



Preliminary Research and Methodology on Developing a Future Security Environment Part 2 Product

Neil Chuka
Shaye K. Friesen
Rachel Lea Heide
Charles Morrissey
DRDC CORA

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Defence R&D Canada
Centre for Operational Research & Analysis

Chief Force Development

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Defence R&D Canada – CORA

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Principal Author

Original signed by N. Chuka, S.K. Friesen, R.L. Heide, C.C. Morrisey, PhD

N. Chuka, S.K. Friesen, R.L. Heide, C.C. Morrisey, PhD

Defence Scientist/Strategic Analysts

Approved by

Original signed by Stephane Lefebvre

Stephane Lefebvre

DRDC CORA Section Head Strategic Analysis

Approved for release by

Original signed by Dale Reding

Dale Reding

DRDC CORA Chief Scientist

Sponsor: CFD

Defence R&D Canada – Centre for Operational Research and Analysis (CORA)

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Abstract

This Technical Memorandum outlines the methodological work conducted by Defence Scientists embedded in the Directorate of Future Security Analysis 2 on Future Security Environment Part 2: Future Shocks (FSE2) between Fall 2007 and Fall 2008. The goals of this Technical Memorandum are to present a methodological foundation for FSE2 and to provide intellectual continuity in the pursuit of the FSE research agenda. It covers the links to FSE1 and the methodological steps taken in conducting FSE work (e.g., lessons learned, mission statement and common lexicon, literature reviews, research and mapping tools, selection criteria, survey instrument, historical case studies, annotated bibliographies and background papers, and liaising and stakeholder participation, and production process). The authors contend that the tools, techniques and approaches outlined in this study constitute a rigorous and defensible methodology required for the conduct of future security analysis.

Résumé

Ce document technique décrit le travail méthodologique qui a été effectué par les scientifiques de la Défense intégrés à la Direction de l'analyse de la sécurité future 2 (DASF 2) pour travailler sur le projet ESA2 (Environnement de sécurité de l'avenir, partie 2 : Chocs du futur), de l'automne 2007 à l'automne 2008. Ce document technique a pour but de présenter la méthodologie qui a été utilisée pour le projet ESA2, et de justifier sur le plan intellectuel la poursuite des recherches sur l'ESA. Il couvre les liens avec le projet ESA1 et les outils méthodologiques qui ont été utilisés pour faire le travail (ex. : leçons apprises, énoncé de mission et lexique, analyses documentaires, outils de recherche et de projection, critères de sélection, instrument de sondage, études de cas, bibliographies annotées et documents d'information, outils de liaison et d'intéressement des intervenants, et processus de production). Les auteurs soutiennent que les approches, les techniques et les outils décrits dans ce document constituent une méthodologie valable et rigoureuse qui est nécessaire pour la conduite des futures analyses de sécurité.

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Executive summary

Preliminary Research and Methodology on Developing a Future Security Environment Part 2 Product:

N. Chuka, S.K. Friesen, R.L. Heide, C.C. Morrissey; DRDC CORA TM 2009-013; Defence R&D Canada – CORA; March 2009.

Introduction: This Technical Memorandum outlines the methodological work done by Defence Scientists embedded in the Directorate of Future Security Analysis (DFSA) 2 on Future Security Environment Part 2: Future Shocks (FSE2) between Fall 2007 and Fall 2008. It covers the links to FSE1 and the methodological steps taken in conducting FSE work (e.g., lessons learned, mission statement and common lexicon, literature reviews, research and mapping tools, selection criteria, survey instrument, historical case studies, annotated bibliographies and background papers, and liaising and stakeholder participation, and production process).

Results: The discussion of future shocks in FSE2 is meant to challenge thinking patterns and expand the bounds of the imagination to help inform the process of force development. The first step in the project was the completion of a literature search meant to inform the team of methodologies, existing “shocks” documents, and lexicons employed by allied defence departments and non-governmental organizations. This allowed the writing team to compose an informed, Canadian-specific mission statement and definition of “future shock” to guide and focus the work. Group discussion and analysis was conducted using the Delphi method, brainstorming sessions, futures wheels mapping, and The PersonalBrain computer software tool. A survey was also distributed among stakeholders from across the Government of Canada to solicit their opinion and insights on future trends and shocks.

The outcome of this work was the development of shock selection criteria and a preliminary list of potential future shocks based upon the chapter themes from the FSE1 document. Concurrent to this work, DFSA 2 had tasked a number of research assistants to produce annotated bibliographies and several research papers on discrete topics for consideration during the project. Also, work began on a separate document discussing historical shocks that could help improve understanding of how strategic shocks had caused discontinuity in strategic trends throughout history. A key component of the early work on FSE2 was engagement with a number of DND/CF stakeholders, and interested international parties. Based on the methodology derived above, DFSA 2 determined the document outline required to support the selection and analysis of future shocks.

Significance: This Technical Memorandum is meant to serve as a record of that work and also to provide a start point for the FSE work of DFSA’s Future Security Analysis Team (FSAT). The authors contend that the tools, techniques and approaches outlined in this study constitute a rigorous and defensible methodology required for future security analysis work. In this sense, it provides a successor team with methodological options to consider, their strengths and weaknesses and the lessons learned by a previous team in conducting the work using such methods.

Future plans: Work was stopped on the development of the FSE2 due to the establishment of the FSAT within DFSA. As FSAT was primarily stood up to take over the futures work, responsibility for refining the methodology presented here as well as developing the document was handed over to its team members.

Sommaire

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Résultats: L'examen des chocs du futur, dans le projet ESA2, avait pour but de bousculer les schémas de pensée et de libérer l'imagination afin d'éclairer le processus de développement des forces. La première étape du projet a été une recherche documentaire dont l'objectif était de renseigner l'équipe de projet sur les méthodologies, les documents et les lexiques utilisés par les ministères de la Défense de nos alliés et par les organisations non gouvernementales. Cela a permis à l'équipe de rédaction de préparer un énoncé de mission et une définition de « choc du futur » adaptés aux besoins du Canada, afin de guider et d'orienter les travaux. Pour les analyses et les discussions en groupe, on a utilisé la méthode Delphi, des séances de remue-méninges, des diagrammes du futur et le logiciel PersonalBrain. On a également procédé à un sondage auprès des intervenants, dans tous les organismes du gouvernement du Canada, pour solliciter leur opinion et leurs commentaires sur les tendances et les chocs du futur.

