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Logistics 2040: How Must Logistics Prepare for the Future Security Environment?

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LOGISTICS 2040: HOW MUST LOGISTICS PREPARE FOR THE FUTURE SECURITY ENVIRONMENT?

By Lieutenant-Commander C.N. Chenell

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TABLE OF CONTENTS

ABSTRACT

The CAF cannot rapidly adapt military capability and readiness in response to a changing and evolving future security environment, as identified during the recent pandemic (shock) that exposed supply chain vulnerabilities. Formalized strategies for anticipating the future will help military leaders be more comprehensive and thorough in their future planning. Foresight analysis is a methodology for testing the assumptions that senior leadership will use to construct the CAF's future. Furthermore, the research findings of foresight analysis techniques are more credible and theoretically useful than those achieved without them. By reviewing relevant literature and studies about the future security environment, this paper conducted foresight analysis by observing trends to identify capability gaps applicable to Logistics. While the CAF must remain relevant now and in the future, Logistics must also adapt to provide appropriate support in the future security environment because to be relevant and effective; logistics must be resilient. Foresight analysis is a long-term forecasting technique where a twenty-year lead time is necessary to develop new capabilities. Therefore the year 2040 was chosen as the focal point for this research and how it can extend to Logistics. By indicating how to apply a foresight analysis in a series of steps, this paper demonstrated how it could help ensure that any such research is carried out systematically, with a level of thoroughness and integrity that would be difficult to achieve without it. The research outcome identified the requirement to develop policies or even organizational changes in light of the alternative futures depicted in this paper. The 15-20 year timeline chosen as the focal point will give the CAF enough flexibility to prepare for unexpected events and opportunities.

DEFINITIONS

GDP. The "total market value of the goods and services produced by a country's economy during a specified period of time."[1]

Controlled Technology Access and Transfer (CTAT). "In general, controlled goods are goods designed or modified for a military or strategic purpose and consist of munitions, strategic goods and technology, including goods covered by the *International Traffic in Arms Regulations* of the United States and missile technology. Controlled goods include controlled technology."[2]

International Traffic in Arms Regulations (ITAR). "The United States regulation that controls the manufacture, sale, and distribution of defense and space-related articles and services as defined in the United States Munitions List (USML). Besides rocket launchers, torpedoes, and other military hardware, the list also restricts the plans, diagrams, photos, and other documentation used to build ITAR-controlled military gear."[3]

North American Free Trade Agreement (NAFTA). "Established a free-trade zone in North America; it was signed in 1992 by Canada, Mexico, and the United States and took effect on Jan. 1, 1994. NAFTA immediately lifted tariffs on the majority of goods produced by the signatory nations. It also calls for the gradual elimination, over a period of 15 years, of most remaining barriers to cross-border investment and to the movement of goods and services among the three countries."[4]

Trend. "A trend is an emerging pattern of change likely to impact large social groups or even state government and require a response. "Trends are experienced by everyone and often in more or less the same contexts insofar as they create broad parameters for shifts in attitudes, policies and business focus over periods of several years that usually have global reach. What is interesting about trends is that normally most players, organizations or even nations cannot do much to change them – they are larger than the power of individual organizations and often nation states as well" (e.g. urbanization, demographic change)."[5]

Littoral. "Those regions relating to or existing on a shore or coastal region, within direct control of and vulnerable to the striking power of naval expeditionary forces."[6]

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[1] Peter Bondarenko, "Encyclopedia Britannica: Gross domestic product," last modified 28 February 2017, https://www.britannica.com/topic/gross-domestic-product.

[2] Department of National Defence, Defence Administrative Orders and Directives (DAOD) 3003-0: Controlled Goods, *Canadian Forces Manual of Abbreviations* (Ottawa: DND Canada, 2002).

[3] Jeff Petters, "What is ITAR Compliance? Definition and Regulations," last modified 29 January 2021, https://www.varonis.com/blog/itar-compliance/.

[4] U.S. Customs and Border Protection, "North American Free Trade Agreement," last accessed 27 April 2021, https://www.cbp.gov/trade/nafta.

[5] European Foresight Platform (EFP), "Megatrend / Trend / Driver / Issue," last accessed 27 April 2021, http://www.foresight-platform.eu/community/forlearn/how-to-do-foresight/methods/analysis/megatrend-trend-driver-issue/.

[6] Office of the Chief of Naval Operations, *Naval Doctrine Publication 1: Naval Warfare*, (Washington, DC: U.S. Government Printing Office, 1994), 73.

Megatrend. "A megatrend is a large, social, economic, political, environmental or technological change that is slow to form. Once in place, megatrends influence a wide range of activities, processes and perceptions, both in government and in society, possibly for decades. These are the underlying forces that drive trends. (e.g., aging population)."[7]

Driver. "Drivers are defined as developments causing change, affecting or shaping the future. A driver is the cause of one or more effects, e.g. increasing sugar intake in our daily food consumption is a driver for obesity."[8]

Foresight. "The ability to judge correctly what is going to happen in the future and plan your actions based on this knowledge."[9]

Futurist. "One who studies and predicts the future especially on the basis of current trends."[10]

Standardization Agreements (STANAG). "A Standardization Agreement (STANAG) is a NATO standardization document that specifies the agreement of member nations to implement a standard, in whole or in part, with or without reservation, in order to meet an interoperability requirement."[11]

Nanotechnology. "Nanotechnology refers to the creation of useful materials, devices and systems through manipulation of matter on the nanometer (nm) scale, with characteristic dimensions below 100nm, and exploiting of novel phenomena and properties specific to this small scale."[12]

Artificial Intelligence. "AI is defined as non-human intelligence that is measured by its ability to replicate human mental skills, such as pattern recognition, understanding natural language, adaptive learning from experience, strategizing, or reasoning about others."[13]

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[7] The Council of State Governments, "Transportation Policy Task Force," (Washington: Shared State Legislation, 2009), 3, https://www.csg.org/events/annualmeeting/policy_sessions_am09/SSL_agendapdfs/TransportationSSL.pdf.

[8] European Foresight Platform (EFP), "Megatrend / Trend / Driver / Issue," last accessed 27 April 2021, http://www.foresight-platform.eu/community/forlearn/how-to-do-foresight/methods/analysis/megatrend-trend-driver-issue/.

[9] Cambridge Dictionary, "Foresight," last accessed 27 April 2021, https://dictionary.cambridge.org/dictionary/english/foresight.

[10] Merriam-Webster Dictionary, "Futurist," last accessed 27 April 2021, https://www.merriam-webster.com/dictionary/futurist.

[11] North American Treaty Organization, "Standardization," last modified 23 June 2017, https://www.nato.int/cps/en/natohq/topics_69269.htm#:~:text=A%20Standardization%20Agreement%20%28STANAG%29%20is%20a%20NATO%20standardization,both%20standards%20and%20standards-related%20documents%20published%20by%20NATO.

[12] Adrian M. Ionescu, "Nanotechnology and Global Security," *Connections: The Quarterly Journal* 15, no. 2 (Winter 2016): 34, https://connections-qj.org/article/nanotechnology-and-global-security.

[13] Maas, Matthijs and Tim Sweij, *Artificial Intelligence and the Future of Defence: Strategic Implications for Small and Medium-Sized Force Providers* (The Hague Center for Strategic Studies, 2017), 28.

INTRODUCTION

> *You will not find it difficult to prove that battles, campaigns, and even wars have been won or lost primarily because of logistics.*
>
> – Dwight D. Eisenhower

Potential future enemies are undefined, creating a challenge for military leaders who must prepare for the resulting uncertain challenges. In the absence of a direct adversary, militaries across the globe discuss whether to structure their armed forces for conventional warfighting, counterinsurgency, or stabilization and regeneration, depending on the potential operational environments. Formalized strategies for anticipating the future will help military leaders be more comprehensive and thorough in their future planning. Foresight analysis is a step-by-step methodology for testing the assumptions that senior leadership can use to build the Canadian Armed Forces (CAF's) future. The framework recognizes challenges that the organization's internal policies are ill-equipped to address. The 15-20 year timeframe will allow the CAF time to plan for disruptive developments and the ability to seize opportunities. Foresight analysis permits the creation of a deliberate framework within the CAF that allows decision-makers to ensure new strategies are sound across a range of futures. The ability to share the thought process, recognize new problems and create a range of "robust policy assumptions" about the future will aid policy-makers in imagining the future and anticipating the foreseeable challenges.[14] It is essential to keep in mind that any policy amendments or inclusions will heavily rely on assumptions. Such approaches, which are commonplace in foresight or futurist research, allow for a methodical examination of the future and its implications.

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[14] Policy Horizons Canada, "Foresight Training Manual: Module 1 – Introduction to Foresight," last accessed 13 April 2021, https://horizons.gc.ca/en/our-work/learning-materials/foresight-training-manual-module-1-introduction-to-foresight/.

Furthermore, the research findings using such techniques are more credible and theoretically useful than those achieved without them.[15] By reviewing relevant literature and studies about the future security environment, this paper will conduct foresight analysis by observing trends to identify capability gaps applicable to Logistics. The CAF's ability to adapt will continue to be driven by the constantly evolving, complex future security environment. For the CAF to remain relevant now and in the future, these efforts must also focus on the heartbeat that keeps it alive, Logistics.[16]

This paper will use the seven-step process utilizing the framework depicted in Figure 1.[17] In effect, this is the framework that will be used to define Logistics 2040:

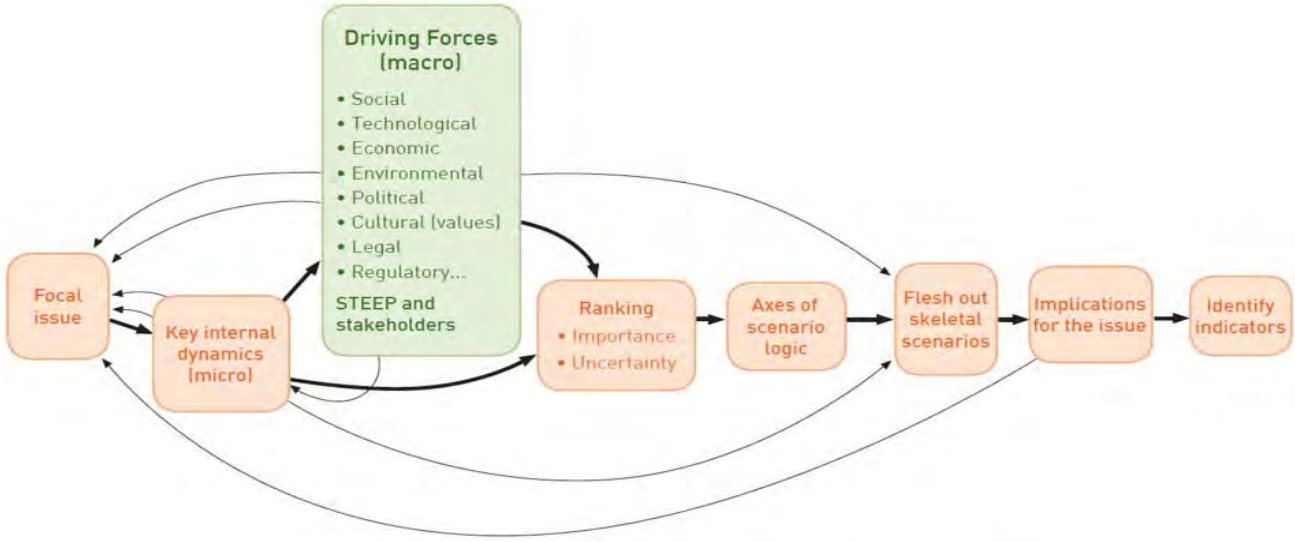

Figure 1: Steps of the 2x2 Matrix Technique

[15] Michael A. Rostek, Peter Gizewski and Regan Reshke, *Conceiving an Army for the 21st Century* (Ottawa: Defence R&D Canada - CORA, 2010), iii.

[16] North American Treaty Organization, *Strategic Foresight Analysis* (NATO: Allied Command Transformation, 2017), 3.

[17] Alun, Rhydderch, "Scenario Building: The 2x2 Matrix Technique," (Paris: Futuribles International, 2017), 11.

The foresight methodology has the capacity to provide a comprehensive account of various, simultaneous, and interconnected aspects of a possible future. Since it promotes overall policy consistent across various contexts, it is frequently used to assess medium to long-term policy changes. Alternative futures created with this method aim to be 10-20 years in the future.[18] Given that a twenty-year lead time is appropriate to develop new capabilities within the CAF, the year 2040 was chosen as the focal point for this research. More specifically, using the above framework to look at how it can extend to Logistics, concentrating on how Logistics must plan for the CAF's long-term survival in the future security environment. While the CAF must remain relevant now and in the future, Logistics must also adapt to provide appropriate support in the future security environment because to be relevant and effective; Logistics must be resilient. The first step in the foresight analysis framework, identifying the focal issue, has been established, and the remaining steps will fall within the following four chapters of the paper.

The first chapter will comprise Step 2: Internal Dynamics. It will focus on the contextual environment using the environmental scanning process by analyzing five domains of the future security environment: social, technological, economic, environmental, and political.[19] The environmental scanning process entails gathering objective and subjective perspectives on the world in which Logistics must operate through to the year 2040. It will do so by detecting emerging trends that can contradict previous hypotheses or provide a fresh outlook on potential challenges.[20]

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[18] Foresight Horizon Scanning Centre, "Scenario Planning," (London: Government Office for Science, 2009), 11. https://webarchive.nationalarchives.gov.uk/20140108141323/http://www.bis.gov.uk/assets/foresight/docs/horizon-scanning-centre/foresight_scenario_planning.pdf.

[19] Alun, Rhydderch, "Scenario Building: The 2x2 Matrix Technique," (Paris: Futuribles International, 2017), 7.

[20] Michael A. Rostek, Peter Gizewski and Regan Reshke, *Conceiving an Army for the 21st Century* (Ottawa: Defence R&D Canada - CORA, 2010), iii.

Step 3: Identify Key Drivers in the Environment, which will consist of the second chapter and derived from the first chapter's literature review. Analyzing the research conducted through the environmental scanning process will help identify converging trends, otherwise known as key drivers, that will point to various outcomes for Logistics and the CAF.[21] Once this is complete, a brief explanation of each key driver will help develop uncertainties and their polarities. Understanding each driver's uncertainties and the associated polarity will help present the key drivers by ranking them on an impact-uncertainty graph. The description of each key driver will allow for the next section of chapter two – Step 4: Rank Key Drivers by Importance and Uncertainty. By focusing on the key drivers with high uncertainty and high impact, this procedure can subjectively assess the degree of uncertainty and effect on small, medium, and large scales. This ranking will provide the framework for the remainder of the research and move into the last section in chapter three – Step 5: Selecting the Scenario Logic.[22] This step of the process helps form the axes and determines two critical uncertainties with a high impact-high uncertainty rating, allowing for the visualization of four possible futures.[23]

The third chapter is a characterization of four alternate futures that, when taken together, provide a credible, clear path into the future, within which actual events can expect to occur. This process is a more reliable way to conceptualize the Logistics of 2040 as it uses objective research from previous chapters. This chapter will comprise Step 6: Fleshing Out the Scenarios by creating alternative futures that consist of future stories based on the research performed in the environmental scanning process. Throughout the creation of the alternative futures process, it

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[21] Jim Woodhill, and S. Hashain, "A Framework for Understanding Foresight and Scenario Analysis," last accessed 26 March 2021, https://www.foresight4food.net/wp-content/uploads/2020/05/Foresight-Approach_May-2020.pdf.

[22] Alun, Rhydderch, "Scenario Building: The 2x2 Matrix Technique," (Paris: Futuribles International, 2017), 8.

[23] Foresight Horizon Scanning Centre, "Scenario Planning," (London: Government Office for Science, 2009), 11.https://webarchive.nationalarchives.gov.uk/20140108141323/http://www.bis.gov.uk/assets/foresight/docs/horizon-scanning-centre/foresight_scenario_planning.pdf.

is important to keep in mind that the focal point, timeline and axes established in the previous chapter apply to Logistics in 2040.

The fourth and final chapter will identify potential policy changes or capability gaps exposed by the alternative futures. Regardless of which of the four situations develops, the results will help assess initiatives and determine whether they will help the CAF accomplish its mission. This last chapter will assess the usefulness and utility of existing and propose new capabilities addressing the future security environment anticipated in the four future scenarios. Such policy changes can assist the CAF in becoming more agile and resilient.[24] The last step of the framework, Step 8: Selection of Leading Indicators and Signposts, is beyond this paper's scope and will not form part of the analysis. Additional research and discussion on this subject are encouraged to fine-tune and wargame the possible futures presented in this paper. All such future work on this topic will benefit from a group setting, which the nature of this paper does not allow.

It is possible to identify gaps that may influence today's defence policy decisions that address future challenges using the technique described in this paper. By indicating how to apply a foresight analysis in a series of steps, it demonstrates how the process can help ensure that any such research is carried out systematically, with a level of thoroughness and integrity that would be difficult to achieve without it. The alternative futures research presented in this paper should receive wide dissemination to engage and advise the CAF's various stakeholders. This paper lays the groundwork for more investigation, dialogue, and enhancement of the process and its results.

[24] Dalhousie University, "Scenario Planning: Process, Tools and Example," last modified 23 April 2020, https://cdn.dal.ca/content/dam/dalhousie/pdf/dept/maceachen-institute/Scenario%20Planning-%20Process,%20Tools%20and%20Example%20(1).pdf.

