations. "The World's Cities in 2016 - Data Booklet." Geneva: United Nations, 2016.

United Nations High Commissioner for Refugees. "Global Trends: Forced Displacement in 2016." UNHCR, 2016. http://www.unhcr.org/statistics/unhcrstats/5943e8a34/global-trends-forced-displacement-2016.html.

United Nations News Service, United Nations News Service. "UN News - Human Trafficking Has No Place in Modern World, General Assembly President Says." UN News Service Section, July 14, 2014. http://www.un.org/apps/news/story.asp?NewsID=48271#.WddBozCxVPZ.

UNWTO. "World Tourism Organization UNWTO | Specialized Agency of the United Nations." Accessed October 6, 2017. http://www2.unwto.org/.

USGS. "The Water Cycle Summary, USGS Water Science School." USGS: Science for a Changing World, 2016. https://water.usgs.gov/edu/watercyclesummary.html.

Valero, Pastora. "Check My Flow: How Cross-Border Data Traffic Drives Innovation," 2016. http://emear.thecisconetwork.com/site/content/lang/en/id/5977.

———. "This Is Why We Should Care about the Free Flow of Data between Countries." World Economic Forum (WEF), July 2016.

Wagstaff, Jeremy. "All at Sea: Global Shipping Fleet Exposed to Hacking Threat." Reuters, 2014. http://www.reuters.com/article/us-cybersecurity-shipping/all-at-sea-global-shipping-fleet-exposed-to-hacking-threat-idUSBREA3M20820140424.

Wetenschappelijke Raad voor het Regeringsbeleid. "Veiligheid in Een Wereld van Verbindingen: Een Strategische Visie Op Het Defensiebeleid." Den Haag: Wetenschappelijke Raad voor het Regeringsbeleid, 2017.

WIPO. "WIPO Statistical Country Profiles," 2015. http://www.wipo.int/ipstats/en/statistics/country_profile/profile.jsp?code=NL.

WITS. "Netherlands | Exports and Imports | by Country 2016 | WITS | Data," 2017. https://wits.worldbank.org/CountryProfile/en/Country/NLD/Year/2016/TradeFlow/EXPIMP#.

Woetzel, Jonathan, Anu Madgavkar, Khaled Rifai, Frank Mattern, Jacques Bughin, James Manyika, Tarek Elmasry, Amadeo Di Lodovico, and Ashwin Hasyagar. "Global Migration's Impact and Opportunity | McKinsey & Company," November 2016. http://www.mckinsey.com/global-themes/employment-and-growth/global-migrations-impact-and-opportunity.

World Bank. "Exports of Goods and Services (BoP, Current US$)." The World Bank Data, 2017. https://data.worldbank.org/indicator/BX.GSR.GNFS.CD.

———. "GDP (Current US$)." The World Bank Data, 2017. https://data.worldbank.org/indicator/NY.GDP.MKTP.CD.

———. "Life Expectancy at Birth, Total (Years)." The World Bank Data, 2017. https://data.worldbank.org/indicator/SP.DYN.LE00.IN.

———. "Natural Disasters Force 26 Million People into Poverty and Cost $520bn in Losses Every Year, New World Bank Analysis Finds." Text/HTML. World Bank, 2016. http://www.worldbank.org/en/news/press-release/2016/11/14/natural-disasters-force-26-million-people-into-poverty-and-cost-520bn-in-losses-every-year-new-world-bank-analysis-finds.

———. “Net Official Development Assistance and Official Aid Received (Current US$)§.” World Bank, 2017. https://data.worldbank.org/indicator/DT.ODA.ALLD.CD.

———. “Personal Remittances, Received (Current US$).” World Bank, 2017. https://data.worldbank.org/indicator/BX.TRF.PWKR.CD.DT.

———. “Stocks Traded, Total Value (% of GDP).” World Bank, 2017. https://data.worldbank.org/indicator/CM.MKT.TRAD.GD.ZS?view=chart.

———. “Trade (% of GDP).” The World Bank Data, 2017. https://data.worldbank.org/indicator/NE.TRD.GNFS.ZS.

World Bank Group. “International Debt Statistics 2017.” Washington, D.C.: World Bank Group, 2017.

World Economic Forum. “Economy Profiles.” *Global Enabling Trade Report 2016* (blog), 2016. http://wef.ch/2faSFhA.

———. “The Global Enabling Trade Report 2016.” World Economic Forum, 2016. http://reports.weforum.org/global-enabling-trade-report-2016/economy-profiles/#economy=NLD.

World Health Organization. *Guidelines for Drinking-Water Quality: Recommendations*. Geneva: World Health Organization, 2004.

———. “WHO | An Estimated 12.6 Million Deaths Each Year Are Attributable to Unhealthy Environments.” WHO, 2016. http://www.who.int/mediacentre/news/releases/2016/deaths-attributable-to-unhealthy-environments/en/.

World Health Organization, and Unicef. “Progress on Drinking Water, Sanitation and Hygiene: 2017 Update and SDG Baselines.” Switzerland: United Nations, 2017.

WTTC. “Benchmarking Travel & Tourism.” WTTC. Accessed October 6, 2017. https://www.wttc.org:443/research/economic-research/benchmark-reports/.

Yadron, Danny, Spencer Ackerman, and Sam Thielman. “Inside the FBI’s Encryption Battle with Apple.” *The Guardian*, February 18, 2016, sec. Technology. http://www.theguardian.com/technology/2016/feb/17/inside-the-fbis-encryption-battle-with-apple.

Zachara, M., and Zachara. “Illegal Trade, Arms.” In *Encyclopedia of Global Studies*, edited by H. K. Anheier and M. Juergensmeyer. Thousand Oaks, CA: SAGE Publications, 2012.

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