Le résultat de ce travail a été l'établissement de critères de sélection et d'une liste préliminaire de chocs du futur, à partir des thèmes du projet ESA1. Parallèlement, le DASF 2 a chargé un certain nombre d'assistants à la recherche de produire des bibliographies annotées et plusieurs rapports de recherche sur des sujets destinés à être examinés pendant le projet. De plus, on a entrepris la préparation d'un document distinct portant sur des chocs historiques susceptibles de faire mieux comprendre comment les chocs stratégiques ont provoqué un bouleversement des tendances stratégiques tout au long de l'histoire. Un élément clé du travail initial dans le cadre du projet ESA2 a été la coopération avec un certain nombre d'intervenants du MDN et des FC, et avec les organisations internationales concernées. À l'aide de la méthodologie décrite plus haut, le DASF 2 a établi les grandes lignes du document requis pour appuyer la sélection et l'analyse des chocs du futur.

Importance: Ce document technique est un compte rendu du travail initial, et il servira également de point de départ pour les travaux de recherche sur l'ESA de l'Équipe d'analyse de la sécurité future (EASF) du DASF. Les auteurs soutiennent que les approches, les techniques et les outils décrits dans ce document constituent une méthodologie valable et rigoureuse qui est nécessaire pour la conduite des futures analyses de sécurité. En ce sens, le document fournit à

l'équipe qui prendra la relève un certain nombre d'options méthodologiques, avec leurs forces et leurs faiblesses, et les leçons apprises par l'équipe initiale sur l'utilisation de ces méthodologies.

Perspectives: Les travaux de développement du projet ESA2 ont été interrompus à cause de l'établissement de l'EASF du DASF. Étant donné que l'EASF a été mise sur pied principalement pour s'occuper de la recherche sur la sécurité future, c'est elle qui s'est vu confier la responsabilité de perfectionner la méthodologie présentée ici et de développer le document.

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1 Introduction

1.1 Purpose and Rationale

The primary intent of examining the international security environment through the publication of the *Future Security Environment 2008-2030, Part 1: Current and Emerging Trends* (FSE1) and the forthcoming follow-on FSE2 *Future Shocks* and FSE3 *Alternate Futures* work is to encourage debate about possible defence and security challenges that DND/CF might face in the coming decades.¹ This debate is intended to assist defence planners in identifying the most effective capabilities and force structure with which to defend Canada at home and abroad. This futures work is especially intended to move DND/CF beyond envisioning the future as generally unfolding along a linear trajectory, where change occurs in a measured and knowable fashion. While it is readily acknowledged that predicting the future accurately is unlikely, we suggest that analyzing current trends, seeking to identify emerging ones, and exploring how they may individually and/or collectively impact the security environment is beneficial.² It is beneficial because the identification of new challenges or opportunities arising from singular or converging trends can enable defence planners to posit options for either meeting or exploiting these trends in a timely fashion. It can also allow for the measurement of risk if, for example, proposed challenges are intentionally disregarded by the capability development community.

As well, this futures work is meant to foster a more comprehensive understanding of the security environment through highlighting the interconnectedness of trends. Convergence and the interconnection of trends are of particular importance to the identification of future shocks, a fact that contributed to the development of a rigorous and defensible methodology for FSE2, the subject of this Technical Memorandum.

In the authors' efforts to develop a methodology for identifying and analyzing future shocks, it was recognized that the trends outlined in the FSE1 served as a logical analytical start point for FSE2. The findings in the published version of FSE2, which the work here began, will serve as the impetus for the development of FSE3, thereby completing the document cycle. In sum, the purpose of all three documents is to provide analyses that assist in the institutionalization of capability based planning and informs the broader force development process, including the generation of Force Planning Scenarios. In the capability development cycle, trends, shocks and alternate futures identified in the Future Security Environment work will help inform the selection and content of the force development scenarios. FSE3 work will posit future scenarios that suggest capability and force structures that may be useful for capability based planning analysis.

¹ The direction and purpose for FSE2 is outlined in the July 2007 version of the Chief Force Development (CFD) handbook, *Force Development and Capability Based Planning*. The handbook states that Part 2 of the FSE project "...shall identify real and potential threats to the projected security environment." The handbook goes on to state that, taken collectively, the parts of the FSE provide the foundation for the scenarios used for capability analysis and development. Chief Force Development, Force Development and Capability Based Planning (July 2007) Short Title: CFD Handbook) 2900-1(DGFDA) v4.2, p. 4.

² Futures research's "primary objective is to help decision-makers gain a better understanding of the potential consequences of present and future decisions by developing images of alternative futures." World Future Society, "Editorial Policy," *Futures Research Quarterly*, accessed at <http://www.wfs.org/frq.htm> on 25 March 2008.

In turn, scenario analysis may identify areas not considered by the FSE documents and thereby feed back into future iterations of that work.

Work was stopped on the development of the FSE2 by the Defence Research & Development Canada (DRDC) Centre for Operational Research & Analysis (CORA) Defence Scientist (DS) team in Directorate of Future Security Analysis (DFSA) due to the establishment of the Future Security Analysis Team (FSAT) within the directorate.³ As FSAT was primarily stood up to take over the futures work, responsibility for refining the methodology presented here as well as developing the document was handed over to its team members. This Technical Memorandum is a summary of the work the authors completed on FSE2. It is meant to serve as a record of that work and also to provide a start point for the new FSAT writing team.

1.2 Background (FSE I)

Preceding the FSE2 methodology work was the production of FSE1. Work on FSE1 began in an effort to provide defence planners with a shared understanding of possible future trends that are expected to impact the future security environment. Led by the DRDC CORA DS team within DFSA, FSE1 was developed in conjunction with key DND/CF stakeholders. Multiple drafts were produced with each undergoing review and revision to ensure comprehensiveness and inclusiveness.

FSE1 offers readers insights into how key global issues could impact Canada over the next thirty years and how the evolving security environment might influence when and where the CF will be called upon to employ its capabilities—both at home and abroad. This knowledge is intended to better enable those responsible for force development to maintain current activities, plan for a long term relevant force structure, and to invest in a CF that is prepared to meet the threats and challenges that are expected to emerge within a timeframe that goes out to 2030 and beyond. At the time of this Technical Memorandum's publication, FSE1 has received Level One endorsement and is awaiting sign-off and distribution.

³ The DRDC CORA DS Team within DFSA is referred to as DFSA 2. This term is used throughout the remainder of the report.