CHAPTER 1 – THE CONTEXTUAL ENVIRONMENT

Step 2: Internal Dynamics

The contextual environment refers to that aspect of the scanning process that has significant implications for the CAF and has little or no power over it. Figure 2 exemplifies the phrase "outside-in thinking" by scanning the world external to the organization's margins before zooming back in to consider the future.[25]

Figure 2: Outside-In Thinking

Although the organization cannot control the surrounding world, its primary goal is to organize its affairs to project its national power regardless of what happens.[26] Environmental Scanning is

[25] Alun, Rhydderch, "Scenario Building: The 2x2 Matrix Technique," (Paris: Futuribles International, 2017), 7.
[26] Kees van der Heijden, *Scenarios: The Art of Strategic Conversation*, (West Sussex: John Wiley & Sons Ltd, 2010), 125.

a means of collecting and reviewing data within the contextual environment by studying the trends and interactions that may have a competitive effect and determine how an organization will conduct itself.[27] Scanning offers facts and observations that, if embraced, may help prepare the organization's future path. Using the Environmental Scanning process, identifying five main target areas for the Logistics 2040 timeframe, with an analysis of each, is essential to understand potentially significant shifts, such as drivers, trends, or inbound changes that we must know about but cannot influence.[28] Otherwise known as the STEEP trend analysis, the following are the chosen priority areas under research: Social, Technological, Economic, Environmental and Political.[29] Throughout the STEEP analysis, a discussion of each inbound change is necessary to identify trends that will affect future Logistics. However, it takes several measures to get the best performance for the time spent doing the STEEP analysis. The first step is understanding the elements under analysis. Second, an assessment of the interrelationship between the different trends is required. This analysis must recognize trends that have a direct effect on the organization. The first section, the social dimension, will discuss characteristics that represent society as a whole.

Section 1 – Social Dimension

Population shifts, demographics, migration location, age, race, health (e.g. death and birth rates), education, socio-economic conditions, religious factors are important social characteristics to consider when evaluating the scope and aspects of potential risks and challenges. Specific

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[27] Chun Wei Choo, "The Art of Scanning the Environment," *American Society for Information Science Bulletin of the American Society for Information Science* 25, no. 3 (1999): 21.

[28] Michael A. Rostek, Peter Gizewski and Regan Reshke, *Conceiving an Army for the 21st Century* (Ottawa: Defence R&D Canada - CORA, 2010), 6.

[29] Morrison, J. L., Environmental scanning. In M. A. Whitely, J. D. Porter, and R. H. Fenske (Eds.), *A primer for New Institutional Researchers* (1992).

viewpoints on critical issues and perceptions and orientations toward the outside world are additional markers within the social dimension.[30]

Demographics

Demographics will remain an essential element that can influence military and security trends—by 2040, projections of the global population may reach over 9 billion inhabitants.[31] One of the most significant demographic trends is the emerging "youth bulge" in developing countries. The anticipation of such youth bulges will be in India, Africa and the Middle East.[32] Extremist organizations take advantage of disadvantaged youth to generate chaos by recruiting teenagers to promote actions that they would not otherwise support but are compelled to do so to survive. One such example of how a shift in demographics can be a threat to security is the Arab Spring phenomenon where "frustrated young men . . . [unite across many states and] . . . turn to violence" to achieve a collective means.[33] Although youth bulges are placing a strain on vulnerable economies and potentially triggering inter-state tensions, decreasing fertility rate projections expect to improve these issues.[34]

Compared to emerging countries, the western world is governed by an ageing population, its most influential demographic trend.[35] An ageing population in Canada will significantly affect the economy that finances social services and other government programs. Low birth rates and

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[30] Michael Rostek et al., *Toward Army 2040: Exploring Key Dimensions of the Global Environment*, Vol. 14 (Kingston: Defence Management Studies Program, School of Policy Studies, Queen's University, 2011), 11.

[31] United Nations, "World Population Prospects 2019: Department of Economic and Social Affairs Population Dynamics," last accessed on 28 February 2021. http://esa.un.org/unpd/wpp/Excel-Data/population.htm.

[32] Department of National Defence, *The Future Security Environment 2013-2040* (Winnipeg: 17 Wing Winnipeg Publishing Office, 2014), 52.

[33] Jack Mangala, *New Security Threats and Crises in Africa – Regional and International Perspectives,* (Palgrave Macmillan, 2010), 98.

[34] Henrik Urdal, "A Clash of Generations? Youth Bulges and Political Violence," *International Studies Quarterly* 50, no. 3 (Summer 2006): 623, http://www.jstor.org/stable/4092795.

[35] Department of National Defence, *The Future Security Environment 2013-2040* (Winnipeg: 17 Wing Winnipeg Publishing Office, 2014), 54.

the resulting ageing workforce, and a population driven by immigration are all factors in the Canadian demographic.[36] While southern Canada is experiencing an ageing population, Northern Canada, on the other hand, is experiencing the youth bulge phenomenon, which is trending to continue well into 2040. The discrepancy between the northern territories and the remainder of Canada is significant. Unemployment rates in Nunavut are almost triple that of the national unemployment rate.[37] As the Canadian labour force changes, it raises recruiting problems for the military. The Military Personnel Command (MPC) describes the following economic and social developments as threats and expectations of the following actualities. The first risk sees the CAF having reduced access to highly qualified applicants due to competition for expertise in a diminishing youth pool. Two concerning risks are the CAF's ageing population and possible lack of technical skillset and knowledge if the CAF does not keep pace with technology advances. MPC also recognizes that as Canadian culture diversifies, the CAF is struggling to represent the diversity in terms of ethnic, linguistic, and religious beliefs, placing the institution's reputation in jeopardy.[38] Recruitment, jobs, and retention plans for the CAF must be comprehensive and flexible. Demographic patterns will likely put a strain on the CAF's human capital.[39] Within the Canadian Arctic, small communities will shrink in population over the next twenty years, and by contrast, expectations are that megacities in the south will increase. The absence of infrastructure will continue to isolate communities, restrict adequate healthcare and social programs, and limit economic opportunity. Northern communities face extreme obstacles due to shortages or delays

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[36] Statistics Canada, "Study: Projected trends to 2031 for the Canadian labour force," last modified 9 January 2013, http://www.statcan.gc.ca/daily-quotidien/110817/dq110817b-eng.htm.

[37] Natural Resources Canada, "Regional Overview," last accessed 15 March 2021, https://www.nrcan.gc.ca/changements-climatiques/impacts-adaptation/regional-overview/10331.

[38] Department of National Defence, *Canadian Forces Military Personnel Strategy* (Ottawa: Chief of Military Personnel, 2011), 9.

[39] Department of National Defence, *The Future Security Environment 2013-2040* (Winnipeg: 17 Wing Winnipeg Publishing Office, 2014), 55.

in an increasingly strained food supply chain, making them particularly vulnerable to developing health threats.[40]

Migration

Natural disasters or the start of war may cause large-scale migrations, often across state boundaries and into regions without the capacity to deal with these burdens. Migrations of this proportion may be economically destabilizing and may lead to violence through growing stress on vulnerable governments who are insufficiently resilient to manage the burden.[41] As the number of poor or failed states increases, humanitarian assistance becomes essential to its stability. Population displacement often forces people to live in cramped and unhygienic environments, rendering them more prone to disease transmission. If left unchecked, a severe epidemic could occur. The uprooted and homeless refugees are vulnerable to many dangers that may require urgent humanitarian assistance.[42]

Urbanization and Megacities

People have been migrating from rural to urban centers for centuries in search of a better quality of life. This urbanization trend is forecasted to continue, with 65 percent of the global population likely to live in cities by 2040.[43] According to some projections, all population increases by 2050 will take place in cities.[44] Most megacities by virtue are located along the coast, but many cities will develop further inland as important secondary trade and industry hubs

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[40] North American and Arctic Defence and Security Network, "Understanding the Future Arctic Security Environment: Applying NATO Strategic Foresight Analysis to Canadian Arctic Defence and Security," last accessed 25 February 2021, https://www.naadsn.ca/wp-content/uploads/2021/01/NAADSN-Arctic-Strategic-Foresight-Analysis-WEB-Final-2020.pdf.

[41] Department of National Defence, *The Future Security Environment 2013-2040* (Winnipeg: 17 Wing Winnipeg Publishing Office, 2014), 49.

[42] United Nations General Assembly, "International Migration and Development: Report of the Secretary-General," last modified 3 August 2012, https://documentsddsny.un.org/doc/UNDOC/GEN/N12/452/13/PDF/N1245213.pdf?OpenElement.

[43] United Nations Population Fund, "State of the World Population 2007: Unleashing the Potential of Urban Growth," last accessed 1 March 2021, http://www.unfpa.org/swp/2007/english/introduction.html.

as urbanization increases.[45] Since the resources and employment available in megacities are significant compared to rural areas, urbanization contributes to economic growth and poverty reduction.[46] The crux of operating in vast urban environments will challenge the CAF, and as more integrated operations occur, joint operations will be complex. Furthermore, the CAF will need the skills, experience and training to grasp the complexities of physical and social environments. In such terrain, adequate force defence will remain a challenge.[47]

This section addressed the social dimension where relatively slow population growth, general ageing in advanced nations, and a youth bulge in emerging countries will characterize the social order in the decades leading up to 2040. With lower death and fertility rates and continued urbanization, a steady transition to yet more multicultural views of the world and ideologies will occur. The next section will concentrate on technological trends that will influence the logistics' future security environment.

Section 2 – Technological

Technology is everywhere, and the social, political, legal, moral, economic, and technological environment in which it is exposed influences it. Even though not everyone gains from technological advances, such advances in technology have resulted in extraordinary global wealth and improved quality of life. Considering technology is critical to many aspects of life, its ability to cause devastation puts even survival in jeopardy.[48] Society will always influence technology, and as the world evolves towards digitalization, modern and evolving technologies

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[44] David J. Kilcullen, *Out of the Mountains* (New York: Oxford University Press, 2013), 7.

[45] Department of National Defence, *The Future Security Environment 2013-2040* (Winnipeg: 17 Wing Winnipeg Publishing Office, 2014), 49.

[46] Mario Artuso, *State of the World's Cities 2010/2011: Bridging the Urban Divide* (London: Earthscan, 2010), 220.

[47] Department of National Defence, *The Future Security Environment 2013-2040* (Winnipeg: 17 Wing Winnipeg Publishing Office, 2014), 50.

[48] Michael Rostek et al., *Toward Army 2040: Exploring Key Dimensions of the Global Environment*, Vol. 14 (Kingston: Defence Management Studies Program, School of Policy Studies, Queen's University, 2011), 19.

pose immense possibilities and new vulnerabilities.[49] This section will highlight technological trends to help the CAF in the future and how those same innovations may help fight or undermine those strategies by Canadian adversaries.[50]

Technological Developments

The growing dependence on networks and sensors quickly leads to a situation where maintaining the security of armed forces and technological advantage over potential adversaries is becoming progressively more challenging. A new set of issues will result as advanced militaries develop the cyber and space domains. Organizations that are quick to leverage technological opportunities can retain an advantage in order to combat adversaries.[51] Canada will not be immune to these problems any more than its allies will. The Arctic will pose particularly unique challenges for Canada. Technological advances in the Arctic are almost entirely contingent on industry realizing the gains of investing in research and development. Technological advances will have environmental impacts on the Arctic; consideration of these impacts must be in cooperation with Northern communities and Indigenous peoples. Funding cuts to the military have resulted in a dependence on commercially available solutions, a lack of defence-focused R&D expertise and the result is an increased threat to national security.[52]

Emerging Technologies

Rapid developments in technology will bring pressure on future acquisitions and

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[49] North American Treaty Organization, *Strategic Foresight Analysis* (NATO: Allied Command Transformation, 2017), 8.

[50] Department of National Defence, *The Future Security Environment 2013-2040* (Winnipeg: 17 Wing Winnipeg Publishing Office, 2014), 63.

[51] *Ibid*., xiii.

[52] North American and Arctic Defence and Security Network, "Understanding the Future Arctic Security Environment: Applying NATO Strategic Foresight Analysis to Canadian Arctic Defence and Security," last accessed 25 February 2021, https://www.naadsn.ca/wp-content/uploads/2021/01/NAADSN-Arctic-Strategic-Foresight-Analysis-WEB-Final-2020.pdf.

interoperability between allies. Offensive cyber, artificial intelligence, automated systems, human enhancement and other emerging technologies have yet to achieve mainstream recognition and will result in differing ethical and legal considerations. It is essential to recognize that individuals and state and non-state actors have access to technologies that can be disruptive to the CAF.[53] Not all groups with access to new technologies will apply the same moral, ethical and legal obligations, increasing the threat to Canada's national security. Several technological trends, artificial intelligence, autonomous systems, additive manufacturing and nanotechnology, are discussed in this section.

Artificial intelligence (AI) is not a new notion; however, it can generate new and emerging technological advances. Artificial intelligence advancements carry views from all ends of the spectrum on how AI can influence the defence and security environment. One predicts that future military forces will look very similar and participate in precisely the same activities/operations. The Hague Center for Strategic Studies (HCSS) argues that AI may have a more significant transformational effect on defence and security as modern militaries continue to challenge norms and best practices.[54] Many actors (state or non-state) can deploy and exploit AI in various ways to achieve their aims and objectives, some of which may not be consistent with or advantageous to the general population or the CAF and its allies. Should smaller defence providers, such as the CAF, piggyback on larger defence entities with more capacity to influence the AI domain?[55] The HCSS recommends that smaller defence organizations strive for "quick wins" to gain momentum and that choosing emerging options that will stand a chance against the

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[53] North American Treaty Organization, *Strategic Foresight Analysis* (NATO: Allied Command Transformation, 2017), 8.

[54] Maas, Matthijs and Tim Sweij, *Artificial Intelligence and the Future of Defence: Strategic Implications for Small and Medium-Sized Force Providers* (The Hague Center for Strategic Studies, 2017), 12.

[55] *Ibid.*, 22-23.

"bigger-ticket legacy items" that are more "powerful" and tend to overpower the smaller ideas without a legitimate champion.[56]

One area where Logistics has embraced artificial intelligence is in autonomous systems. Autonomous systems are addressing challenges at a global level thanks to the rapid rate of technological advances.[57] With the continued increase in global eCommerce, the logistics industry is under extreme pressure to sustain the shipping demand. Many nations are experiencing shortages of truck drivers, and this trend is expecting to continue until 2040. In particular, the US is short 38,000 drivers, which is influencing autonomous vehicle development. Many companies specialize in eCommerce, and in conjunction with the larger logistics companies, will be the driving force towards autonomous truck development.[58] DHL is the worlds leading Logistics Company and has an invested interest in:

> . . . self-driving vehicles with technological advancements in artificial intelligence (AI) and ever-increasing investment in the development of sensors and vision technologies, self-driving capabilities will fundamentally transform the way vehicles are assembled, operated, utilized, and serviced. From long-haul trucking to last-mile rovers, self-driving vehicles will upgrade logistics by unlocking new levels of safety, efficiency, and quality.[59]

DHL will be one such company that influences autonomous vehicle development. While they are cognizant of the legal and safety implications of pursuing these developments, they are interested in advancements in driverless trucks, indoor and outdoor facility autonomous vehicles and last-mile delivery rovers.[60] Military personnel will face increased involvement with autonomous

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[56] Maas, Matthijs and Tim Sweij, *Artificial Intelligence and the Future of Defence: Strategic Implications for Small and Medium-Sized Force Providers* (The Hague Center for Strategic Studies, 2017), 18.

[57] North American Treaty Organization, *Strategic Foresight Analysis* (NATO: Allied Command Transformation, 2017), 16.

[58] Nate Vickery, "Autonomous Vehicles in Logistics: What are the Impacts?" Last modified 24 May 2017, https://cerasis.com/autonomous-vehicles-in-logistics/.

[59] DHL, "Self-Driving Vehicles," last accessed 2 March 2021, https://www.dhl.com/global-en/home/insights-and-innovation/thought-leadership/trend-reports/self-driving-vehicles.html.

[60] *Ibid.*

systems in operational settings as these sophisticated unoccupied systems become more autonomous and commercially available.[61]

Additive manufacturing can potentially transform the supply chain process by reducing component lead times, costs, material waste, transportation, customs challenges and energy consumption. This technological trend:

> . . . has emerged through a process of making three dimensional solid objects, one layer at a time, from digital models using 3D printing technology. Additive manufacturing is already altering global design and prototyping, and production logistics, pressuring intellectual property, patents, legacy licensing models, as well as fee and royalty business models. In the future, designers may be able to email their 3D model data files to a local manufacturer who will then print and ship the part within days.[62]

Current practices have shown additive manufacturing to be a cost-effective way to design and produce one-of-a-kind items. Sustainment and supply chain management may see a complete transformation because of additive manufacturing. With the opportunity to create spare parts and supplementary materials in-theatre, there is a possibility for the CAF to reduce its logistics footprint.[63]

Nanotechnology is undeniably an ensuing technological revolution. It is supposed to provide significant and unparalleled changes in the social and economic realms and directly affect daily life in the areas such as "energy efficient technologies" by using new generations of rechargeable batteries and battery storage systems to reduce energy consumption.[64] Keeping the 2040 horizon in mind, trends in areas such as "fully autonomous electric vehicles, regenerative nano-immunity for immortality, efficient and sustainable generation of storage of electrical

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[61] Department of National Defence, *The Future Security Environment 2013-2040* (Winnipeg: 17 Wing Winnipeg Publishing Office, 2014), 76.

[62] *Ibid*., 68.

[63] *Ibid*., 69.