2 Methodology

Research into the future security environment is assuming increasing significance for all military force developers because of the uncertainty of the post-Cold War era and the rapidity of technological, social and political change. The approach to futures research taken by the DFSA 2 team on FSE projects has been based on an informed methodology that is used by Canada's allies, where literature research, trend and driver identification/analysis, and wider consultation with subject matter experts are combined. The writing team applied the Delphi Method of futures research, which includes an environmental scan of trends, extrapolation of which phenomena will likely endure over a specific period of time, and a cross impact analysis of how various simultaneous trends would likely impact one another.⁴

Since the outset of the FSE2 project, DFSA 2 has been concerned about developing a systematic approach to forecasting potential future shocks with unanticipated consequences of relevance to the Canadian Forces. The basis for this concern links back to the lessons learned identified from DFSA 2's experiences in writing FSE1, which are discussed below. There are a variety of tools, methods, and approaches that can be used for structuring futures analysis and identifying possible future shocks, but each of these has a number of inherent limitations. One of the challenges is that data availability for long-term, future-oriented trends may not be readily available. Another deficiency is that tools and methods can be far more complex than the data available or the problem being solved. In other words, it is important that the tools and methods are rigorous and defensible without being too complex or unusable. A strong reliance on subjective judgement or expert opinion, if used inappropriately, could mean that the study results would be difficult if not impossible to reproduce.

The main approaches adopted by DFSA 2 were designed to address these problems by providing systematic, overt, and replicable ways of generating and structuring information about potential future shocks. Implicit in the adoption of these approaches is the belief that the future security environment is complex, inherently anarchic, volatile, dynamic, uncertain, ambiguous and subject to rapid geopolitical, technological and military change. DFSA 2 understood that there was likely no single solution that would allow the identification, selection, and development of future shocks. Ultimately, it was recognized that soft research and analysis techniques should be supplemented with more rigorous forms of analysis so that a comprehensive, transparent and robust approach to understanding future shocks could be found.

The complementary use of multiple research methods offered a myriad of significant advantages. The combination of different methods allowed the researchers to be more flexible in their approach to the analysis of future shocks. The use of multiple methods enabled the researchers to analyze complex future shocks from a holistic, multi-disciplinary perspective. This also helped generate synergies that served to strengthen confidence and validity in the results. For example, the use of qualitative research for FSE1 informed the mapping of trends and shocks with the PersonalBrain software. Moreover, the inclusion of the survey helped the researchers focus on the judgements and insights provided by key stakeholders, thus improving "buy-in" for the study.

⁴ Darlene Weingand, "Futures Research Methodologies: Linking Today's Decisions with Tomorrow's Possibilities," paper presented at the 61st International Federation of Library Associations and Institutions Annual Conference, August 1995.

Because the researchers utilized mixed methodologies within the same study, they were able to delve deeper into the dataset to understand the complex meaning and cause and effect relationships of future shocks, using one method to verify findings from another method.⁵ When fused together, the methods reinforce one another in a manner that ensures the results obtained are more compelling than those resulting from use of any single method in isolation.

With this in mind, DFSA 2 identified the following components as necessary to contribute to the development of FSE2:

- Analyzing lessons learned from FSE1;
- Developing a mission statement and common lexicon;
- Conducting literature reviews;
- Applying research and mapping tools to analyze future shocks;
- Identifying future shock selection criteria;
- Soliciting views of stakeholders through a survey instrument;
- Studying historical shocks;
- Preparing annotated bibliographies and background papers;
- Investigating collaboration opportunities; and
- Developing a document production process and outline.

The following sections will discuss each of these components in turn.

2.1 FSE1 Lessons Learned

The development of FSE1 provided DFSA 2 with a number of lessons learned. Chief among these was that the level of sign-off is directly correlated to the length of the document's review cycle. If an expeditious publication of FSE2 is sought, sign-off at no higher than a Level Two is suggested. Another FSE1 lesson learned is that the development and documentation of a methodology is paramount to the production of sound analysis (indeed the work presented here is an effort to act on this very lesson). External review of drafts is beneficial to the work's coherence and credibility and must be sought early in the drafting process.

Experience from FSE1 also demonstrated that the number of possible trends one could analyze is only exceeded by the number of opinions on the trends that should be given prominence in the

⁵ Anthony J. Onwuegbuzie & Nancy L. Leech, "On Becoming A Pragmatic Researcher: The Importance of Combining Quantitative and Qualitative Research Methodologies," *International Journal of Social Research Methodology*, Vol. 8., No. 5, 2005, pp. 383-384.

final document. Although axiomatic, it was also apparent from the FSE1 experience that only broad trend themes can be discussed, mainly due to the fact that the number of potential variables and relationships can overwhelm decision-makers and exhaust resources. These lessons suggest that the list of possible shocks could be infinite and only limited by the imagination of the authors. This lesson was the primary impetus to develop a rigorous methodology that would elevate the selection of shocks beyond those suggested by imagination and opinion. Scoping and defining the limits of the analysis, therefore, is key to the success of the FSE project.

2.2 Mission Statement and Common Lexicon

In order to develop a more thorough understanding of the term “future shocks,” DFSA 2 conducted literature searches for existing definitions of future shock and related concepts. This initial literature search also identified potential methodologies and lists of future shock scenarios that could be used to support the conceptualization of FSE2. The concept of “future shock” has featured prominently in key allied military organizations. Although the mission statements and definitions from non-governmental organizations (NGOs) were consulted, DFSA 2 wanted to focus on the lexicon most applicable to security and defence. In doing so, DFSA 2 concentrated on allied military sources, including government reports, conference proceedings and presentations. The focus on government information sources was to understand how future shocks were being applied to aid in improving decision-making and strategy development.

Specifically, DFSA 2 closely examined definitions from United Kingdom Ministry of Defence’s Development, Concepts and Doctrine Centre (DCDC) and the US Department of Defense’s (DoD) Office of the Undersecretary for Defense (Policy) to determine how Canada’s close allies defined “future shocks.”

- The DCDC defines shocks as: “the possibility for major discontinuities...which will change global outcomes in more radical ways.”⁶
- The US DoD defines strategic shock as: “an event that punctuates the evolution of a trend—a discontinuity that either rapidly accelerates its pace or significantly changes its trajectory—and, in doing so, undermines the assumptions on which our current policies are based.”⁷

The results of the literature search suggested that there was no single, agreed upon definition for what constitutes a “future shock.” The mission statements, definitions, and interpretations of future shock vary widely and depend heavily on academic perspectives, organizational needs, and the timeframe being considered. Despite the lack of consensus in the literature, the mission

⁶ The document states that Strategic Shocks are either, typically, very unlikely, or likely to occur at extremely infrequent intervals. United Kingdom, Ministry of Defence, Development, Concepts and Doctrine Centre (DCDC), *The DCDC Strategic Trends Programme 2007-2036*. Accessed at: http://www.prisonplanet.com/articles/april2007/strat_trends_23jan07.pdf on 7 November 2008. As of a result of discussions with DCDC representatives in October 2008, DFSA 2 learned that the term “strategic discontinuities” would likely replace the use of the word “strategic shocks.” While DFSA 2 believes that the term “strategic discontinuities” better reflects the fact that not all historic shocks have in fact been surprises, CFD and DFSA leadership have continued to use “shocks”.

⁷ Forces Transformation Chairs Meeting, *Visions of Transformation 2025—Shocks and Trends*, 12-13 February 2007, Naval Postgraduate School Transformation Chair, 21 February 2007.

statements and definitions shared such common elements as surprise (event and perceptions), unexpected change, and discontinuity of trends—all pointing to an alternative future.

After considering these definitions of future shock, it was determined that a new set of mission statements and definitions was required for FSE2. It was recognized that the key concepts and terms related to future shocks were required from a uniquely Canadian perspective. DFSA 2 identified that a further analysis of these concepts and terms would provide a better understanding of future shock and its relationship to the Canadian Forces. This would also ensure that FSE2 was strongly consistent with force development analysis and capability based planning requirements.

2.2.1 Mission Statement

DFSA 2 held a brainstorming session in May 2008 specifically to develop and tailor a mission statement and a definition for FSE2. The preliminary mission statement for FSE2 consisted of the following statement: “To provide risk assessment based on the identification and evaluation of plausible Strategic Shocks out to the 2030 timeframe in order to inform and enable policymaking and capability development.” This mission statement points to the need for a robust analytical framework to evaluate the importance of strategic shocks on the DND/CF. It takes into account different interpretations on the timeframe which a future shock could occur. The statement describes shock in terms of a strategic-level phenomenon that has broad implications for national policy making, although tactical and operational surprise was acknowledged as having strategic implications. The same thinking was applied to timeframe. Since the focus of FSE2 is the Horizon 3 timeframe,⁸ the use of the term “strategic shock” addresses events that may occur in the short-term, whereas future shock implies that events will consist of discontinuities that take place in the long-term. DFSA 2 realized that the terms “short” and “long” are relative in terms of how an organization responds and adapts to a particular change.

It was felt that the purpose of the document needed to be further clarified. To this end, the DFSA 2 team determined that the objectives of FSE2 were the following:

- To provide a future-oriented perspective that stretches thinking/imaginative capacity and challenges existing policies, plans, and strategies;
- To generate insight and understanding of the nature of strategic shocks and their potential defence and security implications;
- To identify potential opportunities and possibilities that assist in the development of strategies and capabilities for improved responses to future shocks; and
- To provide an intellectual basis that educates and assists decision makers at all levels in mitigating the long-term risks of potential strategic shocks.

The objectives of FSE2 are connected in several ways. First, one of the intended purposes of FSE2 was to re-orient current force development efforts away from scenarios that match existing capabilities to instead focus on major events of low possibility that would highlight national vulnerabilities. The assessment of national vulnerabilities consists of a process to identify critical

⁸ Refer to glossary for definitions of Horizon 1, 2 and 3.

cause and effect relations through prioritization and risk assessment. A prioritization effort based on subjective judgement that ranks future trends and shocks according to probability of occurrence and severity of consequences would enhance the ability to understand these national vulnerabilities and the CF's ability to respond to such events. Second, since the concept of FSE2 was new to the DND/CF, there would be a requirement to educate and inform decision makers of the key issues, challenges, and potential unintended consequences associated with strategic shocks. Third, it was felt that FSE2 would serve to stimulate broader discussion and debate within the force development and policy making communities regarding the types of equipment and force structure needed to minimize the impact of strategic shocks.

In accordance with the mission statement, it was determined that an "out of scope" statement was required in order to distinguish between the nature of FSE2 and other types of assessment products. The FSE 2 document is not intended to serve as a predictive model that anticipates or forecasts Strategic Shocks, but rather to provide plausible bounds to futures research for aiding in the improvement of decision-making.

In formulating this statement, DFSA 2 wanted to qualify the exact aim of the document and address a recurring criticism of futures work that it is designed to produce predictions, when in fact it is not. It was felt that the out of scope statement would manage expectations by helping situate readers with respect to the nature, purpose, and assumptions behind FSE2. Overall, DFSA 2 believed that it was important to stress that FSE2 was not a predictive tool, but rather a planning and decision support tool to inform decision makers at all levels.

2.2.2 Lexicon

After reviewing the definitions of shocks found in the literature search, DFSA 2 formulated the following definition of a strategic shock for use in FSE2: "An event or series of events that precipitates a discontinuity in trends and fundamentally challenges the basis of existing national policies."⁹ DFSA 2 arrived at this statement during a brainstorming session. The definition attempts to illustrate the notion of how strategic shocks are not merely events that happen in isolation or occur with little or no advanced warning. Rather, this definition recognizes that strategic shocks are the result of one or more underlying trends that have been evolving for some time. These trends may come together or converge in such a manner so as to produce an event that triggers change. Many events may lead to structural or organizational changes, but strategic shocks will likely tend to manifest themselves at the level of national decision-makers, where changes in policy will have major repercussions on the role of the military in Canada.

There were a number of supporting elements to the definition that were identified during the brainstorming session. These elements were meant to dispel potential criticisms that could emerge by acknowledging the limitations of a futures oriented exercise. The supporting elements are meant to show that DFSA 2 understood the nuances and difficulties of defining shocks. It is also meant to demonstrate that the potential future shocks identified and selected for discussion in FSE2 were only examples of shocks and by no means a comprehensive representation of all possible types of shocks:

- Strategic Shocks can have either positive or negative effects;

⁹ In this document, future shocks and strategic shocks are used interchangeably.

- Strategic Shocks can either be abrupt or evolutionary taking place gradually over time;
- It is difficult to identify the transition between a trend, a catalyst, and a shock;
- A Strategic Shock is normally not the outcome of a single trend, but results from the convergence of numerous variables;
- Strategic Shocks may be unexpected, but can often be observed by analyzing current trends in a non-conventional way;
- Strategic Shocks can accelerate or decelerate a trend, reverse the direction of a trend, halt a trend, or even precipitate a new trend;
- Strategic Shocks can have temporary or long-term effects; and
- A Strategic Shock could result in an alternative future.