[64] Adrian M. Ionescu, "Nanotechnology and Global Security," *Connections: The Quarterly Journal* 15, no. 2 (Winter 2016): 34, https://connections-qj.org/article/nanotechnology-and-global-security.

energy" are all within the realm of possibility.[65] Like any other emerging technology, nanotechnology's legal and ethical dimensions are significant, and as a result, the approach to nanotechnology should be in a conscientious and fully accountable manner.[66] The US Army and the Massachusetts Institute of Technology (MIT) formed a partnership in 2002 called the Institute for Soldier Nanotechnologies (ISN). As part of its function, "the ISN mission is to help the Army dramatically improve protection, survivability, and mission capabilities of the soldier and of soldier-supporting platforms and systems."[67] The ISN strives to provide soldiers with "high-tech protection and survivability capabilities through affordable clothing and equipage of lighter weight, increased comfort, and decreased energy demand."[68] ISN is researching portable electric power, communications, blast protection, and chemical warfare detection capabilities, all of which are significant advancements for the US Army.[69]

Globalization of Science and Technology

For defence and security technologies, if US technology in the defence sector starts to lag, Canada and its conventional partners may start using non-US equipment, affecting the US military's evolution. This trend will affect International Traffic in Arms Regulations (ITAR) and Controlled Technology Access and Transfer (CTAT) agreements.[70] Both national and allied defence and security agencies will face more pressure to ensure network and system integrity and credibility with the necessity for certification of foreign-sourced platforms and integrated

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[65] Adrian M. Ionescu, "Nanotechnology and Global Security," *Connections: The Quarterly Journal* 15, no. 2 (Winter 2016): 43-44, https://connections-qj.org/article/nanotechnology-and-global-security.

[66] European Commission, *Nanotechnology: The Invisible Giant Tackling Europe's Future Challenges* (Luxembourg: Publication Office of the European Union, 2013), 37.

[67] Massachusetts Institute of Technology, "Institute for Soldier Nanotechnologies," last accessed 16 March 2021, http://catalog.mit.edu/mit/research/institute-soldier-nanotechnologies/.

[68] *Ibid*.

[69] *Ibid*.

[70] T.J. Rowtre, "Is Globalization Undermining the Military Capability of the Nation State – and does it Matter?," (Seaford House Paper: The Royal College of Defence Studies, Ministry of Defence, 2008).

components. The CAF must select which components will stay under Canadian or US influence while maintaining relationships with defence sector partners.[71] Throughout this section, changes within the technological environment were addressed to include technological developments, emerging technologies and what that means to the CAF. It also discusses additive manufacturing and how it may transform supply chain management. It discussed artificial intelligence to include autonomous systems and nanotechnology and how both industries influence autonomous vehicle development. Lastly, it addresses impacts on the globalization of defence and security technologies. The following section will address changing trends affecting the economic environment.

Section 3 – Economic

Since economies are interrelated and will become even more so in the coming decades, understanding the global economy is essential to understanding ones own. Globalization and the differences between developed and developing nations are possibly the best examples of this concept. Although increased mutual dependency from global economies and alliances contribute to international cooperation and stability in developed nations, poverty and human rights violations in developing nations create conditions for increased global insecurity.[72]

Global Economy

As a part of globalization, economic power is changing. Over time, globalization has increased the economic influence of developed nations by expanding economies and deepening international economic integration. The rise of developing economies has moved employment to markets with cheaper labour, corroding the working middle class's income base in Western

[71] Department of National Defence, *The Future Security Environment 2013-2040* (Winnipeg: 17 Wing Winnipeg Publishing Office, 2014), 68.

[72] Michael Rostek et al., *Toward Army 2040: Exploring Key Dimensions of the Global Environment*, Vol. 14 (Kingston: Defence Management Studies Program, School of Policy Studies, Queen's University, 2011), 29.

nations and fueling social disparity. As shown by the emergence of populism and anti-globalization political positions, this has clear consequences for Western governments' capacity to raise tax revenue. While the expectation is that globalization will continue, the belief is that it will expand at a slower pace due to several factors. During the recent pandemic, there have been extreme instances of "nationalism, protectionism and regionalization."[73] More and more nations have been promoting *buy local* to boost local economies and consequently eroding globalization.

Canadian Economy

The economic outlook for Canada is positive, though there are some concerns. Because of the Canadian population's ageing, the labour market would strain pension and healthcare systems, resulting in added pressure on federal and provincial budgets. Although immigration has accounted for more than half of Canada's demographic growth, it will not be enough to reverse the baby-boomer population's ageing, putting a strain on the labour force. Finally, as the baby-boomer generation retires, competition for skilled workers is in higher demand, stifling Gross Domestic Product (GDP) expansion. Even if optimistic immigration projections come to fruition, there will still be a significant reduction in labour force growth, weakening GDP growth.[74]

Simultaneously, with natural resource surpluses and limited domestic demand experienced in Canada, exports will marginally outpace imports for the majority of the long-term forecast period. The trade sector will modestly continue to contribute to GDP growth until 2040, and as a result, incremental changes in the current growth are likely to increase over time. Global tensions between Canada and its largest trading nation, the US, make increased protectionism a

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[73] North American Treaty Organization, *Strategic Foresight Analysis* (NATO: Allied Command Transformation, 2017), 57.

[74] Conference Board of Canada, "Canadian Outlook Long Term Economic Forecast: 2020," (Ottawa: The Conference Board of Canada, 2020), 16.

risk. China is Canada's next major trading nation, and the tensions between the US and China are taking a serious toll on Canada's already slow-growing GDP.[75]

Global Trade

Trade, which accounts for over 60% of our national economy, remains critical to Canadian growth. The shock of the pandemic in 2020 has had a significant impact on GDP growth worldwide. With the uncertainty of when the pandemic will end, industries have to find innovative ways to overcome the challenges faced in global trade. As a result, protectionism is at an all-time high and makes it difficult to source otherwise readily available products.[76] In 2020, Canada saw another significant turn of events: the North American Trade Agreement (NAFTA) converted to the Canada-United States-Mexico Agreement (CUSMA). An assessment of the economic effect from CUSMA states that Canada can expect GDP gains of $6.8 billion.[77] The newly formed agreement strives to preserve NAFTA's key elements and addresses modern trade challenges; however, due to the global pandemic's unexpected shock, results from the first year in place will be skewed.[78] Strengthening global trade agreements into emerging foreign markets, especially those with enormous growth potential, are expected into the foreseeable future. These relationships are critical to the Canadian trade sector, as greater diversification will help cushion the exposure to any further economic downturns or tensions with the US. Whether with the United States or other nations, ongoing trade tensions highlight Canada's vulnerability in putting all its eggs in one basket and emphasizes the need for greater diversification.[79]

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[75] Conference Board of Canada, "Canadian Outlook Long Term Economic Forecast: 2020," (Ottawa: The Conference Board of Canada, 2020), 101.

[76] Government of Canada, "Canada's State of Trade," (Ottawa: Global Affairs Canada, 2020), 4.

[77] Global Affairs Canada, "The Canada-United States-Mexico Agreement: Economic Impact Assessment," last modified 26 February 2020, https://www.international.gc.ca/trade-commerce/assets/pdfs/agreements-accords/cusma-aceum/CUSMA-impact-repercussion-en.pdf.

[78] Government of Canada, "Canada's State of Trade," (Ottawa: Global Affairs Canada, 2020), 28.

[79] Conference Board of Canada, "Canadian Outlook Long Term Economic Forecast: 2020," (Ottawa: The Conference Board of Canada, 2020), 102.

Globalization will prove a source of opportunity and a source of danger for economies in the coming decades. As the developed world faces an ageing population and a slowdown of economic development, emerging nations herald a change in the global economic power balance.[80] As globalization continues, the concerns mentioned above will impact Logistics, such as securing new and existing supply chains, strategic lines of communication and transportation. Therefore, these trends are necessary to consider for future planning. The natural environment and raw materials derived from it will be the topic of discussion in the next section and how this will continue to cause friction or possibly regional conflict.[81]

Section 4 – Environmental

Physical geography is increasingly debated in the light of international security. Research claims the resources available in our natural environment (and how they are used) may lead to the emergence of violence. Using the examples of energy and water, this section explores the ramifications of environmental trends in light of global resource shortages. It discusses climate change concerns before considering their consequences not only in the context of the Canadian Arctic but globally.[82]

Climate Change

"Climate change is one of the defining challenges of the 21st century," and therefore a global issue that necessitates global solutions.[83] Governments worldwide are committing to and uniting to limit global warming, acknowledging that climate-related threats increase in

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[80] Michael Rostek et al., *Toward Army 2040: Exploring Key Dimensions of the Global Environment*, Vol. 14 (Kingston: Defence Management Studies Program, School of Policy Studies, Queen's University, 2011), 32.

[81] Department of National Defence, *The Future Security Environment 2013-2040* (Winnipeg: 17 Wing Winnipeg Publishing Office, 2014), 43.

[82] Michael Rostek et al., *Toward Army 2040: Exploring Key Dimensions of the Global Environment*, Vol. 14 (Kingston: Defence Management Studies Program, School of Policy Studies, Queen's University, 2011), 5.

[83] Environment and Climate Change Canada, *Canada's Changing Climate Report* (Ottawa: Canada, 2019), 11.

proportion to subsequent climate changes.[84] Food and water shortages and increasing sea levels in some nations are influenced by climate change. Dangerous water levels will have consequences such as flooding along the coast.[85] Tropical cyclones with high winds are causing rising water levels and will have intensified effects in certain regions, such as tropical island nations. In the widespread loss of inhabitable territories, some states are already debating problems like "de-territorialization" and people becoming "environmental refugees."[86] According to studies, 1 billion people will migrate by 2050, with up to a quarter of them caused by climate change.[87] Potential climate change effects in North America could range from heat waves, extreme storms, and substantial rainfalls and associated flooding to drought and forest fires. If this pattern continues, North America could be vulnerable to more frequent extreme disasters.[88]

Scientific studies on climate change indicate that the world must move to a net-zero economy by 2050 to prevent disastrous consequences.[89] It will be challenging to achieve even a slight decline in gross Greenhouse Gas (GHG) emissions from logistics by 2050.[90] This challenge is partially due to the requirement for logistics services to skyrocket for the next four decades. Previous research into the relationship between logistics and economic development predicted that freight by all modes of transportation would nearly triple between 2020 and

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[84] Environment and Climate Change Canada, *Canada's Changing Climate Report* (Ottawa: Canada, 2019), 11.

[85] T.F. Stocker et al, *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: Special Report of the Intergovernmental Panel on Climate Change* (New York: Cambridge University Press, 2012), 15.

[86] *Ibid.*, 16.

[87] Rachel Baird, Katy Migiro, and Judith Melby, "The Forced Migration Crisis," in *Human Tide: The Real Migration Crisis*, ed. Angela Burton and Jane Lewis (London: A Christian Aid Report, 2007), 5, 47, http://www.christianaid.org.uk/Images/human-tide.pdf.

[88] Department of National Defence, *The Future Security Environment 2013-2040* (Winnipeg: 17 Wing Winnipeg Publishing Office, 2014), 44.

[89] Environment and Natural Resources, "Net-Zero Emissions by 2050," last modified 26 February 2021, https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/net-zero-emissions-2050.html.

[90] A.C. McKinnon and M. Piecyk, "Logistics 2050: Moving Freight by Road in a Very Low Carbon World" in "Supply Chain Management in a Volatile World," Sweeney, E. ed. (Dublin: Blackrock Publishing, 2009.)

2050.[91] Most other industries, including transportation, long-haul trucks, and aircraft, all rely on carbon-based fuel in the near term. Nonetheless, by 2050, this fuel's net carbon emissions would be much smaller than it is now. At that time, more environmentally friendly biofuels would have replaced fossil fuels in most of the freight transportation infrastructure. New logistics technologies can take a long time to implement, particularly in the air, rail, and sea industries, where the capital equipment replacement process can take decades and technology is mature.[92]

Canadian Arctic

Climate change is the driving factor of environmental and ecological shifts in the Canadian Arctic, thereby intensifying existing geographic problems. Human-made disasters constitute a substantial threat to the Arctic, posing severe challenges for Northern populations and federal and territorial governments.[93] The strategic importance of the Arctic will be enhanced by resource scarcities associated with climate change impacts. Global warming will allow the Northwest Passage (NWP) to be navigable for several months of the year.[94] Some speculate that the NWP could be commercially feasible; however, amid the enthusiasm towards a bright future for Arctic shipping along the Arctic routes, in the near term, the NWP is unlikely to become a feasible large-scale transportation route. This stance is primarily due to "unpredictable ice in the NWP [that] poses significant navigational challenges and other routes [Northern Sea

[91] World Business Council for Sustainable Development, "Mobility 2030: Meeting the Challenges to Sustainability," (Switzerland: WBCSD, 2004), 32.

[92] H. van der Gracht *et al*, *Future of Logistics 2025: Global Scenarios*, (Wiesbaden: BrainNet Supply Management Group AG, 2008), 145.

[93] North American and Arctic Defence and Security Network, "Understanding the Future Arctic Security Environment: Applying NATO Strategic Foresight Analysis to Canadian Arctic Defence and Security," last accessed 25 February 2021, https://www.naadsn.ca/wp-content/uploads/2021/01/NAADSN-Arctic-Strategic-Foresight-Analysis-WEB-Final-2020.pdf.

[94] Michael Rostek et al., *Toward Army 2040: Exploring Key Dimensions of the Global Environment*, Vol. 14 (Kingston: Defence Management Studies Program, School of Policy Studies, Queen's University, 2011), 8.

Route] are likely to be more commercially viable."[95] In addition to the potential savings in shipping routes and the debated sovereignty of the NWP and other areas in the Arctic, the Canadian Arctic's oil accounts for up to 20.6% of the Arctic's undiscovered fossil fuels.[96] Mineral exploration and exploitation, fishing, and tourism will also bring both opportunities and challenges. As the Arctic becomes more accessible than in the past, so will its strategic worth, and with that will come increased military presence.[97]

Non-renewable Resources

Research suggests "oil and other fossil fuels are expected to remain the main source for transport and electric power generation for the next two decades."[98] Emerging countries' fast economic growth has a strong effect on global energy consumption.[99] The two most prominent global energy trends rise in all energy sources, with green energy being the fastest-growing source and the continuation of relatively high oil prices.[100] A promising form of renewable energy is biofuel. When combined with a new technique known as "carbon capture and storage," the mechanism of processing and utilizing biofuels could successfully extract CO2 from the atmosphere.[101] According to studies, global energy demand will grow by 50% by 2040, with oil, gas, and other fossil fuels responsible for roughly 80% of this growth.[102] The CAF will only

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[95] The Arctic Institute, "Canada in the Arctic: Arctic Shipping: Routes, Forecasts, and Politics," last accessed 4 March 2021, https://www.thearcticinstitute.org/canada-arctic-shipping-part2/.

[96] The Arctic Institute, "Canada in the Arctic - Arctic Oil and Gas: Reserves, Activities, and Disputes," last accessed 4 March 2021, https://www.thearcticinstitute.org/canada-arctic-oil-gas-part1/.

[97] North American Treaty Organization, *Strategic Foresight Analysis* (NATO: Allied Command Transformation, 2017), 70.

[98] *Ibid.*, 57.

[99] Government of the United States of America, *Global Trends 2030:Alternative Worlds*, (National Intelligence Council, 2012), 34.

[100] U.S. Energy Information Administration, "Annual Energy Outlook 2020: With Projections to 2050," last modified 29 January 2020, https://www.eia.gov/outlooks/aeo/pdf/AEO2020%20Full%20Report.pdf.

[101] Lehman, C. "Biofuel." Last modified March 31, 2020. https://www.britannica.com/technology/biofuel.

[102] International Energy Association, "World Energy Outlook 2020," (Paris: 2012), 1, https://www.iea.org/reports/world-energy-outlook-2020.

benefit from implementing policies to mitigate energy demand and promote attempts to identify alternative solutions. The delivery of fuel and other energy services to forces during international operations creates specific vulnerabilities. Domestic and continental energy supplies' certainty in the coming decades and ensuring communication and fair trade in the international arena could be essential for energy exportation instead of importations.[103]

Renewable Resources

With increased economic population growth, the need for resources rises. Food and water supplies have failed to keep up at times, and there are fears that this will exacerbate tensions in some areas.[104] Water scarcity and current political conflicts between some nations make it impossible to rule out the possibility that water scarcity can trigger civil unrest and regional conflict.[105] A significant concern in many parts of the world, *water stress* is unlikely to be a direct violence source. Instead, it may be linked to poor governments, large heterogeneous societies, social inequality, low economic growth, and conflict-prone areas to explain differences in conflict danger.[106] According to the United Nations, "water scarcity will continue to increase in the future, with around 52% of the world's population living in water-stressed regions by 2050."[107] Desalination is a technique for supplementing freshwater sources by separating dissolved salts from brackish or saltwater. Desalination can significantly increase water quality and replace local and manufacturing water demand by 2050 due to the limitless availability of

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[103] Department of National Defence, *The Future Security Environment 2013-2040* (Winnipeg: 17 Wing Winnipeg Publishing Office, 2014), 46.

[104] Alex Evans, "Resource Scarcity: Fair Shares and Development," (WWF-UK/Oxfam Discussion Paper, 2011), 4.

[105] Catholic Relief Services, "Water Security Strategy for 2030," (Baltimore: CRS, 2019), 18, https://www.crs.org/sites/default/files/tools-research/water_security_for_2030_-_strategy.pdf.

[106] Halvard Buhaug and O.M. Theisen, "On Environment Change and Armed Conflict" in "Climate Change, Human Security and Violent Conflict: Challenges for Societal Stability," (Berlin: Springer-Verlag Heidelberg, 2012), 43-55.

[107] United Nations, "World Water Development Report 2020: Water and Climate Change," (Paris: UNESCO, 2018), https://www.unwater.org/publications/world-water-development-report-2020/.