The supporting elements of the definition of strategic shocks were debated extensively during the brainstorming session. The above components were felt to be a “best effort” being delivered so that it could support the development of a conceptual framework and factor into subsequent networking discussions and liaison meetings with key stakeholders.

2.3 Conducting Literature Reviews

In the Fall of 2007, the members of DFSA 2 and DFSA 4 began working collaboratively on determining the scope of the FSE2 Future Shocks project.¹⁰ Familiarization with the existing literature on futures shocks was the first step so as to not be creating and choosing definitions, methodologies, and approaches without building a foundation on others’ expertise and efforts. In order to build a preliminary list of references, searches of open source material for works that discussed definitions, methodologies, drivers, and examples of shocks, wild cards and alternative future scenarios was conducted. The result of this effort was three separate literature reviews, one focused on alternative futures and future shocks material written by public, private, and military think-tanks in the United States, one that focused on other allied military sources, while the third provided a summary of a methodological report published by the RAND Corporation.

The first literature review was based on alternative futures and future shocks work conducted by various United States think tanks and military institutions. These works contained various definitions worth considering for shocks, wild cards, drivers, alternative futures, scenarios, prediction, and projection. Although many of these definitions were specific to the projects through which they were created, they still provided a sense of the relevant terminology and how the terms are being used in the wider futures research community. Although each study had its own unique methodology, there are similarities underlying the various approaches: environmental scanning of political, economic, social, technological, demographic domains; critical analysis of current trends; exposure to works and methods of futurists and scientists;

¹⁰ The DFSA 4 Team is staffed with Defence Scientists from DRDC Corporate Office.

identification of drivers; synthesis of findings; selection and scripting of scenarios/alternative futures; and determination of implications and recommendations. The methodologies consulted combined brainstorming, researching, and consultation with subject experts.¹¹ These sources identified drivers likely to influence the outcome of scenarios and alternate futures,¹² which were very similar to the chapter themes in FSE1.¹³ These sources also identified a lengthy list of possible and plausible future shocks that warrant consideration.¹⁴

A second literature search focused primarily on allied military sources. From this body of literature, two major points emerged with respect to the characterization of the nature and definition of future shocks: one being the abrupt discontinuity that suddenly occurs within a very short time frame and the other being evolutionary discontinuity that takes place over a long period of time but may nevertheless be unexpected. Common elements to definitions of “future shocks” included the idea of the unexpected and a transition to a different state of affairs. From these sources, a draft methodology was built around a four-step process. Step one would involve a scan of the future security environment and the development of definitions, methodological approaches, and shocks lists based upon FSE1 trends and deductions. Step two would be the identification and definition of future shocks. A description of a strategic shock would follow which would include an analysis of the event, how it would alter trends’ trajectories, options for CF reaction, and Canadian vulnerabilities. Step three would be an evaluation of the future shocks selected for their military impact and likelihood of occurrence. This would require the development of risk metrics and a mapping of the shocks in a decision matrix to isolate potential high-risk events. Step four would identify capability gaps and vulnerabilities by determining which gaps are common to several shocks and by recommending ways to reduce the level of aggregate harm.

The final product provided a summary of a methodology proposed in a RAND study entitled *Alternative Futures and Army Force Planning: Implications for the Future Force Era*.¹⁵ The authors of the RAND study identified five drivers of change (geopolitics, economics, environment, technology and demographics) and assigned three different trend lines between the present and the future: good (beneficial), medium (neutral), and bad (damaging). Using the drivers of change and the three trend lines, a matrix of outcomes as depicted in Figure 1 can be created.

¹¹ See Annex B “Various Definitions and Methodologies from Literature Review” for a list of definitions and methodologies taken from these sources.

¹² Number and distribution of **people** on the planet; world’s **geopolitical** organizations and interactions; world’s **economic** process; effects of new **technology**; constraints imposed by the natural **environment** (*The World of 2020 and Alternative Futures*); demographics, natural resources/environment, science/technology, global economy/globalization, national and international governance, future conflict, role of United States (National Intelligence Council, *Mapping the Global Future*), p. 25.

¹³ Chapter 1: Economic and Social Trends; Chapter 2: Environmental and Resource Trends; Chapter 3: Geopolitical Trends; Chapter 4: Science and Technology Trends; Chapter 5: Military and Security Trends.

¹⁴ See Appendix C: “Shocks from Literature Review.”

¹⁵ Brian Nichiporuk, *Alternative Futures and Army Force Planning: Implications for the Future Force Era* (Santa Monica: RAND Corporation, 2005).

	Good	Medium	Bad
Demographics	Population stability	Regional overpopulation	Systemic demographic pressure
Geopolitics	Hegemonic stability or benign multipolarity	Peer competition or multipolarity	Nation-state collapse
Economics	Steady growth/ low inflation	Slowdown	Stagnation
Environment	Resource management	Water scarcity, soil erosion	Climate change, famines
Technology	Information technology boom, biotech growth	Information technology slowdown	Destructive applications

Figure 1: RAND Matrix of Outcomes¹⁶

From this matrix, a spectrum of possible futures can be determined. In the best-case scenarios, all the drivers have good outcomes; conversely, for the worst-case scenarios, all the drivers have bad outcomes. Combinations of medium and good outcomes or medium and bad outcomes produce middle of the spectrum scenarios. The RAND study discounted the possibility and likelihood of mixing good and bad outcomes.¹⁷ The review identified two deficiencies in the RANDs study’s approach. Firstly, the drivers of change do not include ideological factors (for example, the rise of militant religious fundamentalism). Secondly, since the study was based on the analysis of linear trends, the RAND methodology does not handle sudden discontinuities or what is commonly defined as future shocks.

The literature review enabled a more informed discussion on the creation of a definition of future shocks appropriate for the FSE2 project, on the development of a methodology and allowed for a more comprehensive review of the sample shocks provided in the literature.

2.4 Research and Mapping Tools

The tools and methods used for generating future shock scenarios that would affect the CF in new and potentially destabilizing ways consisted of the following: group brainstorming, “Futures Wheels” and the use of The PersonalBrain software.¹⁸ The tools themselves were not responsible for generating a list of future shocks. They enhanced DFSA 2’s collective understanding of the linkages, interconnections and potential convergence among and between trendlines that would facilitate the identification of future shocks.

¹⁶ Nichiporuk, p. 7.

¹⁷ Nichiporuk, pp. 8-10. Examples of RAND’s futures: Best-case – US Uni-polarity, Democratic Peace; Medium-Good: Major Competitor, Competitive Multi-polarity; Medium-Bad: Trans-national Web; Worst-case: Chaos/anarchy.

¹⁸ For more information on TheBrain, visit <http://www.thebrain.com/>, last accessed in July 2008.

2.4.1 Brainstorming

Brainstorming is cost effective and extremely flexible. DFSA 2 utilized brainstorming primarily because FSE2 was a new project for which there was no pre-existing corporate scientific knowledge. A number of complex issues with respect to FSE2 were ill-defined and imprecise at the outset of the project. Structured brainstorming sessions helped DFSA 2 elicit knowledge and opinions of all team members with respect to the development of the FSE2 mission statement and definitions. Structured brainstorming sessions also aided in the identification and selection of historical case study topics of past strategic shocks. By using brainstorming as a primary technique, DFSA 2 was able to develop a more thorough understanding of the context and key components of FSE2.

The challenge with brainstorming was that it is resource intensive since it essentially involved face-to-face meetings. Areas requiring input and feedback from other team members needed to be formulated in advance through internal consultation prior to a brainstorming session. Meetings needed to be organized, and situations invariably arose when not all team members were able to participate in discussions due to conflicting schedules. Despite these shortcomings, the brainstorming sessions were integral to FSE2 and were part of an iterative process that sought to elicit information with respect to the key assumptions, objectives, and requirements of FSE2.

2.4.2 Futures Wheels

DFSA 2 considered the feasibility of using a “Futures Wheel” as a way of graphically structuring FSE2 and to help identify second and third order effects of possible future shocks. Defence Scientist Regan Reshke introduced DFSA 2 to Futures Wheels.¹⁹ The Futures Wheel methodology is analogous to structured brainstorming in that it is quite straightforward and represents a simple way of organizing information and thinking about the future. In a Futures Wheel, the name of a trend or event is written in the centre, smaller lines or “spokes” are drawn out in a wheel-like fashion from the centre, and the primary impacts are depicted at the end of each spoke. The secondary impacts constitute the second ring of the wheel. The mapping out of impacts (first, second and third order) continues until a detailed picture of the implications and consequences of an event or trend becomes clear. Common applications of Futures Wheels include creating forecasts within alternative scenarios, showing complex interrelationships and developing multi-concepts.²⁰ An example of a Futures Wheel is provided in Figure 2.

¹⁹ Regan Reshke, Directorate Science & Technology (Land) 7, “Future Army 2040: Futures Methodologies,” presentation to DFSA 2, Ottawa, 3 July 2008.

²⁰ Jerome C. Glenn, “The Futures Wheel,” in Jerome C. Glenn and Theodore J. Gordon (eds) *Futures Research Methodology* Version 2.0, AC/UNU Millennium Project Millennium Project.

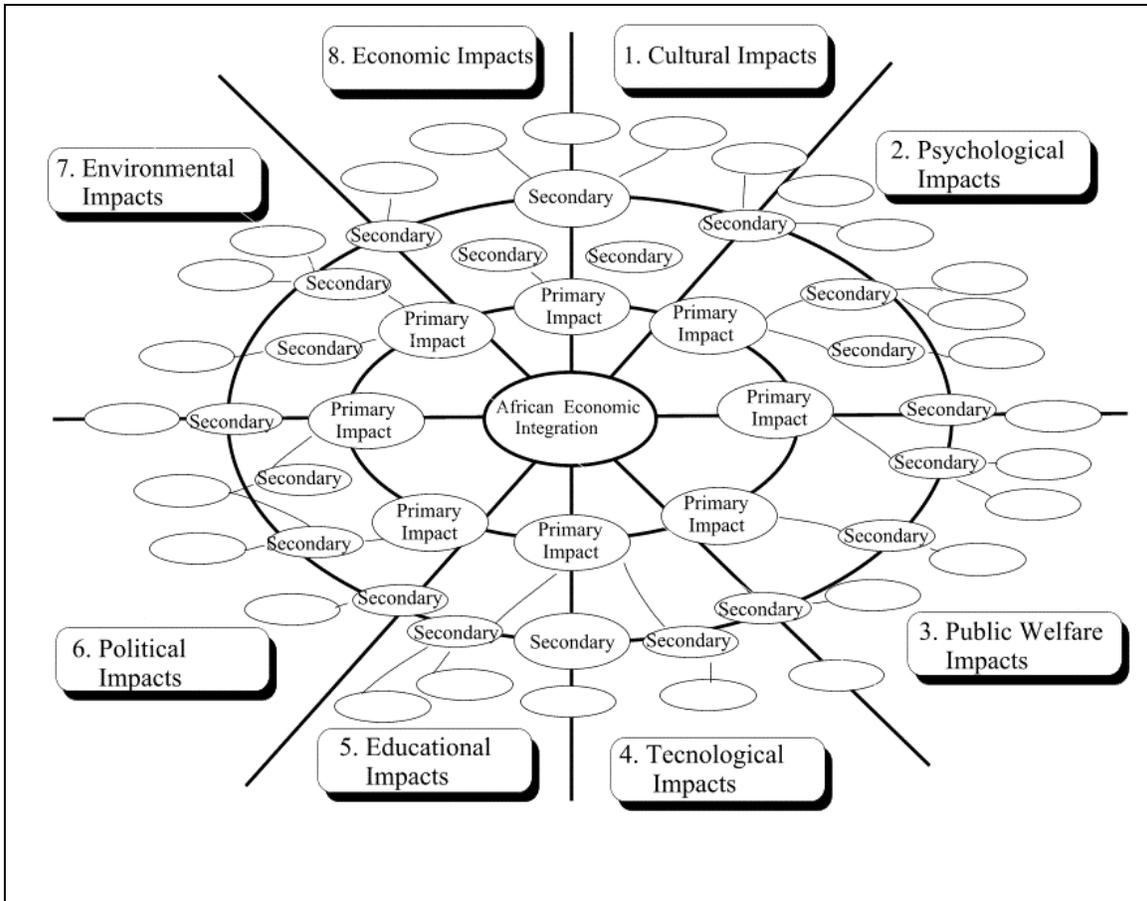


Figure 2: Futures Wheel on African Economic Integration

In terms of strengths, a Futures Wheel is simple to use and does not require specialized software tools or advanced training. It is easily adapted to a variety of situations and can be used at any point throughout the planning process to help groups further understand future events, trends and impacts. The Futures Wheel provides a relatively clear, visual map of the potential complexity of interactions and patterns involved.