"seawater and the decreasing cost of renewable energy sources."[108] Canada and its allies and partners will continue to lead global efforts to help vulnerable regions.[109]

Sustainability

The European Commission unveiled the European Green Deal in December 2019, an ambitious reform aimed at making the European Union's economy more environmentally friendly. By 2050, the aim is to achieve climate neutrality and transform it into a business and industrial opportunity for Europe. The EU's arrangements with leading energy providers will restructure if this flow drastically reduces. Russia, Algeria, and Norway, for example, would eventually lose their primary export market. Inevitably, Europe's move away from fossil fuels would harm various regional allies, potentially destabilizing them economically and politically.[110] Second, about 20% of global crude oil imports go to Europe. Even if they do not trade more with the EU, the drop in oil demand caused by Europe's transition to renewables would affect the global oil market, depress prices, and reduce the significant exporters' profits. Coal, the most polluting component of the energy mix, must be phased out by 2030, whereas oil and, mostly, natural gas can be phased out at a later point in time. The majority of the transition in the oil and gas industry will occur between 2030 and 2050. Oil is predicting to be phased out almost entirely within this timeframe, with natural gas accounting for just a tenth of EU energy in 2050. Trade between Russia and the European Union accounts for 75% of Russian natural gas exports and 60% of Russian crude oil exports.[111]

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[108] United Nations, "World Water Development Report 2020: Water and Climate Change," (Paris: UNESCO, 2018), 26, 54, https://www.unwater.org/publications/world-water-development-report-2020/.

[109] Department of National Defence, *The Future Security Environment 2013-2040* (Winnipeg: 17 Wing Winnipeg Publishing Office, 2014), 46.

[110] Leonard, Mark, Jean Pisani-Ferry, Jeremy Shapiro, Simone Tagliapietra, and Guntram Wolff. *The Geopolitics of the European Green Deal*. (Bruegel: Policy Contribution, 2021), 2.

[111] *Ibid.*, 5.

The consequences of further degradation will be disastrous as climate change becomes a more urgent problem. If the impacts of global warming become more widespread and extreme, drastic changes are needed to reverse the effects. If the planet looks for a more prosperous future, environmental developments would significantly affect the gas and oil industries. The next segment will look at political developments that will affect the security climate in the future.

Section 5 – Political

Geopolitics is the study of the redistribution of power amongst states in the global system, focusing on the interaction of both geography and politics. Geopolitics encompasses mutual and multilateral interactions between and among nations, allies and partners, working together to advance mutual goals. However, since security assessments are contextual, shifts in state authority and efforts to further geopolitical goals often result in friction and, in some cases, military conflict.[112] This section will provide a practical assessment of emerging geopolitical trends relevant to the CAF. We can count on an underlying expectation that the state will continue to be the international community's primary political actor until 2040.[113]

Shifts in Power

Increased geopolitical rivalry, even among regional players, will result from the current power shifts in the international system.[114] Although recent developments show that the risk of major powers fighting has decreased, changes in power balance have often been followed by systemic violence. As a result, given the instability level that will follow the current state of flux in the international community, war cannot be ruled out. Much will be determined by potential

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[112] Department of National Defence, *The Future Security Environment 2013-2040* (Winnipeg: 17 Wing Winnipeg Publishing Office, 2014), 1.

[113] *Ibid.*, 2.

[114] ABCA, "Strategic Assessment of the Security Environment 2012-2035," (ABCA: Report Number 154, 2012), 6.

government estimates of the possible risks of military action to settle conflicts.[115] Such circumstances can currently be seen between Japan, China, and rivalry for power in Central Asia among China, Iran, Pakistan and India. The capacity for a confrontation between states can be imminent in those geographical areas where power is contested.[116] The increased dispersal of economic resources and fluctuations in geopolitical power can create instability between competing states. However, the high level of connection that currently embodies the global system reduces the likelihood of prolonged confrontation between major powers. Nations will use their resources to influence and protect their rights and further their domestic interests. To protect Canada and Canada's interests, the CAF must deploy internationally, even in insecure regions, to support the Government's foreign policy and project national power. Due to this paper's scope, it is unrealistic to discuss all nations and players that will affect the geopolitical climate for the next twenty years. On the other hand, a quick analysis of key global powers and other prominent players, an articulation of the geopolitical situation, can help the defence organization.[117]

Major Global Powers

The US will probably continue to be the leading armed forces in the upcoming decades due to its ability to project power to any corner of the world. It is also possible that the steady rise of Chinese diplomatic and military power will be significant. By 2050, trends show that China will be the world's leading economy by a wide margin, with India edging out the United States for second place and Indonesia rising to fourth. Russia, one of the seventh largest

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[115] Department of National Defence, *The Future Security Environment 2013-2040* (Winnipeg: 17 Wing Winnipeg Publishing Office, 2014), 2.

[116] *Ibid.*, 3.

[117] *Ibid.*

emerging economies and currently experiencing a resurgence of diplomatic and military power, will gradually constrain US political, commercial, and military freedom of manoeuvre.[118] The United States will uphold and reinforce its core alliances and find ways to maintain its global influence and power. The social, political, and economic relations between Canada and the US will continue as the country's largest trading partner.[119] The United States' role in maintaining global independence is doubtful to change in the short to medium term; the decrease in powers would put more strain on the military and bring a new focus on the US to pursue foreign cooperation. Amid the continuing growth of new and technologically sophisticated military technologies, CAF Force Development (FD) will face challenges in ensuring emerging capabilities' ability to align with the US defence. To promote integration with US activities, CAF FD must prioritize interoperability with the US.[120]

China is not likely to threaten its growth and economic power by engaging in a long-term strategic struggle with existing forces.[121] As a result, long-term violence that interrupts the international economic centre will undoubtedly be seen as a roadblock rather than a roadmap to growth. Internal complexities, such as rising inequalities, regional inequalities, employment shortage, rising wages, environmental pollution, exploitation, and the lack of structural verifications, all of which may create substantial socio-economic challenges posing a threat to

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[118] Price Waterhouse Coopers, "The World in 2050: The Long View: How will the Global Economic Order Change by 2050?" last modified February 2017, https://www.pwc.com/gx/en/world-2050/assets/pwc-the-world-in-2050-full-report-feb-2017.pdf.

[119] Government of Canada, "Canada-United States Relations," last modified 18 February 2021, https://www.international.gc.ca/country-pays/us-eu/relations.aspx?lang=eng.

[120] Department of National Defence, *The Future Security Environment 2013-2040* (Winnipeg: 17 Wing Winnipeg Publishing Office, 2014), 6.

[121] Michael D. Swaine and M.T. Flavel, "China's Assertive Behaviour – Part Two: The Maritime Periphery," *China Leadership Monitor* no. 35 (Summer 2011): 14, http://carnegieendowment.org/filesCLM35MS.pdf.

China's rise. China's Belt and Road Initiative expects to bolster global GDP by $7 trillion yearly by 2040. In addition, Russia's GDP is anticipating to increase by 18%.[122]

In recent years, Russia has been more assertive. The invasion of "Crimea in 2014, the military intervention in the Syrian civil war in 2015, and the interference in the US presidential elections in 2016 and 2020" are all well-known examples.[123] Europe will almost certainly continue to be faced with a resurgent Russia as a distant neighbour. Except for spectacular upheavals, it is fair to say that a forceful Russian defence policy will be a long-term phenomenon during the current period of strategic rebalancing. This trend indicates Europe will have to maintain ties with significant political and military powers and stands together to maintain its global position.[124] It is uncertain how long the Russian people would endure the country's economic downturn, which began in 2014 and is related to a strong dependence on fossil fuels and the new regime's repression and diplomatic aspirations. However, it is clear that Russia's new business model, based entirely on fossil fuels, faces serious problems and may not be viable in the long run.[125]

Studies show that trends will shift global power away from Europe and towards Asia. The EU's global GDP share is projecting to decline, and the UK's recent withdrawal from the EU has eroded its global influence even further.[126] Canada's contribution to NATO will help to promote interoperability with its European allies. Reduced NATO countries' defence spending

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[122] The Center for Economics and Business Research, "Belt and Road Initiative to Boost World GDP by over $7 Trillion per Annum by 2040," last modified 27 May 2019, https://cebr.com/reports/belt-and-road-initiative-to-boost-world-gdp-by-over-7-trillion-per-annum-by-2040/.

[123] Hague Center for Strategic Studies, "Geopolitical Genesis: Dutch Foreign and Security Policy in a Post-COVID World," (The Hague: Clingendael, 2021), 31, https://hcss.nl/sites/default/files/files/reports/Strategische%20Monitor%202021.pdf.

[124] *Ibid.*

[125] *Ibid.*, 3.

[126] Price Waterhouse Coopers, "The World in 2050: The Long View: How will the Global Economic Order Change by 2050?" last modified February 2017, https://www.pwc.com/gx/en/world-2050/assets/pwc-the-world-in-2050-full-report-feb-2017.pdf.

will impede interoperability and complicate Joint Interagency Multi-National and Public (JIMP) operations.[127] Nonetheless, the United Kingdom, France, and Germany expect to be Europe's most strong nations. The US, NATO, and the Five Eyes (FVEY) community should continue to be the CAF's top priorities in terms of interoperability.[128]

NATO will almost certainly continue to play an essential part in Western security issues and take decisive measures when necessary. NATO's mission is "To contribute to preserving the peace, security and territorial integrity of Alliance member states by leading the warfare development of military structures, forces, capabilities and doctrines. The mission must enable NATO to meet its level of ambition and core missions."[129]

The FVEY network, formed after WWII, "is an intelligence alliance comprising Australia, Canada, New Zealand, the United Kingdom and the United States."[130] In 2040, the FVEY community predicts the future security environment to be "complicated, contested, and congested," especially for Logistics, and enemies can and will detect and exploit vulnerabilities to the point where there is an expectation of intervention.[131]

The United Nations (UN), through organizations such as the World Food Program and the World Health Organization, help to alleviate specific humanitarian hardships and raise living standards through improvement programmes. Similar support programmes expect to continue to impact the economic economy positively in the future. Canada will assist multilateral

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[127] Gizewski, Peter and Michael Rostek, "Towards a JIMP-Capable Land Force," *Canadian Army Journal* 10, no.1 (Winter 2007): 55-72, publications.gc.ca/collections/collection_2007/nd-dn/D12-11-10-1E.pdf.

[128] Department of National Defence, *The Future Security Environment 2013-2040* (Winnipeg: 17 Wing Winnipeg Publishing Office, 2014), 8.

[129] North American Treaty Organization, "Allied Command Transformation: NATO's Warfare Development Command," last accessed 5 March 2021, https://www.act.nato.int/.

[130] The National Counterintelligence and Security Center, "Five Eyes Intelligence Oversight and Review Council (FIORC)," last accessed 19 April 2021, https://www.dni.gov/index.php/ncsc-how-we-work/217-about/organization/icig-pages/2660-icig-fiorc.

[131] Australian Defence Force, "Concept for Future Logistics," last accessed 18 April 2021, https://www.defence.gov.au/VCDF/forceexploration/_Master/docs/ADF-Concept-Logistics.pdf.

organizations as it has in the past. The Government of Canada (GoC) can guide CAF involvement in multilateral military operations to maintain specific United Nations Security Council Resolutions (UNSCR).[132] The shift of economic and military influence has contributed to the West's relative decline, especially in Asia. There is an expectation that re-emerging states and their forces will pose a growing threat to NATO and the West's supremacy.[133] The relationship of the "three global powers – the US, China, and, increasingly, the European Union – will play a larger role in defining the landscape."[134]

By analyzing the contextual environment, Step 2 is complete and highlights significant trends that will be useful to the CAF in the years ahead, up to 2040. Indeed, the paper demonstrates that Canada operates in a complex, ever-changing world where change and uncertainty are constant. The overarching conclusion drawn from this paper's considerations is that the CAF will need to prepare for domestic military and contingency operations and expeditionary operations.[135] Throughout the chapter, this paper demonstrated how a close examination of future trends and their implications, using the environmental scanning process, would reveal new areas that may guide current defence policy decisions to resolve potential challenges. By showing step-by-step employment of the environmental scanning process demonstrates the ability to ensure that such research is carried out consistently and with a level of rigidity and reliability that would be impossible to accomplish otherwise.

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[132] Department of National Defence, *The Future Security Environment 2013-2040* (Winnipeg: 17 Wing Winnipeg Publishing Office, 2014), 24, 25.

[133] North American Treaty Organization, *Strategic Foresight Analysis* (NATO: Allied Command Transformation, 2017), 8.

[134] Hague Center for Strategic Studies, Geopolitical Genesis: Dutch Foreign and Security Policy in a Post-COVID World. (The Hague: Clingendael, 2021), 5. https://hcss.nl/sites/default/files/files/reports/Strategische%20Monitor%202021.pdf.

[135] Department of National Defence, *The Future Security Environment 2013-2040* (Winnipeg: 17 Wing Winnipeg Publishing Office, 2014), 127.

CHAPTER 2 – TWO AXES METHODOLOGY

The study of alternative futures may be referred to in other literature as "futures studies, futures thinking, foresight and futurism," however, it will be referred to as an alternative future for this paper's purposes.[136] The development of alternative futures uses a rational framework to define the future operating environment. It offers a way to defend against volatility while simultaneously encouraging an organization to prepare for potential requirements. Using alternative futures means explaining what a future will look like from an objective point of view. This paper's methodology will not measure the likelihood of each alternative future occurring; instead, it suggests that each future follows a criterion that is within the realm of possibility. In an increasingly competitive environment, developing alternative futures is an essential task for organizations such as the CAF and must ensure it does not overlook Logistics. Alternative futures are a long-term forecasting technique that identifies shifts in the operating environment that can affect and even form the logistics field's direction in the coming decades. Although some alternative future elements are likely to be incorrect, their implementation will aid in long-term logistics planning. This process will help senior leadership make decisions that are more informed by reducing uncertainties in the future security environment.[137]

By scanning the contextual environment, it enabled the ability to observe a convergence of future trends more clearly. This section will look at the convergence of trends rather than simply extrapolating individual trends. This methodology assists in subjectively categorizing nine key change drivers for Logistics in the year 2040 as listed below:

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[136] Alex Fergnani, "Futures Studies, Foresight, Futurism, Futurology, Futures Thinking…What Name???," last modified 30 April 2020, https://medium.com/predict/futures-studies-foresight-futurism-futurology-futures-thinking-what-name-3b3863ceab8c.

[137] Michael A. Rostek, Peter Gizewski and Regan Reshke, *Conceiving an Army for the 21st Century* (Ottawa: Defence R&D Canada - CORA, 2010), 11.

1. Sustainable Environment – The world can no longer ignore climate change, and, as such, it is a global issue that requires global solutions. Over the next twenty years, the expectation is that more natural disasters will result, such as flooding, food and water shortages, sea levels will increase, drought and forest fires will be more common. The CAF has a long history of providing support to disaster relief operations, not only abroad but domestically. The CAF will respond more effectively to crises due to the development of standing operations that support relief efforts, such as Operation LENTUS, which supports domestic disasters, and Operation RENAISSANCE, which supports disaster relief overseas.[138] The requirement for a scalable and adaptive supply chain and sustainment infrastructure that can support emergency operations in any place around the world has consequences for logistics. Given the lack of infrastructure and resources, providing support and sustainment to operations in remote areas such as the Arctic will be problematic for the CAF. According to scientific studies on climate change, the planet must transition to a net-zero economy by 2050 to avoid catastrophic consequences. This global initiative will significantly impact future operations as this transition occurs both at home and abroad.

2. Emerging Technologies – With the fast pace of technological advancements, armed forces face the challenge of determining what forms of technology to invest in and how much to invest in each. Since most militaries have limited research and development budgets, they must be selective about the technological capabilities they adopt. In today's

[138] Department of National Defence, "Operation LENTUS," last accessed 18 March 2021, https://www.canada.ca/en/department-national-defence/services/operations/military-operations/current-operations/operation-lentus.html; Department of National Defence, "Operation RENAISSANCE," last modified 5 April 2020, https://www.canada.ca/en/department-national-defence/services/operations/military-operations/current-operations/operation-renaissance.html.

security climate, emerging technologies are becoming more commercially accessible and inexpensive, and this challenge could interrupt CAF operations. The CAF must not only protect itself from individuals, state and non-state actors, but it must also ensure interoperability with its allies. The developments leading up to 2040 are very positive in terms of a number of technological advances that will see prospects for logistics efficiencies. Personnel will be the CAF's most limited resource, and, as a result, investing in technologies that reduce personnel requirements and will assist in decreasing the logistics footprint.[139] Artificial Intelligence, Autonomous Systems, Additive Manufacturing, and Nanotechnology are all innovations that offer those possibilities.

3. Global Commerce – Nations are becoming more reliant on trade agreements as globalization and foreign trading progress. Although trade tends to lower costs for the average customer, it also comes with risks. This danger was evident during the recent pandemic when nationalism, protectionism, and regionalism hampered the CAF's ability to procure necessary safety supplies and equipment.[140] With the potential for the future security environment to present similar shocks to global trade, logistics must have a robust procurement structure that can source critical supplies to sustain the CAF.

4. Global Power Shift – Current trends indicate that the United States will remain the world's leading power until 2040; however, they also suggest that other nations, such as China and India, will gain power. Experts do not anticipate the major powers to engage in war because of the world economy's interconnectedness. Economic resources and

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[139] M.N. Popov, "A Confluence of Factors: Canadian Forces Retention and The Future Force," (Joint Command and Staff Program Masters in Defence Studies, Canadian Forces College, 2011), 136.