With respect to weaknesses, a Futures Wheel takes time to develop and may become unwieldy if analysts are not disciplined in maintaining focus on project objectives. If the rings of associations and implications increase, the complexity of the Futures Wheel can become overwhelming. According to one commentator, if analysts are not disciplined in using a Futures Wheel, they can end up with some messy “intellectual spaghetti” that makes the implications of the trend or event more difficult to see clearly.²¹ Furthermore, a Futures Wheel is very much dependent on the collective inputs and judgements that go into it. There is also a tendency to make premature judgements regarding the outputs and outcomes of a Futures Wheel. Groups may think they

²¹ Glenn, “The Futures Wheel,” p. 9.

understand complex causal relationships when in fact they have only identified correlations by making linkages among circles.

2.4.3 The Brain

The concept of using a tool or process to systematically identify future shocks emerged early on during informal discussions and brainstorming meetings among DFSA 2 Defence Scientists. The requirement was again confirmed during the thought-provoking discussions with Mr Reshke. DFSA 2 was interested in conducting a thorough examination of the sources of information and then using this as a basis to explore trends and identify possible shocks, drivers of shocks and their relation to national vulnerabilities. DFSA 2 work initially relied on FSE1 as a starting point to map out the trends and deductions.

The software selected for this mapping was The PersonalBrain. It was chosen partially because the collaboration with the Directorate of Land Concepts and Designs (DLCD) Future Army 2040 project demonstrated its utility. The PersonalBrain is a knowledge mapping software tool that provided DFSA 2 with the ability to display large amounts of information across multiple categories and develop associated relationships. Information items in the The PersonalBrain are called “Thoughts,” and can include files, webpages, or records. The PersonalBrain interface is organized around a Thought, which is surrounded by all related Thoughts. Clicking on any Thought brings it to the centre of the display, and the interface is automatically reconfigured to the new related Thoughts. As analysts navigate through the data, the information on the screen is always related to the selected data. The PersonalBrain lets one follow a train of thought, flowing from one item to the next.²² Figure 3 presents a screenshot of the trends that were mapped by DFSA 2 using The PersonalBrain software engine (Version 4).

²² “Moving Beyond Information Hierarchies: An Introduction to Dynamic Mind Mapping,” 6 May 2008. Accessed at <http://blog.thebrain.com/beyond-hierarchies/> on 19 November 2008.

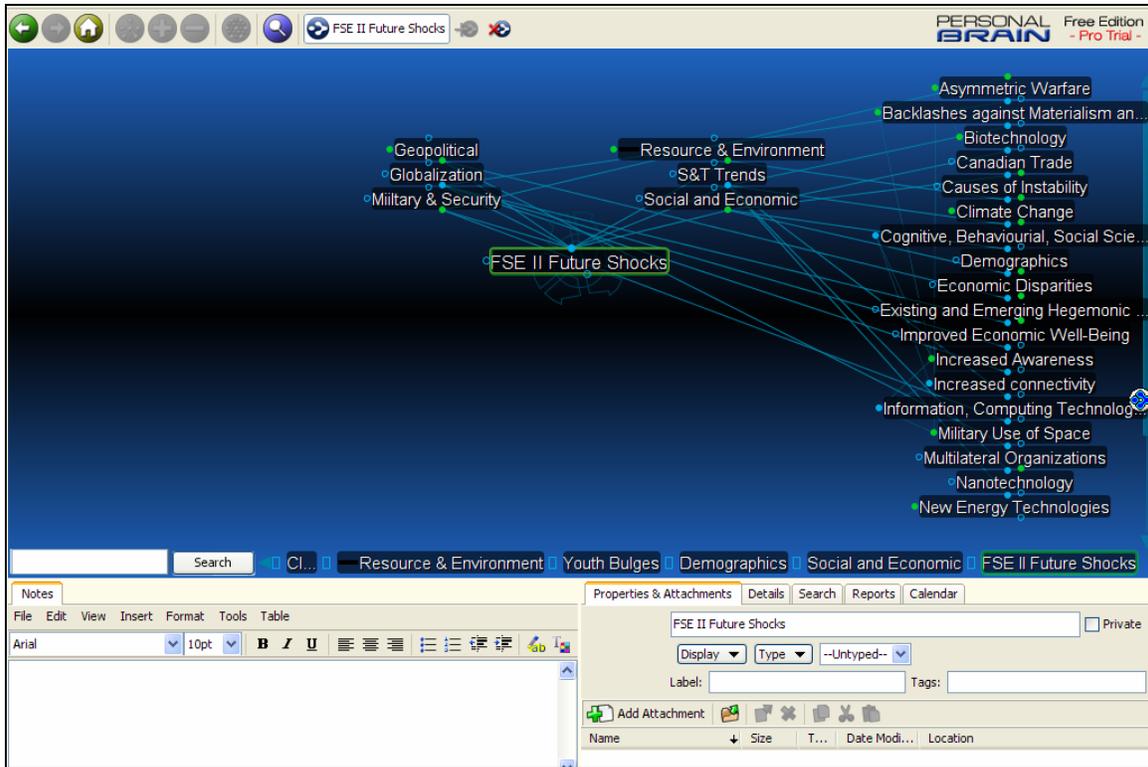


Figure 3: Screenshot of TheBrain and FSE Part II Linkages

The information contained in TheBrain was derived by “data mining” the existing FSE1 document. In July 2008, the relevant trends and sub-trends were taken from FSE1 and inserted into TheBrain software. Subsequently, using group discussion and brainstorming, DFSA 2 was able to link the pieces of information together and create connections among the trends and sub-trends. This helped DFSA 2 think about the associations among the trends and draw insights from these linkages leading to the eventual identification of potential future shock scenarios.