[140] Department of National Defence, "CDS/DM Directive for the Resumption of Sustained Activities in a COVID-19 Environment (Fall 2020 Posture) – Amendment 2," last modified 17 December 2020, https://www.canada.ca/en/department-national-defence/corporate/policies-standards/cds-dm-directive-fall-2020-posture.html.

political influence expect to fluctuate because of the change of power in Asia. Conflict between China, Iran, India, and Pakistan over disputed areas in that region and China and Japan appears to be on the horizon. By participating in Operation PROJECTION, the Canadian Armed Forces is committed to promoting stability operations worldwide.[141] As tensions in Southeast Asia rise, the CAF is likely to support its allies and maintain operations in the area, especially in the maritime domain. It will be vital more than ever that logistics establish strategic lines of communication that support sustainment to CAF operations in a far-reaching part of the world.

5. Megacities – According to projections, 65 percent of the world's population will live in megacities along the coast by 2040.[142] This trend will bring new challenges for the CAF, as it will be expected to have cultural awareness and the requisite expertise to deal with the complexities of this environment. As forces prepare to operate in urban areas vice rural locations, the logistics footprint to support such operations must not be disruptive. Conflict in urban areas will challenge logistics to find innovative ways to sustain its forces. Future operations expect to occur in the "narrow zone astride coastlines," otherwise known as the littorals, where the "air, land and maritime domains intersect in complex ways."[143] The predicted congestion of a megacity and the difficulties of working in a collaborative environment will bring unprecedented demands on the

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[141] Department of National Defence, "Operation PROJECTION," last modified 2 February 2021, https://www.canada.ca/en/department-national-defence/services/operations/military-operations/current-operations/operation-projection.html.

[142] United Nations Population Fund, "State of the World Population 2007: Unleashing the Potential of Urban Growth," last accessed 1 March 2021, http://www.unfpa.org/swp/2007/english/introduction.html.

[143] Department of National Defence, *Canada in a New Maritime World: Leadmark 2050*, (Ottawa: Commander, Royal Canadian Navy, 2016), 26.

capacity to support broadly scattered forces. As a result, emerging technology will play an essential role in overcoming this challenge.[144]

6. Migration – Large-scale migration is generally caused by conflict or a lack of stability in poor or failing nations. It may also be the result of natural disasters that cause people to evacuate their homes. When this happens, humanitarian assistance is generally required to support a large number of refugees. Humanitarian assistance and disaster relief (HA/DR) will continue to be an issue well into 2040, and the Canadian Armed Forces will do its part to help. Canada is reinforcing its commitment to the United Nations (UN) humanitarian relief efforts.[145] As with disaster relief, logistics must have the necessary plans to support humanitarian assistance efforts where and when necessary, including remote and resource-constrained parts of the world. The CAF will likely be called upon to transport urgent supplies for other organizations in the circumstances like HA/DR and UN missions. As a result, logistics must have an agile movement strategy to balance supporting its forces in addition to external organizations.

7. Natural Resources – For the next two decades, most sources observe trends that oil and gas will continue to be the primary source of transport and energy generation. As economies and the global population expand, energy demand will rise dramatically, keeping fuel prices high. On the other hand, green energy is a trend that is gaining significant importance on a global scale. The use of fossil fuels will decrease as demand rises and green energy technology becomes more widely available and affordable. Fears

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[144] Department of National Defence, *Canada in a New Maritime World: Leadmark 2050*, (Ottawa: Commander, Royal Canadian Navy, 2016), 56.

[145] Global Affairs Canada, "Canada's Ongoing Humanitarian Efforts in Response to COVID-19 Pandemic," last modified 15 June 2020, https://www.canada.ca/en/global-affairs/news/2020/06/canadas-ongoing-humanitarian-efforts-in-response-to-covid-19-pandemic.html.

that fossil fuels may become scarce in the future may now be unfounded as the world works to decrease its carbon footprint. Besides the potential for economic instability in gas and oil-dependent nations, other factors are at play with this trend. The European Union has an unprecedented plan to phase out most of its dependency on fossil fuels by 2050 through the European Green Deal.[146] This plan may affect future operations because fossil fuel availability may be limited in Europe, a common CAF and NATO operating area. As countries transition from fossil fuels to green energy, the ability to source fuel for CAF future operations (its primary energy source) will be a challenge for logistics.

Food and water scarcity offers an entirely different set of challenges for sustaining the CAF on operations. With over half of the world's population living in water-stressed regions by 2050 and the CAF committed to supporting peace and stability operations for the foreseeable future, logistics planners can no longer assume that water can be commercially sourced when deployed.[147] Improving technological advancements such as desalination and increasing its ability to support larger-scale water requirements on CAF deployments will be vital to future operations success.

8. Canadian Arctic – The increasing strategic importance of the Arctic will provide both opportunities and challenges for Canada. While there are many uncertainties over the possibility of conflict over resources or the Northwest Passage, CAF presence will continue, and so will the requirement to deploy and sustain forces while in the Arctic. No matter what the reason, whether it be a natural disaster, conflict or simply an operation or exercise, the lack of infrastructure will continue to be an issue for the foreseeable future.

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[146] Leonard, Mark, Jean Pisani-Ferry, Jeremy Shapiro, Simone Tagliapietra, and Guntram Wolff. *The Geopolitics of the European Green Deal*. (Bruegel: Policy Contribution, 2021), 5.

[147] Catholic Relief Services, "Water Security Strategy for 2030," (Baltimore: CRS, 2019), 18, https://www.crs.org/sites/default/files/tools-research/water_security_for_2030_-_strategy.pdf.

Airport and seaport infrastructure, storage facilities, health care facilities, communications, fuel and road networks are all limiting factors to sustainment in the Arctic.[148] At present, the Arctic economy cannot support CAF requirements, and therefore all support must be integral. As the Arctic continues to open, logistics support concepts must overcome the sustainment issues that will continue into 2040.

9. Age & Demographics Composition – The composition of age and demographics influence the future security environment. Over the next two decades, India, Africa, and the Middle East expect to see a youth bulge. These countries' economic opportunities are limited, and high unemployment rates contribute to instability. On the other hand, Western societies are dealing with an ageing population, with the workforce shrinking as baby boomers retire and the birth rate declines. Instability will persist elsewhere, and the CAF will support its allies in peace and security; however, maintaining personnel levels in the CAF with a smaller, highly sought-after workforce will be challenging. Expecting retention to improve over the next two decades may be unrealistic. As a result, focusing on technological advancements that decrease the demand for personnel is critical.

To reiterate this paper's process, Figure 3 depicts the foundation for building the alternative future. Now that the first two steps are complete, the next step will assess the key drivers' uncertainties and identify their polarities.

[148] Arctic Today, "A New Report Measures the Infrastructure Gap Between Nunavut and the Rest of Canada," last modified 26 October 2020, https://www.arctictoday.com/a-new-report-measures-the-infrastructure-gap-between-nunavut-and-the-rest-of-canada/.

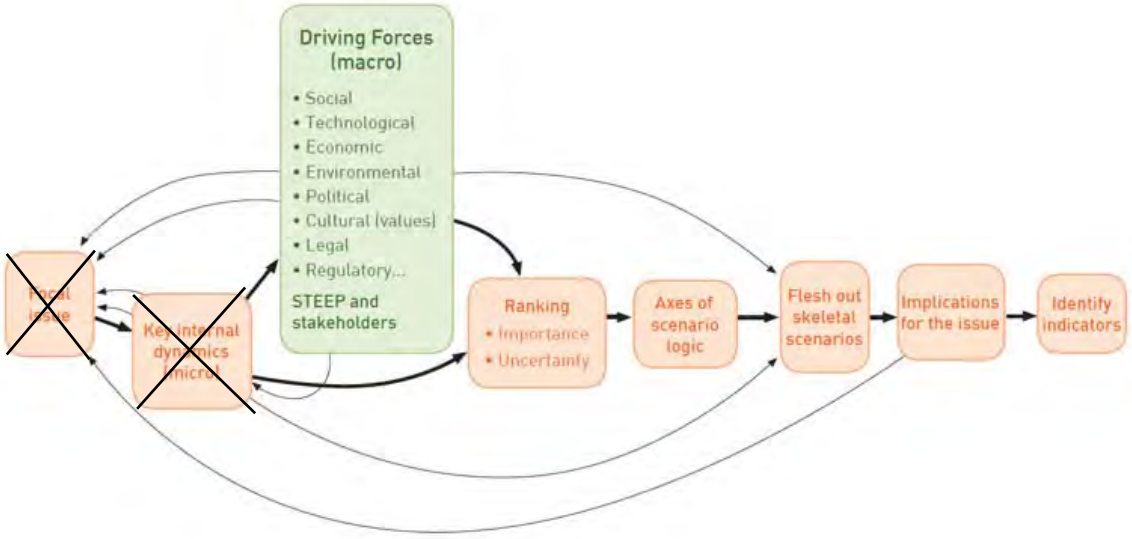

Figure 3: Steps of the 2x2 Matrix Technique

Step 3: Identify Driving Forces in the Environment

Critical uncertainties are the unanswered questions significant to the focal issue in play, namely, how must Logistics prepare for the sustainment of the CAF in the future security environment in the year 2040? A viable framework that supports alternative futures will base itself on two critical uncertainties consistent with the general issue, which concerns Logistics. In the process of identifying key drivers and the polarities associated with each, the following outcomes emerged:

1. Sustainable Environment – Deceleration of Global Warming vs. Acceleration of Global Warming;
2. Emerging Technologies – Falling Behind vs. Driving New Technologies;
3. Global Commerce – Increased Interdependency vs. Increased Nationalism;

4. Global Power Shift – Stability & Global Cooperation vs. Instability & Increased Rivalry;
5. Megacities – Sustainable Infrastructure vs. Inadequate Infrastructure;
6. Migration – Decreased vs. Increased;
7. Natural Resources – Sustainable vs. Unsustainable;
8. Canadian Arctic – Able to Protect vs. Unable to Protect; and
9. Age & Demographics Composition – Young Population & Growth vs. Aging Population & Decline.

Step 4: Rank Key Drivers by Importance and Uncertainty

After determining each key driver's polarities, the next step in the process will be to subjectively determine the degree of *uncertainty* and *impact* on a small, medium, and large scale, resulting in a ranking of each key driver. In this context, uncertainty applies to a subjective estimation of how well the key drivers and their associated trends are recognized or accepted. Consequently, a reduced level of uncertainty means a greater level of optimism that inferring trends will resemble more realistic future events. The term impact corresponds to a subjective evaluation of how much the key drivers can affect future events. This subjective evaluation paints a simple picture of each key drivers place reference one another on an impact-uncertainty graph.[149] Therefore, the alternative future framework will focus on the key drivers with high uncertainty and high impact. Figure 4 depicts each key driver's ranking and will form the basis for the remainder of the study.[150]

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[149] Michael A. Rostek, Peter Gizewski and Regan Reshke, *Conceiving an Army for the 21st Century* (Ottawa: Defence R&D Canada - CORA, 2010), 13, 14.

[150] T. Wulf, C. Brands, and P. Meissner, "A Scenario-Based Approach to Strategic Planning," last accessed 22 March 2021, https://canvas.uts.edu.au/courses/1276/pages/uncertainty-slash-impact-matrix.

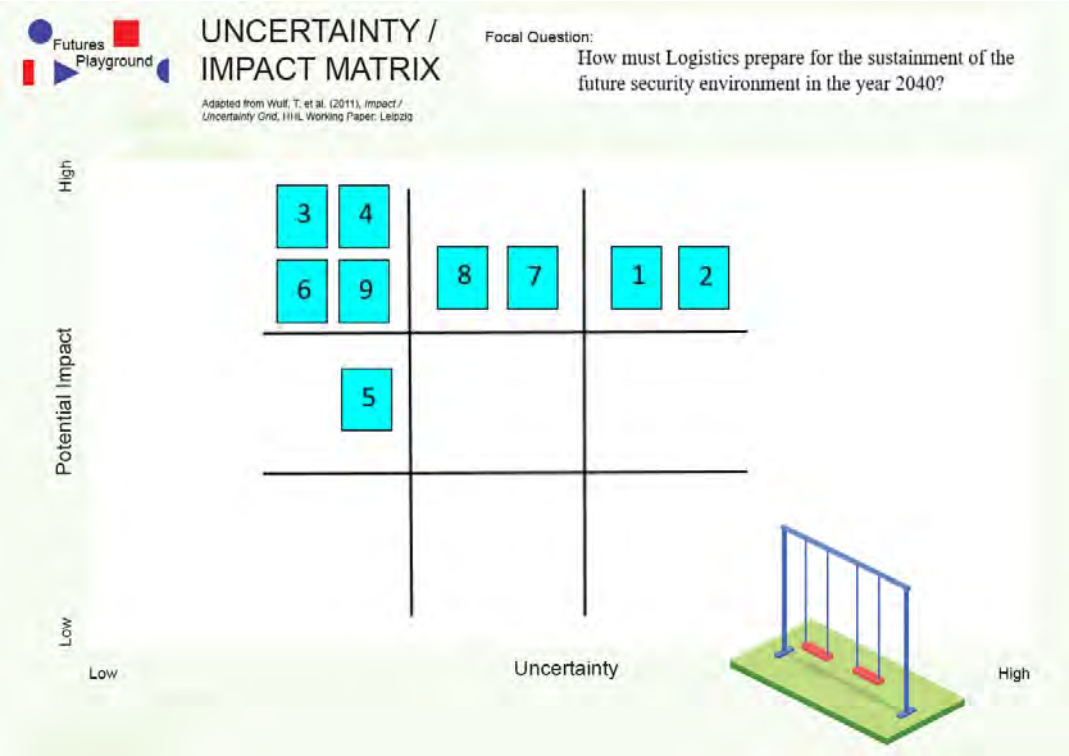

Figure 4: Uncertainty / Impact Matrix

Step 5: Selecting the Alternative Futures Logic

The next step in the process, which forms the axes, identifies the two critical uncertainties having a high impact-uncertainty rating, making it possible to visualize the four conceivable futures: the positive, the negative, and two mixed quadrants (refer to Figure 5).[151]

[151] Creately, "Scenario Planning Example (Block Diagram)," last accessed 27 March 2021, https://creately.com/diagram/example/jvoum6r32/Scenario%2Bplanning%2Bexample?utm_source=pinterest&utm_medium=social&utm_campaign=pinblock.

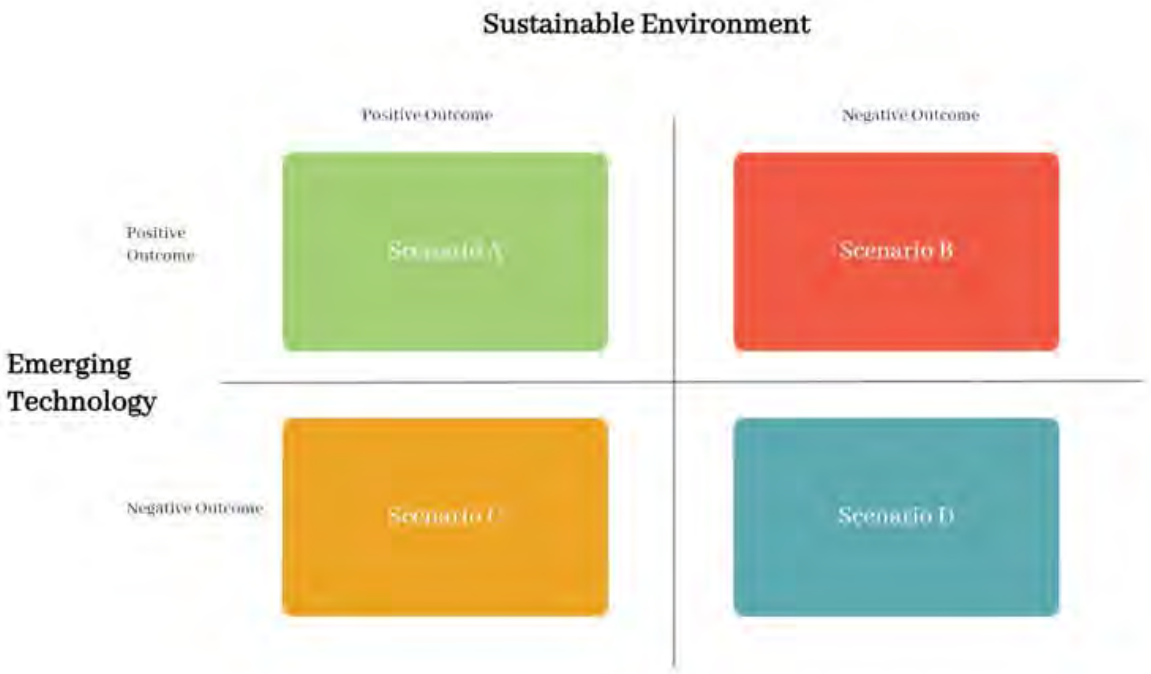

Figure 5: Critical Uncertainties Alternative Futures Matrix

Each alternative future will receive appropriate titles centred on the idea that each quadrant will convey. All quadrants must remain compatible with the overarching focal point and timeframe. This consistency makes for more stable futures and helps develop alternative futures, which is the next step.

Using the research and the two axes introduced in chapter 2, the next chapter will expand on the key drivers with high uncertainty/high impact and their polarities. The data from the previous two chapters will be used in this step to help shape the four alternate futures.

CHAPTER 3 – ALTERNATIVE FUTURES

Step 6: Fleshing Out the Alternative Futures

An alternative future is not a prediction of what will happen in the future; however, it endeavours to comprehend all of the drivers that concern the organization and what to do to resolve them.[152] Instead, alternative futures "test policy and planning assumptions" within an organization.[153] They are stories based on the research undertaken to construct a storyline constant with the logic of the space while considering the axes as depicted in figure 5 above. By injecting other key drivers with high rankings into each storyline, the aim is to achieve the creation of more plausible alternate futures and, as a result, build a strong foundation for the ultimate phase of futures creation. Each alternative future will analyze converging trends and create a narrative that leads to its conclusion. Alternative futures should strive to be conceivable.[154] Shocks or sudden developments may trigger a rapid change in direction, such as a ground-breaking development or a catastrophic event, bringing substance to the situation and theoretically allowing for the discovery of mitigation strategies. Shocks are unanticipated occurrences that alter the intended course of strategy and policy of an organization. As an example, the recent pandemic can be defined as a shock. Shocks are described as occurrences with a low likelihood but a high effect on the organization. Such experiences will drastically alter future events and force a profound rethinking of perspectives. Organizations may find additional

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[152] Dalhousie University, "Scenario Planning: Process, Tools and Example," last modified 23 April 2020, https://cdn.dal.ca/content/dam/dalhousie/pdf/dept/maceachen-institute/Scenario%20Planning-%20Process,%20Tools%20and%20Example%20(1).pdf.

[153] Policy Horizons Canada, "Foresight Training Manual: Module 6 – Scenarios and Results," last accessed 24 March 2021, https://horizons.gc.ca/wp-content/uploads/2018/12/2016-0276-presentation-eng.pdf.

[154] Alun, Rhydderch, "Scenario Building: The 2x2 Matrix Technique," (Paris: Futuribles International, 2017), 10.

solutions and improve their capacity to respond to shocks. They assist in broadening viewpoints and assessing the feasibility of policies and strategic thinking.[155]

Each alternate future has a title based on the idea that each quadrant will convey, as seen in Figure 6, and each occurs in the year 2040. For the rest of this chapter, the four parts that follow will include a narrative for each alternate future.

Figure 6: Alternative Futures 2x2 Matrix

[155] H. van der Gracht *et al*, *Future of Logistics 2025: Global Scenarios*, (Wiesbaden: BrainNet Supply Management Group AG, 2008), 53; Michael A. Rostek, Peter Gizewski and Regan Reshke, *Conceiving an Army for the 21st Century* (Ottawa: Defence R&D Canada - CORA, 2010), 16.

Section 3.1 – A Green Earth System

A future in which emerging technologies are adopted and at the same time in which global warming is decelerating.

The Paris Agreement and Net Carbon 2050 were two bold initiatives made by the international community between 2015 and 2020 to tackle global warming. Carbon efficiency gains by 2040 have resulted in substantial reductions in GHG emissions throughout the last two decades due to these efforts. The world is on track to achieve the 2°C maximum warming objective.[156] As a result of these initiatives, the permafrost melting in the Arctic has stalled. Governments and industries collaborated and invested heavily in Research and Development (R&D) in sustainable technology, which accelerated the use of green energy. Nanotechnology in the fields of batteries and energy storage has made substantial progress. Portable electric power and sustainable storage of electrical energy breakthroughs at MIT led to fully electric vehicle conversion, including trucks and heavy-duty vehicles. This transition was mainly due to the technology being more affordable to the average consumer. As a result, long-haul trucking has started to turn to all-electric vehicles. The most well-known logistics firms, such as DHL, have been collaborating with R&D companies for the past thirty years to advance breakthroughs in autonomous vehicles and are now paving the way for further developments in fully autonomous electric vehicles. With the growing demand for foreign trade, these new technological advances have substantially reduced carbon emissions. Logistics companies have overcome two of their most significant challenges, personnel shortages and their reliance on fossil fuels, which are now transforming the logistics industry. By 2035, international companies such as DHL and Amazon have converted their warehouses to 80% robotics or autonomous vehicles, and last-mile

[156] International Energy Agency, "World Energy Outlook 2020," last accessed 5 April 2021, https://www.iea.org/reports/world-energy-outlook-2020; United Nations, "Climate Action," last accessed 3 April 2021, https://www.un.org/en/climatechange/paris-agreement.

deliveries are beginning to be fully autonomous. Money invested in research and development to expand AI and nanotechnology has made great strides. The public has managed to overcome the legal and ethical concerns of certain aspects of both technologies.

National and regional regulations supporting carbon reduction, especially environmental initiatives such as the European Green Deal (to phase out its dependency on fossil fuels by 2050), were bold moves established to stimulate a sustainable future. During the initial onset of the initiative in energy transition, expectations were that it would create adverse impacts with the European Union's partners; however, it worked just the opposite. Other influential regions, primarily developed nations (such as North America, Australia, Japan, India, South America, and Scandinavia) with high consumption rates, created their version of the European Union Green Deal. The power of these nations combined started the trend of sustainable renewable energy advancements. Instead of taking harsh stances that would cause economic turmoil in developing nations, they worked to form partnerships that helped the transition by developing alternative ways of income and production that also saw economic gains within the developing nations. Time and effort were made for mutually beneficial partnerships. Asia has significant economic influence and has been dominating trade for two decades. Despite this dominance, the potential loss of trade with environmentally friendly nations due to failure to adopt sustainable practices and convert to renewable energy sources was a significant hurdle. Over the past fifteen years, this shift in Asia contributed to other emerging nations developing sustainable practices. A phenomenon that futurists did not anticipate within the realm of possibility.

The breakthroughs in technology managed to relieve the burden on ageing populations; however, it has also resulted in high unemployment rates in developing countries. These initiatives began shifting the world from an industrialized to an automated one, with fewer

people finding employment and global instability. As a result, the eradication of poverty has been unsuccessful. The high unemployment rates in developing countries, especially those that have undergone a youth bulge in recent decades, contribute to poverty issues. Economic growth in developing countries has focused chiefly on trade and production rather than social programmes and education for the wider population. As a result, migration continues. Youth are also vulnerable to further recruitment by extremist organizations. Trade revenues are also being squandered by political regimes and used for self-serving purposes, widening the divide between populations. This trend is no longer acceptable to the young generation, who continue to petition for social change, even with violence. The global alliances developed to deter further environmental destruction and manage the increased demand for energy resources have been offset through numerous GHG reduction strategies, especially fossil fuel dependence.[157]

Powerful nations that rely on gas and oil revenues have been using their residual power to erode the renewable energy sectors. They have repeatedly used cyber, information operations and non-kinetic means, such as fake news and conspiracy theories, to deter the global community from transforming into renewable energy. After these efforts to save the oil industry failed to have the desired effect, most large oil companies went bankrupt by 2040. Unable to survive the loss of revenue after fuel prices crashed and sales were only a fraction of what they once were, supply also dropped significantly. While this was a win for climate change, it was a big hit to nations that are still reliant on fossil fuels. The supply of fuel became challenging to source in certain parts of the world. The nations and industries that were unable to convert to renewable energy face considerable challenges sourcing fuel when required. To stay afloat after two decades of transitioning to renewable energy, companies were forced to prioritize the rapid

[157] United Nations, "World Population Prospects 2019: Department of Economic and Social Affairs Population Dynamics," last accessed on 28 February 2021, http://esa.un.org/unpd/wpp/Excel-Data/population.htm.

construction of newly developed supply chains. In the early 2020s, the threat of energy revolutions spurred many countries to establish economies that were not dependent on oil and gas revenues. Various Middle Eastern nations, inspired by the United Arab Emirates, were constructive and used the surplus revenue to invest in sustainable economies, removing their reliance on the oil and gas industries. By 2040, any income from the oil sector will only contribute to their economic prosperity rather than dictating it. As a result, they have maintained relationships with their international partners, and stability has been essentially constant over the last decade. Extremist movements and terrorists groups have mostly migrated to less stable regions to take advantage of their vulnerability and inability to maintain order.

Section 3.2 – Archaic Pandemonium

A future in which emerging technological advances are lagging, and global warming is accelerating.

An economy dependent on mass consumption by a world population of 10 billion in 2040 has inflicted havoc on the environment. The destruction or perhaps even loss of natural habitat is generally permitted in the relentless scramble for wealth. Ever since the signing of the Paris Agreement in 2015, the world has been unable to come together on climate change, making the goal of a Net Carbon 2050 unattainable. Forest fires and drought have destroyed crops in rural areas regularly, and mass refugees relocating to megacities remain a concern. The majority of megacities in the developed world lack the resources to sustain such migration. Many people who do not have access to medical care suffer from chronic health problems caused by unsanitary and crowded living conditions, unresolved pollution, and inadequate air quality. Water bodies are becoming increasingly contaminated and unfit for consumption. Nearly half of the world's population currently lives in water-stressed areas, and projections expect this number

to rise to more than half by 2050.[158] The planet suffers from severe food shortages due to population growth and disruption to the remaining arable land. Food prices have nearly doubled since 2010 because supply can no longer meet demand. Poverty-stricken areas are at a disadvantage compared to developed countries, and humanitarian aid is at an all-time peak.

Many countries pledged their support to the United Nations' humanitarian relief efforts in the early 2000s.[159] A significant amount of equipment and resources have been invested in global HA/DR efforts throughout the last three decades. Even those nations supporting humanitarian efforts have not been immune and have been affected by natural disasters' devastating effects. Due to older technology and outdated processes in many developed countries, the number of resources invested in supporting HA/DR has been costly. As a result, as governments responded to environmental crises, money for research and development was pushed to the back burner for the past fifteen years. Since most countries did not automate their processes on time, the amount of human capital required to sustain HA/DR has grown exponentially, monopolizing the limited workforce available in other sectors. Natural disasters have various secondary and third-order effects, putting a burden on government funding.

Since the outbreak of the pandemic twenty years ago, protectionism has prevailed. Regardless of the consequences for other countries, each country prioritizes its prosperity. Unlike the early 2000s financial crisis, the economy was more resilient due to unprecedented growth rates preceding the crisis. Although the economy began to rebound shortly after the pandemic, the extent of protectionism and nationalism reduced free trade, and most economies have yet to recover. Several other virus outbreaks (on the scale of Ebola and SARS) have occurred since

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[158] Catholic Relief Services, "Water Security Strategy for 2030," (Baltimore: CRS, 2019), 18, https://www.crs.org/sites/default/files/tools-research/water_security_for_2030_-_strategy.pdf.

[159] United Nations Office for the Coordination of Humanitarian Affairs, "Our Work," last accessed 3 April 202, https://www.unocha.org/about-ocha/our-work.

2020, all of which, though easily contained, have served to remind the world of the challenges in obtaining life-saving equipment and supplies. Protectionism is causing a trend in which countries must manufacture essential goods domestically to guarantee availability. In the year 2040, these viruses have kept protectionism at the forefront. Efficiencies once found by global trade are working against industries. Many enterprises have struggled with inadequate infrastructure, increased demand for national production, and increased labour demand. Owing to old technologies, most countries have been unable to adapt. Humanitarian assistance and disaster relief receive more resources and support than infrastructure spending. After the outbreak of the pandemic, Asia's economic supremacy has been eroding. During the pandemic, decisions to withhold life-saving equipment and supplies sowed distrust among trading partners. Trust in nations and regions has eroded to the point that the ties will not rebuild to prevent a global economic collapse. Developing countries that were once rapidly developing are now regressing because they could not break into world trade before the pandemic. As the United Nations and the World Trade Organization (WTO) ask developed countries for help, they only receive marginal financial assistance relative to decades ago. Most countries are no longer offering financial assistance to developing countries because their primary concern is to protect their economies and quality of life. The World Trade Organization (WTO) is a relic of its former self when it comes to removing trade barriers, and it has lost prestige when it comes to resolving trade disputes.[160]

Renewable energy sources have not been successful in substituting fossil fuels. Consequently, the demand for conventional fossil fuels is higher than ever. Energy rates have

[160] World Trade Organization, "What is the WTO," last accessed 5 April 2021, https://www.wto.org/english/thewto_e/whatis_e/whatis_e.htm.

skyrocketed, and the price of oil has nearly tripled since 2010. Unconventional deposit extractions are causing environmental destruction when most readily available fossil fuel deposits are near exhaustion. To maintain national power and avoid economic decline, Canada has been mining natural resources in the Arctic since 2030, despite it not being politically or theoretically feasible 40 years ago. To ensure its supply of oil and gas and its closest ally, the US, Canada has been reluctant to break away from the gas and oil industry. In an attempt to harvest its resources in the Arctic, numerous environmental disasters resulted between 2025 and 2040, causing irreparable damage to the ecosystem in the protected waters. The government was unable to enforce policies that would provide environmental protection and preservation. The progress made to repair the relationship with the Indigenous peoples deteriorated due to the governments' decision to backtrack on promises made to preserve the Arctic ecosystem.

While the United States remains the world's leading power in 2040, the political unrest and uncertainties that followed the pandemic twenty years ago have spread worldwide. Other global powers took advantage of the US's division to extend their geographic spheres of influence. Although Asia's economic strength is waning, it has chosen to invest in artificial intelligence. Such breakthroughs have allowed Asia to use AI to accomplish their goals and objectives; however, protectionism has prevented the West from using such technology without first developing it. Attempts to open trade barriers have been unsuccessful, and therefore R&D in the technology sector is now a national responsibility.

Section 3.3 – The Missed Mark

A future in which emerging technology is driving change but in which global warming continues to accelerate.

The first two decades of the new millennial were pivotal in creating global partnerships to fight climate change; however, the desire to retain power and competition for control over scarce

natural resources exceeded the desire to contain global warming. Since then, the momentum was lost, and environmental concerns have played a secondary consideration for the past twenty years unless they resulted in economic gains or increased power. Frequent drought and forest fires are destroying crops and continue to cause further destruction of limited arable land. There was a 25% worldwide reduction in arable land between urbanization expansion and environmental destruction over the past thirty years. This phenomenon is causing severe food shortages, and demand exceeds supply in providing adequate essential food to sustain 10 billion people. Countries are racing to find alternatives to food shortages, and additive manufacturing receives much attention to relieve food supply shortages. 3D printing of food is one of the single most trending technologies.[161] Environmentalists are increasingly frustrated with the lack of interest in global warming. After 2030, there have been rumours of more violent efforts to threaten high-carbon gas and oil markets, leading fuel prices to increase.

Businesses struggled to generate enough revenue to guarantee their sustainability after the global pandemic's economic crisis in 2020. Even though many businesses did not survive the pandemic, those who did were able to improve their productivity by using digitization and technological advances.[162] To avoid further losses, the shipping industry created contingency measures in response to the shocks that occurred in the years leading up to 2020-2025, such as the pandemic, protectionism that culminated in decreased world trade crippling blockades of main shipping routes. Even though the Arctic's geopolitical significance piqued the international community's attention in the first two decades of the twenty-first century, conflicts over the

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[161] K. Porter *et al*, "3D Opportunity Serves it Up: Additive Manufacturing and Food," (Dallas: Deloitte University Press, 2015), 13, https://www2.deloitte.com/us/en/insights/focus/3d-opportunity/3d-printing-in-the-food-industry.html.

[162] Department of National Defence, *Digital Navy: A Strategy to Enable Canada's Naval Team for the Digital Age* (Ottawa: Commander, Royal Canadian Navy, 2020), 13.

Northwest Passage remained low. By the mid-2020s, the economic benefits of using the Northwest Passage as a secondary major shipping route had received further attention. Owing to the failure to meet the Net Carbon target by 2050, the Arctic has seen an unprecedented sea ice loss. Within a few more years, the Northwest Passage will be completely free of ice during the summer season. Canada can no longer ignore the inevitable and is receiving extreme pressure from the international community to make the NWP an international shipping route. Tourism, cruise ships, illegal fishing and research vessels operate all over the Arctic Archipelago. Throughout the navigable season, search and rescue operations and ship groundings have been constant. Thus far, shipwrecks that resulted in oil spills have been contained, with a significant amount of resource investment. An increase in activity will place strain on Canada's emergency response that it is unable to sustain.

Asia now dominates the emerging technology sector. They have invested significantly in R&D, including advancements in artificial intelligence, (robotics) nanotechnology, autonomous systems and additive manufacturing, advances that are well beyond initial predictions. These developments are mainly due to the increase in the economic influence over the last three decades. China's economic supremacy remains, and it is now the world's second most dominant economy, after the United States. Rather than engaging in long-term development and welfare services for its population, the emphasis was on the intense competition with other global superpowers. Despite social opposition, developing countries' leaders invested in emerging technology without concerns for the associated ethical and legal issues. Due to technological advancements, the Asia region, especially China, has continued to grow in influence. China is exploiting impoverished countries' internal strife in order to obtain access to the remaining natural resources. People in China and other developing Asian countries are increasingly

dissatisfied. The general public seeks what developed countries have, such as better infrastructure, education, and human rights, rather than the decade-long power struggle of little wealth distribution to citizens. Protests occur occasionally, but they are quickly and violently suppressed to show that the public does not have a way to express themselves. Tensions in Southeast Asia are still high, and regional tensions are becoming more violent. Following volatile tensions between India and China over shipping in the Malacca Strait, several UN Security Council Resolutions ensued to preserve peace and security in the area.

Over the past two decades, the integration of urban centers globally is a result of technological advancements. Through world commerce growth, hubs have evolved significantly to accommodate significantly larger transportation modes, particularly capability. Global networks are becoming more centralized, with fierce competition to be the leading global network. Autonomous vehicles have permitted efficient economic trade and growth in megacities; however, these locations are at threat of terrorist attacks, and increased natural disasters create disruptions to trade flow. Megacities currently house 65 percent of the world's population. As the climate continues to deteriorate and sea levels continue to rise, forcing more people to leave their homes along the coast and islands. These mass migrations due to humanitarian migration are causing havoc in already overpopulated urban areas. Social imbalances continue to be a problem; citizens are not receiving equal access to social programs, and poverty is now a systemic problem, causing social inequalities and crime rates are escalating. Law enforcement struggles to keep the peace in overcrowded cities, where instability is a significant concern.

The youth bulge persisted well into 2030 in developing countries such as Africa, the Middle East, and Asia. Due to increased pollution and environmental issues, fertility rates

dropped, and the birth rates in these nations began to decline a decade earlier than initially projected. This sudden demographic loss served as a wake-up call for developing countries that had assumed they would have an adequate workforce to advance their economic development. They were obligated to find more efficiencies in technology to replace the workforce. Advances in autonomous vehicles in the transportation industry and additive manufacturing allowed for reductions in labour and supply chains. Countries that did not invest in these innovations now have difficulty managing their workforces as their populations mature.

Section 3.4 – Victorious Inefficiencies

A future in which emerging technological advances are lagging but one in which the environment is sustainable.

Around 2015-2020, national and regional efforts to combat climate change gained considerable momentum, resulting in significant carbon emissions reduction. Unfortunately, successes in preventing global warming from accelerating have not included eliminating the use of fossil fuels. Governments invested heavily in subsidizing more sustainable forms of energy, which are now affordable to the average consumer. Fuel costs fell dramatically as a result of the reduced reliance on fossil fuels. In developing countries, falling prices in both fossil fuel and renewable energy made trade more affordable. As a result, for the last two decades, economic growth and development have been exponential. Developed nations kept their commitment to the Paris Agreement by actively engaging in emerging economies to reduce their environmental effects as their economies grew. For the most part, the same faults that developed countries made were avoided, and the environmental effect was much lower than anticipated. Countries on track to achieve Net Carbon 2050 are collaborating with emerging nations to develop environmentally friendly and sustainable practices. These alliances have aided in developing more secure relationships and have resulted in the opening and strengthening of trade barriers. The prospects

are optimistic that most nations can continue to obtain economic growth through sustainable energy and practices.

Economic growth in developing countries has increased environmental practices while also improving its inhabitants' standard of living. Better living conditions have resulted in increased productivity and improved population wellbeing. Now that most developing nations' urban centers are along the coast, seawater desalination is a major industry. Water stress is less prevalent in 2040 because of less polluted urban areas and cleaner water sources. Potable water exportation is vital in providing water supply for crops, and food supply is much more sustainable than fifteen years ago.

Supply for essential commodities, especially fossil fuels, far outnumbers demand, causing desperation and financial ruin in gas and oil-dependent economies. Between 2030 and 2035, previous trade negotiations began to fall apart, and regional tensions rose as declining countries fought to keep the competition for the remaining demand for fossil fuel energy. Instead of engaging in infrastructure to reduce their reliance on gas and oil revenues, they have had a massive effect on regional powers by refusing to recognize the unavoidable and refuse to adapt to the progressive era. The shift in power experienced since the Cold War is now shifting again. Russia and Iran have been slow to transition and have been reliant on gas and oil revenues. Inflationary costs and efficiencies in transportation did not compensate for the deficit caused by substantial declines in demand. The affordability of green energy was the catalyst for the world's transition away from fossil fuel dependence and toward a cleaner, more prosperous setting. Russia and Iran's regional dominance and authority have passed to other regions whose activities do not obey a rule-based order.[163]

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[163] Randall L. Schweller, "The Balance of Power in World Politics," last modified 9 May 2016, https://oxfordre.com/politics/view/10.1093/acrefore/9780190228637.001.0001/acrefore-9780190228637-e-119.

Since the retirement of baby boomers, developed nations struggle to balance social programs for their ageing populations, such as healthcare and pension plans. Developed countries' economic growth has been stagnant for the past two decades, owing largely to labour shortages. Many countries with ageing populations have relied on immigrants to alleviate labour shortages; however, migration has slowed in recent years due to developing countries' economic prosperity, and unemployment rates have reached historic lows. Immigration is less prevalent than it was in the early 2000-2020s, thanks to economic growth and improved quality of life. Although immigration helps with labour shortages, some countries have struggled to cope with the cultural sensitivities and diversity challenges that come with it. In the early 2020s, several major ethnic incidents occurred, causing tension between cultural groups. In the first two decades of the twenty-first century, these events sparked a movement to boost culture and diversity education and awareness, which was missing in most countries, especially the West.

In the technology sector, investments in research and development have also been limited. As a result, most nations must be selective in which technologies to invest. Most developed nations have a limited workforce and even more limited specialization to expand this sector. Over time, many developed nations are now lagging behind the emerging nations, such as Asia and Latin America. Authoritarian regimes and corruption in many developing nations have been redirecting money from their citizens and infrastructure to invest in technology as a means to increase their regional influence. Instead of investing in technology that will improve the environment or solve other pressing global issues, these nations choose to invest in weapons systems and uncrewed aerial vehicles (UAVs). They intend to build stronger relationships with other state and non-state actors known to pose a threat to global security. Instability in these

regions has been mounting as the authoritarian regimes are committing inhumane acts against their citizens as their stronghold strengthens.

Unemployment rates have declined in developing countries; however, this is not the case in some regions, such as the Canadian Arctic. Over the last thirty years, the Northern Territory's youth bulge has only compounded the region's high unemployment rates. Permafrost melting has been stable and is no longer a threat to the environment, thanks to the stabilization of climate change over the last two decades. Furthermore, the Northwest Passage is no longer navigable for long enough to remain a feasible trading route, and maritime activity has declined to more manageable levels. The imminent danger of waterways opening has passed, and as a result, the government has reduced its investment in Arctic infrastructure upgrades. External players attempting to establish a foothold in the Arctic to exploit its resources are more vulnerable to the youth population. Several foreign businesses have already developed economic links to the Arctic. They are continuing to take advantage of the Northern communities' separation from the rest of Canada by providing infrastructure that is currently lacking. This step by foreign corporations causes instability in the country and jeopardizes Canada's ability to project national power.

The final stage, which is the last chapter of this paper will:

> . . . develop policies in light of these [alternative futures]. The policies [will] help evaluate programs and determine if these programs [will] help the organization achieve its mission, irrespective of which of the four [futures] occurred. In other words, the programs are not developed or approved because they are successful in one specific scenario; [instead], these programs should be successful if any one of the four [futures] occurs. These policies [will] help the [CAF] to become more adaptive and resilient.[164]

[164] Dalhousie University, "Scenario Planning: Process, Tools and Example," last modified 23 April 2020, https://cdn.dal.ca/content/dam/dalhousie/pdf/dept/maceachen-institute/Scenario%20Planning-%20Process,%20Tools%20and%20Example%20(1).pdf.

CHAPTER 4 – ANALYSIS

The concluding aspect of the framework used in this paper entails developing plans, practices, and activities in response to the alternative futures and visions presented above. The methodology's goal is for stakeholders to outline strategies for applicable changes resulting from the anticipated futures.[165] This paper will identify capability deficiencies between the current:

> . . . force employment model and the Logistics 2040 capability structure derived from the alternative future analysis to allow military planners to cope with and take advantage of future change. Subsequent research or monitoring activities and policy change can further help steer the CAF, and in particular Logistics, toward a more desirable future.[166]

Through foresight analysis, senior leadership can understand the relevant risks and mitigation strategies they can use while also considering the feasibility of changes to various policies and plans resulting from different futures.[167] In addition to this, the alternative future methodology gives readers a perspective on a variety of possible futures. It exposes readers to new concepts and points of view that can change their perceptions of the organization. Throughout this chapter, the paper will address different strategies and propose recommendations using various alternative futures. The narratives for the four alternative futures written in the previous chapter aim to "identify emerging issues and potential policy challenges and opportunities, clarify and test policy and planning assumptions and develop a better understanding of the system and its future."[168] Now that the alternate futures are complete, the remainder of this chapter will "test the

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[165] Jim Woodhill, and S. Hashain, "A Framework for Understanding Foresight and Scenario Analysis," last accessed 26 March 2021, https://www.foresight4food.net/wp-content/uploads/2020/05/Foresight-Approach_May-2020.pdf.

[166] Michael A. Rostek, Peter Gizewski and Regan Reshke, *Conceiving an Army for the 21st Century* (Ottawa: Defence R&D Canada - CORA, 2010), 16.

[167] David A. Axson, "Scenario Planning: Applying a Six-Step Process to Your Organization," (Toronto: Canadian Professional Accountants of Canada, 2018), 13.

[168] Policy Horizons Canada, "Foresight Training Manual: Module 6 – Scenarios and Results," last accessed 24 March 2021, https://horizons.gc.ca/wp-content/uploads/2018/12/2016-0276-presentation-eng.pdf.

robustness of existing policy, provide a context for new policy development and identify uncertainties that need to be monitored as leading indicators of change."[169]

Alternative future planning receives criticism for being essentially an intellectual practice with no actual implementation. An honest critique is more on how the results are used or not used rather than the methodology itself. Organizations invest significant resources in designing rich futures but struggle to incorporate them into their planning and decision-making processes.[170] The Royal Canadian Logistics Service currently does not have a Logistics authoritative body that can be a champion for capability gaps it is currently experiencing. Each Logistics discipline has authority by a separate L1 and further authority delegated to the three services (Maritime, Land, and Air). As such, there is no united authority to ensure the priorities meet the CAF's overall objectives. As the implications of the analysis are discussed, it is important to keep in mind that the 2040 time frame was chosen for this analysis to enable new capabilities to conceive, design, and implement the stages of force development.

Each alternative future's implications, both in terms of organizational goals and decisions in general, will be elaborated upon in the following section.[171]

Step 7: Implications

This stage of the framework will consider the consequences of the alternative futures, both broadly and explicitly, in operational and strategic settings. Implications of the issues are the final step in the foresight analysis framework used in this paper. Step 8: Selection of leading indicators and signposts will not be incorporated in this study, as the first seven steps meet the

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[169] Policy Horizons Canada, "Foresight Training Manual: Module 6 – Scenarios and Results," last accessed 24 March 2021, https://horizons.gc.ca/wp-content/uploads/2018/12/2016-0276-presentation-eng.pdf.

[170] David A. Axson, "Scenario Planning: Applying a Six-Step Process to Your Organization," (Toronto: Canadian Professional Accountants of Canada, 2018), 13.

[171] Alun, Rhydderch, "Scenario Building: The 2x2 Matrix Technique," (Paris: Futuribles International, 2017), 11.

intent of this paper's analysis. Step 8 can be discussed further in a separate session as a follow-up review. Applying the alternative futures depends on the purpose of the analysis. When futurists are using it for military future security planning, it is good to analyze how effectively the objective was in achieving each alternative future. It is likely to identify that the alternative futures have actual problems that lead to either a shift of objective that is stable amongst all futures or the development of new capabilities that enable the CAF to work in more challenging environments.[172]

Personnel

Many countries are struggling with an ageing population, resulting in a shrinking workforce as baby boomers retire and the fertility rate declines. This trend is not expecting to change over the next twenty years. Canada's ageing population will hamper the CAF's ability to meet its domestic and global commitments. Canada's allies, especially the United States, the FYES, and NATO, will expect it to sustain its foreign cooperation and commitment as other countries also contend with labour shortages. While immigration has filled the void, crucial labour shortages will become a significant problem for the CAF if immigration levels fall. In addition to the amount of personnel the CAF can recruit, technological advances will necessitate improvements in the Logistics workforce, with members requiring the technological knowledge and proficiency to operate new systems and equipment. By 2040, the CAF's viability will be determined by its ability to retain a workforce with adaptability and technical literacy at a rate that ensures a competitive edge. To address the CAF's workforce difficulties, digitization, automation, and more flexible processes that depend less on human capital are needed to ensure Logistics can meet the demands of the future security environment.

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[172] Neil MacDonald, "Intrac for Civil Society: Scenario Planning," last accessed 11 April 2021, https://www.intrac.org/wpcms/wp-content/uploads/2017/01/Scenario-Planning.pdf.

Logistics Authority

To implement and align the generation of logistic effects for its Force Elements (FE), the CAF must establish and appoint a Logistics Authority. Creating a Logistics Authority allows for enforceable decisions, streamlined processes, and the resources required to carry out the new roles and responsibilities. It will take a significant cultural shift and a strategic authority appointment to coordinate commonality across the L1s regarding support and sustainment and mutually advantageous cooperation with Logistics partners. Capabilities will be better coordinated and supportable due to this appointment, allowing for less strain when overlapping contingencies ranging from domestic disaster relief to combat operations. Through designing the processes and capacity to incorporate and align logistic effects across the CAF, this structure will benefit the L1s. If this proposal is not considered, previous unsuccessful attempts to achieve logistical unity across the CAF will be repeated.[173] With the current organizational structure, there is no such authority, and decisions on funding and sustainability are stovepiped and tailored to the environmental services, resulting in duplication of effort, personnel and resources. Logistics functions and authorities are currently spread across various L1s throughout the CAF and DND, with different priorities and often limited exposure to the other elements and their unique requirements. One central Logistics Authority that works with the Logistics organizations of each environment may achieve greater efficiency and effect. The opportunity to fully integrate sustainment with other CAF Force Elements will be limited in the absence of a centralized Logistics Authority due to each environmental L1 having its unique language, process and culture, which further complicates interoperability.

[173] Australian Defence Force, "Concept for Future Logistics," last accessed 18 April 2021, https://www.defence.gov.au/VCDF/forceexploration/_Master/docs/ADF-Concept-Logistics.pdf.

The recommended responsibilities of a newly appointed Logistics Authority are as follows:

- To refine the logistic network architecture, assist the L1s by organizing and synchronizing Logistics operations, including the implementation of current and evolving "platforms and systems";
- To provide logistics governance and advises on Logistics capability to senior decision-makers;[174]
- To facilitate joint integration, ensure that professional development, "individual, joint, and collective training uses" shared language, procedures, and systems;
- On behalf of the CAF, approve and facilitate funding plans and technical authority for the procurement of logistics capital equipment and systems;
- Facilitate through ADM(IE) the acquisition of adequate facilities and training establishments to support Logistics functions across the CAF;[175] and
- "Supporting the environmental senior logistics appointees (Director Naval Logistics, Army G4, and A4 Logistics) in achieving intra-Service logistics objectives and inter-service integration."[176]

Future Operating Environment

The necessity for the CAF to deploy globally, often in unstable, poverty-stricken regions, will continue into the foreseeable future. It will also be necessary to support concurrent commitments nationally, regionally and internationally. The anticipated increase in China's global power, in addition to Asia's economic growth by 2040, will challenge US dominance. As

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[174] Department of National Defence, *Logistics Branch Governance Framework* (Ottawa: Logistics Branch, 2010), 1.

[175] A function primarily left to the environmental L1s.

[176] Australian Defence Force, "Concept for Future Logistics," last accessed 18 April 2021, https://www.defence.gov.au/VCDF/forceexploration/_Master/docs/ADF-Concept-Logistics.pdf.

a result of China's increased economic influence and the contested South China Sea, the Asia-Pacific region will have increased strategic importance. Thus, the CAF can expect to increase its presence in the region, creating the need for extended lines of communication, secure supply networks and forward support hubs. As a result, it is critical to reinforce strategic logistics contracts and relationships with alliance partners in the Asia-Pacific region.

With the trend of migration and refugee movement to megacities, the CAF will continue to be challenged by the nature of performing operations in these congested environments, emphasizing the need for agile operational support. CAF Logistics personnel will need to understand and manage the technical, social, and cultural complexities of operating in megacities.[177] The logistics footprint to support such operations must not be disruptive. Conflict in urban areas will challenge logistics to find innovative ways to sustain its forces. The predicted congestion of a megacity and the difficulties of working in a collaborative and joint environment will bring unprecedented demands on the capacity to support broadly scattered forces. As a result, emerging technology will play an essential role in overcoming this challenge.

Protectionism hampered the CAF's ability to procure necessary safety supplies and equipment during the pandemic. With the potential for the future security environment to present similar shocks to global trade, logistics must have a robust procurement structure that can source critical supplies to sustain the CAF while also having the flexibility to foster economic trade when opportunities exist.

[177] Department of National Defence, *The Future Security Environment 2013-2040* (Winnipeg: 17 Wing Winnipeg Publishing Office, 2014), 50.

Interoperability

Since Canada is committed to improving relationships with NATO, the FYES, the United Nations, and the United States, interoperability will be a critical component of future military capabilities. These alliances necessitate a fresh commitment to long-term, mutually beneficial cooperation. The CAF's integration with government departments and allies will increase as a result of this strategy. As such, sustainment improvements must adhere to Standardization Agreements (STANAGs).[178] The NATO Support and Procurement Agency (NSPA) is a service arrangement open to Canada, which "provides acquisition and logistics support to NATO, its Allies, partners and other international organizations."[179] Emphasis on standardization in agreements like the NSPA and commonality across domains is essential for mutual integration. Due to contracting concerns, the Treasury Board has imposed limits on Canada's ability to subscribe to specific NSPA programmes.[180] The ability to leverage this support arrangement to its fullest extent will allow for alternative solutions and achieve resiliency when on CAF operations. Like all other branches within the CAF, Logistics must advance its allied and joint support doctrine to ensure a more collaborative approach to planning in joint and coalition settings.

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[178] North American Treaty Organization, "Standardization," last modified 23 June 2017, https://www.nato.int/cps/en/natohq/topics_69269.htm#:~:text=A%20Standardization%20Agreement%20%28STANAG%29%20is%20a%20NATO%20standardization,both%20standards%20and%20standards-related%20documents%20published%20by%20NATO. "NATO standardization is the development and implementation of concepts, doctrines and procedures to achieve and maintain the required levels of compatibility, interchangeability or commonality needed to achieve interoperability. Standardization affects the operational, procedural, material and administrative fields. This includes a common doctrine for planning a campaign, standard procedures for transferring supplies between ships at sea, and interoperable material such as fuel connections at airfields. It permits NATO countries to work together, as well as with their partners, preventing duplication and promoting better use of economic resources."

[179] North American Treaty Organization, "NATO Support and Procurement Agency (NSPA)," last accessed 18 April 2021, https://www.nato.int/cps/en/natohq/topics_88734.htm.

[180] North American Treaty Organization, "Users and Potential Users of NSPA Services," last modified 18 May 2020, https://www.nspa.nato.int/resources/site1/General/business/whatweoffer/Flyer_Users_EN.pdf. Naval Logistics Support (NLSP) is an example of a service within NSPA that the Royal Canadian Navy is restricted from using. When deployed, NLSP is a programme that offers a standardized, flexible, and valuable support arrangement.

During Arctic operations, interoperability is essential for ensuring the coordination of limited resources to achieve the required national power projection. The CAF must use its expertise to help develop Arctic sustainability capability in collaboration with other government departments and agencies. For quick evacuation, surge sustainment activities, or routine deployment, logistics must continue to ensure the viability of and connections to airfields, seaports, rail, and main service routes. Expectations are that infrastructure expansion in the Arctic will no be significant enough to meet CAF requirements over the next two decades. As a result, critical equipment that helps CAF Force Elements be self-sufficient when on operations can only help them project power in the Arctic. The development of strategic lines of communication and an Operational Support Hub and spoke concept in the Arctic will result in a more robust and flexible support concept.[181]

Educating members for the ethnic, technical, and institutional transition will bring about commonality, education, and training initiatives. If CAF Logistics is to "become survivable, assured, resilient, and adaptive," it will have to break free from the status quo.[182] Though emerging technology will provide possibilities to be more productive and competitive, gaining an edge in all domains will depend on the synchronization and mutual coordination of processes, networks, and systems. Allowing for the inclusion of single service-specific requirements without jeopardizing the benefits gained from integration is imperative to bear in mind.[183]

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[181] Department of National Defence, "Operational Support Hubs," last modified 21 August 2018, https://www.canada.ca/en/department-national-defence/services/operations/military-operations/conduct/support/hubs.html. Operational support hubs (OSH) are facilities in other countries that provide support for Canadian Armed Forces (CAF) operations. The CAF maintains the hubs in overseas locations because of cost and convenience. They offer fast, flexible and cost-efficient ways to launch and sustain global operations. They also allow the CAF to respond to crises like natural disasters in a timely way. OSH may be used in remote locations such as the Arctic to facilitate CAF operations.

[182] Australian Defence Force, "Concept for Future Logistics," last accessed 18 April 2021, https://www.defence.gov.au/VCDF/forceexploration/_Master/docs/ADF-Concept-Logistics.pdf.

[183] Martin Christopher, and Matthias Howleg, "Supply Chain 2.0: Managing Supply Chains in the Era of Turbulence," *International Journal of Physical Distribution & Logistics Management* 41, no. 1 (Winter 2011): 72.

Supply Chain

The ongoing globalization of commercial supply chains will have consequences for the CAF regarding stability and self-sustainment. Steps to ensure national self-sustainment for essential military equipment, parts, and materials must occur to counteract this development.[184] As witnessed during the 2020 pandemic, just in time delivery is an economical means of distribution during ideal conditions; however, it does not provide the CAF with a resilient means of sustainment during a crisis. Such disruption to the supply network must be taken into consideration when planning the future procurement of defence materiel. Developing supply chain resilience and scalability can incur incremental expenses, and as the pandemic demonstrated, it is impossible to eliminate all sources of risk.

The most considerable in-service support (ISS) contract awarded in Canadian history is the Thales Group contract for the Arctic and Offshore Patrol Ship / Joint Support Ship In-Service Support (AJISS). The unique aspect of this ISSC is that it is a relational contract that is performance-based. The effectiveness of this latest contract model can be determined by engaging industry in trials and simulation tasks as part of a performance-based contract to help learn when and how they will benefit in a deployed environment. Transformation of supply management may take place by increased use of relational contracts.[185] If the number of relational contracts in the Department of National Defence grows, the Canadian Forces Supply System will need to rethink how it serves the CAF.

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[184] Department of National Defence, *The Future Security Environment 2013-2040* (Winnipeg: 17 Wing Winnipeg Publishing Office, 2014), 42.

[185] Vanguard, "AJISS: An Innovative Approach to In-Service Support," last modified 14 December 2020, https://vanguardcanada.com/ajiss-an-innovative-approach-to-in-service-support/.

Climate Change

When deployed in austere locations, the CAF should expect that resources in the region would be limited. These resources range from water, food to fossil fuels. By 2040 over 52% of the world will be water-stressed, and the CAF can no longer assume it will have the availability of potable water it requires to sustain its forces when it deploys. The Canadian Army currently uses Reverse Osmosis Water Purification Units (ROWPU), which can sustain its forces.[186] As water stress becomes the norm, instead of the exception, solutions for water purification will be necessary for all of its deployed forces, particularly the Royal Canadian Navy (RCN) and the Royal Canadian Air Force (RCAF). For example, the RCN cannot purify water when alongside and entirely rely on contracting water supply while in foreign ports. In 2040 and in locations where contracting is not an option, it will reduce the RCNs self-sufficiency when in port. Natural disasters and climate change (drought, flood and fires) will impact arable land and the ability to grow an adequate amount of food to sustain a global population of 9.7 billion. As with water, it may not be easy to source food when in regions where there is food scarcity.

Over the next twenty years, the expectation is that more natural disasters will result, such as flooding, food and water shortages, sea levels will increase, drought and forest fires will be more common. The CAF has a long history of providing support to disaster relief operations, not only abroad but domestically. The CAF will respond more effectively to crises due to the development of standing operations that support relief efforts, such as Operation LENTUS, which supports domestic disasters, and Operation RENAISSANCE, which supports disaster relief overseas. The requirement for a scalable and adaptive supply chain and sustainment infrastructure that can support emergency operations in any place around the world has consequences for logistics. Given the lack of infrastructure and resources, providing support and

sustainment to operations in remote areas such as the Arctic will be problematic for the CAF. Considering HA/DR will play a significant role in the CAF for the foreseeable future, equipment to support such operations is strongly recommended. In particular, the "RCN and allied Navies have highlighted a pressing need for the Canadian Armed Forces to consider the acquisition of a dedicated peace-support ship to meet the unique demands of HA/DR."[187] The CAF will benefit from this capacity as more maritime operations take place in the littorals. Furthermore, since a vast number of megacities are located along the coast, the CAF would most likely provide a significant amount of ship-to-shore HA/DR support.

Another incentive to store materiel in critical positions is to ensure that the CAF's operating capability is not hampered by limited access to essential resources. This mitigation entails risk management for seaports, airports, roads, and rail networks affected by climate change and extreme weather events.[188]

Although the CAF will continue to rely on fossil fuels in 2040, prospective platform and infrastructure investments should aim to expand power/energy resources, battery, and energy storage technology. Industry will be much faster than militaries to achieve net-zero emissions goals and embrace renewable energy sources, particularly transportation.[189] The constraints in procurement will be a challenge the CAF must start preparing for as it commences the transformation to renewable energy. One concern it must address is the CAF's need to comply with NATO's strict standardization standards, which will further complicate matters. To reach

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[186] Blu Metric Environmental, "Military," last accessed 15 April 2021, http://www.blumetric.ca/military.

[187] Department of National Defence, *Canada in a New Maritime World: Leadmark 2050*, (Ottawa: Commander, Royal Canadian Navy, 2016), 47.

[188] Australian Defence Force, "Concept for Future Logistics," last accessed 18 April 2021, https://www.defence.gov.au/VCDF/forceexploration/_Master/docs/ADF-Concept-Logistics.pdf.

[189] The Climate Centre, "Actions by countries to phase out internal combustion engines," last accessed 24 April 2021, https://theclimatecenter.org/actions-by%20countries-phase-out-gas/#_edn1; Government of Canada, "Greening Government Strategy: A Government of Canada Directive," last modified 24 February 2021, https://www.canada.ca/en/treasury-board-secretariat/services/innovation/greening-government/strategy.html#toc3-1.

net-zero by 2050, logisticians must collaborate with their NATO counterparts to develop a cohesive strategy. Canada's fossil fuel supply will be adequate for the next two decades, but its forces will not always deploy domestically. It is unknown whether present and future CAF capital equipment can convert to clean technology before completing their service life, estimated to be about 50 years.[190]

Canadian Arctic

The increasing strategic importance of the Arctic will provide both opportunities and challenges for Canada. While there are many uncertainties over the possibility of conflict over resources or the Northwest Passage, CAF presence will continue, and so will the requirement to deploy and sustain forces while in the Arctic. No matter what the reason, whether it be a natural disaster, conflict or simply an operation or exercise, the lack of infrastructure will continue to be an issue for the foreseeable future. Airport and seaport infrastructure, storage facilities, health care facilities, communications, fuel and road networks are all limiting factors to sustainment in the Arctic.[191] At present, the Arctic economy cannot support CAF requirements, and therefore all support must be integral. As the Arctic continues to open, logistics support concepts must overcome the sustainment issues that will continue into 2040. The CAF must build resilience by providing alternate options for sustaining its military with the help of other government agencies and industries by supporting the growth of infrastructure in the Arctic and working with regional partners that share similar security concerns.

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[190] Large capital equipment projects such as Arctic Offshore Patrol Ships, Joint Support Ships and CF-18 replacement have traditionally remained in service for an upwards of 50 years.

[191] Arctic Today, "A New Report Measures the Infrastructure Gap Between Nunavut and the Rest of Canada," last modified 26 October 2020, https://www.arctictoday.com/a-new-report-measures-the-infrastructure-gap-between-nunavut-and-the-rest-of-canada/.

Emerging Technology

The CAF must structure its training system to be agile as very high technological expertise and skills will be needed. The increased use of robotics and automation, particularly in manufacturing, warehousing, and transport functions, will allow for repurposing specific tasks from an "all-human workforce" to an automated one.[192] AI will expedite processes and reduce the need to expose personnel to potentially dangerous conditions such as combat and environmental threats.[193]

Implementation of "additive manufacturing has the potential to dramatically change the sustainment function [where] the CAF could reduce its logistical tail to build spare parts and other supplies in the joint operational area."[194] Decentralized production and increased mobility for deployed Force Elements will make the CAF highly adaptable. The incorporation of 3D printing will necessitate modelling and analysis instruction for staff, and it is representative of the more extensive improvements to the education and training system. A core feature of the opportunities posed by 3D printing is the shift from cultivating manual labour to improving the technical knowledge of CAF members. By 2040, additive manufacturing in "the automotive industry, aerospace, healthcare, construction, energy . . . and manufacturing industries [will all be] reshaped by 3D printing."[195] Additive manufacturing will mitigate the requirement for extended lines of communication and long transit times for replacement parts. By minimizing

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[192] Kim Bhasin and Patrick Clark, "How Amazon is Creating a Robot Arms Race Where it Always Wins," last modified 30 June 2016, https://www.independent.ie/business/technology/news/how-amazon-is-creating-a-robot-arms-race-where-it-always-wins-34844243.html.

[193] Forbes, "5 Examples of How AI Can be Used Across the Supply Chain," last modified 17 September 2018, https://www.forbes.com/sites/blakemorgan/2018/09/17/5-examples-of-how-ai-can-be-used-across-the-supply-chain/?sh=39beefbc342e.

[194] Department of National Defence, *The Future Security Environment 2013-2040* (Winnipeg: 17 Wing Winnipeg Publishing Office, 2014), 69.

[195] D. Alexander, "3D Printing Will Change the Way You Eat in 2020 and Beyond," last modified 27 March 2020, https://interestingengineering.com/3d-printing-will-change-the-way-you-eat-in-2020-and-beyond.

expenses linked to warehousing, customs and procurement delays and the slow turnover of material due to obsolescence, future production via 3D printing will supplement and extend existing integral capabilities.

Within twenty years, UAVs will become largely self-sufficient. Increased involvement of autonomous systems in tactical decisions can ultimately create a threat to CAF personnel. Warehouses operated by robotics, procurement and logistics roles through the optimization of AI, and heavy equipment and medical supplies transported by automated vehicles will all be part of the future supply chain.[196] Technological advancements have made the development of last-mile logistics feasible. They can be delivered "through different means, such as light goods vehicles, heavy goods vehicles, electric vehicles, bicycles, tricycles, or drones."[197] Autonomous systems will be essential for creating logistic impacts in challenging environments, including congested megacities and remote rural areas with limited infrastructure.[198]

Nanotechnology's innovative improvements to energy use, especially in the "effective and renewable generation of electrical energy storage," will result in significant logistics efficiencies.[199]

Artificial intelligence, automated systems, additive engineering, and nanotechnology are all technologies that deliver productivity and less dependence on human resources, which will be

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[196] Kim Bhasin and Patrick Clark, "How Amazon is Creating a Robot Arms Race Where it Always Wins," last modified 30 June 2016, https://www.independent.ie/business/technology/news/how-amazon-is-creating-a-robot-arms-race-where-it-always-wins-34844243.html; Forbes, "5 Examples of How AI Can be Used Across the Supply Chain," last modified 17 September 2018, https://www.forbes.com/sites/blakemorgan/2018/09/17/5-examples-of-how-ai-can-be-used-across-the-supply-chain/?sh=39beefbc342e; Aryn, Baker, "The American Drones Saving Lives in Rwanda," last accessed 24 April 2021, https://time.com/rwanda-drones-zipline/.

[197] John, Olsson, Daniel Hellstrom,and Henrik Palsson, "Framework of Last Mile Logistics Research: A Systemic Review of the Literature," *Sustainability* 11, no. 24 (Fall 2019): 12, https://pdfs.semanticscholar.org/ffd4/f854b5110c1816eb307c6a1e5144e5f08f63.pdf?_ga=2.160906549.905481910.1619301500-413724484.1616545882.

[198] Aryn, Baker, "The American Drones Saving Lives in Rwanda," last accessed 24 April 2021, https://time.com/rwanda-drones-zipline/.

[199] Adrian M. Ionescu, "Nanotechnology and Global Security," *Connections: The Quarterly Journal* 15, no. 2 (Winter 2016): 43-44, https://connections-qj.org/article/nanotechnology-and-global-security.

one of the CAF's most significant challenges. Every scenario in the future leads to these eventualities, and the CAF must prepare for it. Therefore a level of commonality is required to be successful in this area. For the CAF to be interoperable with its allies and partners, it must first be interoperable within its force. Commonality across all domains using standard terminology, processes, and systems will help mitigate these challenges. Achievement of the future desired Logistics effects will be through establishing a Logistics Authority that considers all Logistics functions.

CONCLUSION

Although the CAF must be relevant now and in the future, logistics must also adapt to provide adequate support in the future security climate, so logistics cannot fail to be relevant and reliable. In an increasingly competitive environment, developing alternative futures is an essential task for organizations such as the CAF and must ensure it does not overlook Logistics. Showing how to apply a foresight analysis in a sequence of steps helped ensure that all such research was carried out consistently, with a degree of thoroughness and integrity that would otherwise be difficult to accomplish. The research on alternative futures presented in this paper should receive the widest dissemination to the CAF's various stakeholders. This paper laid the foundations for further study, discussion, and refinement of the process and its results. Think tanks, academics, industry, and wargaming would indeed benefit from the analysis, which was beyond the scope of this research.

This paper demonstrated that Canada would live in a complex, ever-changing world in 2040, with constant change and uncertainty. It illustrated how the environmental scanning process reveals concepts that will direct existing defence policy decisions to address emerging threats by closely examining future trends and their implications. Step-by-step employment of

the environmental scanning process using the STEEP trend analysis (social, technological, economic, environmental and political) is suitable for longer-term scanning. The research derived from the 2040 contextual environment permitted an in-depth examination of each factor. This scanning was essential to understand potential significant shifts, such as drivers, trends, or inbound changes, which we must be aware of but cannot control. Once the environmental scanning took place, it allowed for creating alternative futures by explaining what a future looks like from an objective point of view. This paper's methodology did not measure the likelihood of each alternative future occurring; instead, it suggested that each future follows a criterion that is within the realm of possibility.

The CAF cannot rapidly adapt military capability and readiness in response to a changing and evolving future security environment, a fact showcased by the recent pandemic (shock) that exposed supply chain vulnerabilities. Furthermore, in the future, the competitive environment will become more dynamic, disputed, and chaotic. As a result, the standard method of delivering specific logistic results through environmental commands must extend to a pan-domain system, with deliberate decisions about the degree of control made by upgrading different capabilities. Therefore a level of commonality is required to be successful in this area. Personnel will be the CAF's most limited resource by 2040. By investing in technologies now that reduce personnel requirements in the future and decrease the logistics footprint. As depicted in the alternative futures, artificial intelligence, autonomous systems, additive manufacturing, and nanotechnology are all innovations that offer those possibilities. Furthermore, the future desired Logistics effects will be difficult to achieve without establishing a Logistics Authority that considers all Logistics functions.

The final stage of the framework identified the requirement to develop policies or even organizational changes in light of the alternative futures depicted in this paper. Regardless of which of the four futures emerges, the policies will help assess policies and decide whether they will help the organization accomplish its mission. The framework used assisted in identifying real-world issues that the organization's internal policies are ill-equipped to solve. The 15-20 year timeline chosen as the focal point will give the CAF enough flexibility to prepare for unexpected events and opportunities. As seen in the study, the foresight analysis allowed for a deliberate structure that enables the CAF to make sound decisions and scan potential futures, and predict the challenges it will face in 2040. Except for the final step, identifying indicators, this paper shared the thought process from beginning to end. It assisted in identifying new challenges that the CAF, especially Logistics, will face. This project's research allowed for concrete strategic assumptions, which will help leaders imagine the future. As mentioned previously, alternative futures are a long-term forecasting technique. As identified in this paper, shifts in the operating environment will affect and even form the logistics field's direction and aid in long-term planning.

The Royal Canadian Logistics Branch is the largest in the Canadian Armed Forces, with a presence in every organization and unit within CAF and the Department of Defence. Logistics is a dynamic and complex enterprise that will become unsustainable if it does not adapt to the changing security environment.

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