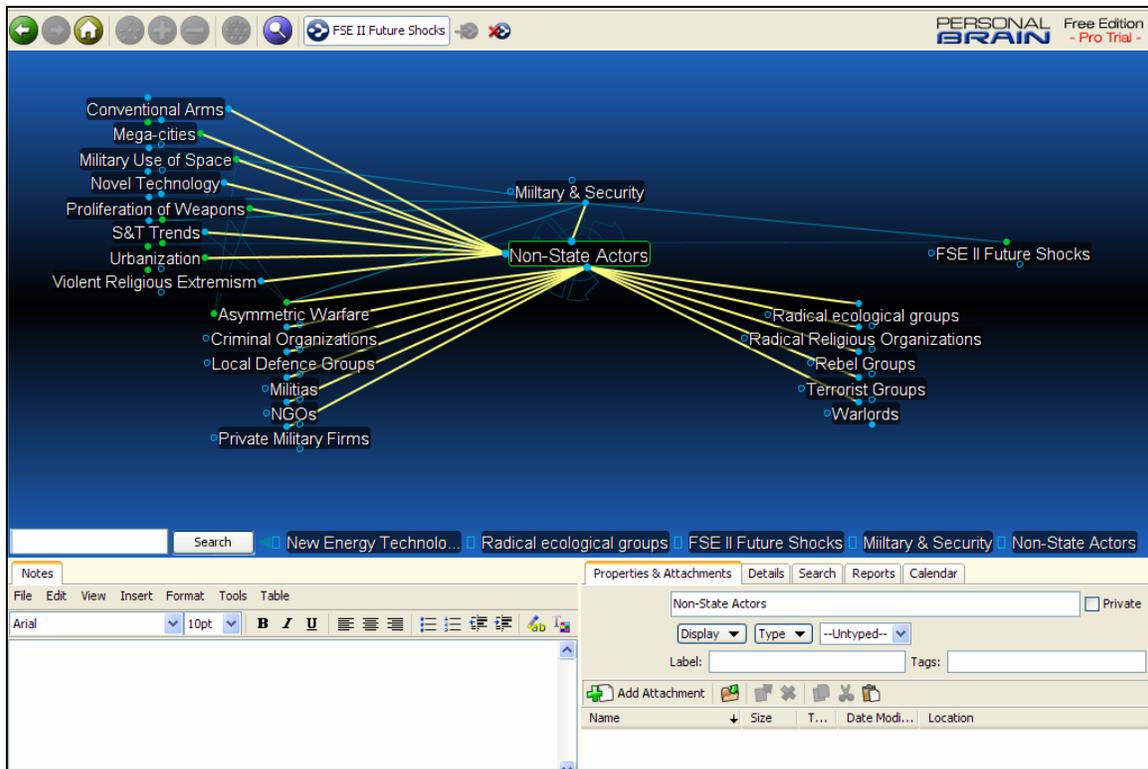


Figure 4: Screenshot of TheBrain Showing Linkages of Non-State Actors

The case of non-state actors is considered above to illustrate how DFSA 2 began to utilize TheBrain to identify future shock scenarios. Figure 4 shows the linkages that have been made between non-state actors and novel science and technology. A link was made to the overarching trend and several of the sub-trends, which allows for idea generation from the observed linkages. In this example, the connections can be taken out to some point in the future, and analysis of the linkages would point to a possible future shock. Carrying on with this example, a potential future shock could be identified as a malignant non-state actor (e.g., criminal organization) armed with directed energy weapons that could be used to destroy capabilities, systems, and networks on which Western militaries depend.

In using these mapping tools, DFSA 2 concluded that while they were effective in organizing knowledge and identifying linkages they were not substitutes for detailed analysis, and they were not in and of themselves a methodology. The tool is only as good as the information entered into it. Therefore, to be useful to the capability based planning process and force development, the information organized by these tools needs to be synthesized, analyzed and reviewed by subject matter experts.

2.5 Identifying Future Shocks and their Selection Criteria

Brainstorming sessions, survey results and literature review were among the many approaches that provided DFSA 2 with an understanding of possible future shocks that were applicable to

FSE2. The analysis of trends in FSE1 also provided DFSA 2 with a strong background of the types of indications, events, and scenarios that had the potential to culminate in a future shock. From this preliminary work, several sample shocks were notionally identified as a starting point for stimulating discussion and guiding subsequent research and analysis efforts.

A sample list of shocks was compiled to be representative of the types of events that could be encountered in the future. It was felt that this sample list of future shocks could be used to inform senior leadership of what was meant by future shock and to appreciate the future challenges faced by the Canadian Forces. It was also recognized that the initial list of shocks needed to be cross-referenced and validated through modeling with TheBrain software so that all of the possible trends and effects (e.g., second and third order) could be understood.

The sample future shocks identified by DFSA 2 are listed as follows in Table 1.

Table 1: Representative Future Shock Scenarios

Area	Representative Shock	Description
Economic	Global Depression	Rapid onset of global depression, caused by severe fluctuations in the value of currencies, commodities, energy, and financial institutions, which trigger a collapse of international financial markets around the world.
Resource and Environment	Earthquake on North American West Coast	A geological event akin to the volcanic eruption on Krakatoa (1883) on the North American coastline that would cause extensive damage to property/facilities and result in unacceptable loss of life.
Geopolitics	Rise of an Asian Superpower	A nation state in the Asia-Pacific region with global reach capabilities emerges to challenge the military and economic supremacy of the U.S. and promotes an alternative model for change to the existing geopolitical world order.
Science and Technology	Computer-Nerve Interface	Unintended malicious application of the fusion of people with artificial intelligence spawns a new generation or class of intelligent beings that lead to vast and sudden changes in human performance.

Military and Security	Cyber Attack on U.S. or U.K. Economic or Defence Infrastructure	A cyber attack on critical infrastructure (e.g., power, finance, communications) causes catastrophic and potentially permanent disability to mission critical systems, networks, or capabilities.
Social	Pandemic Influenza	An undetected, highly communicable, deadly, and untreatable virus spreads rapidly among human populations, causing millions of casualties worldwide and disrupting the economy/social behaviour on a global scale.

The list of all possible future shocks has the potential to be endless. However, not all possible future shocks are plausible, relevant or are of concern to defence planners and the Canadian Forces. For instance, although a Tsunami in a faraway region has the potential to generate loss of life and cause environmental damage on a significant scale, such an event would neither test Canadian national vulnerabilities nor immediately involve defence capabilities, unless the CF was specifically tasked by the Government of Canada to assist in relief efforts.

Bearing this in mind, DFSA 2 started to develop selection criteria that could be used as a filtering mechanism to help its Defence Scientists choose from various competing future shocks the scenarios to be included for further analysis. This set of criteria would serve as broad guiding principles to assist DFSA 2 or others in selecting and evaluating future shocks according to a rigorous and replicable methodology.

The criteria were intended to identify future shocks that were relevant to the CF, had the greatest impact on Canadian national vulnerabilities and were considered plausible. The purpose behind the selection criteria was to screen all potential future shocks and systematically evaluate each one in order to determine which shocks were most relevant. It was determined that future shocks must satisfy the criteria indicated in Table 2.

Table 2: Future Shock Selection Criteria

Criteria	Description
Strategic Fit	Potential future shocks must be generally consistent with the range of trends identified in FSE1, including Economic and Social, Environmental and Resource, Geopolitical, Science and Technology, and Military and Security Trends.
Defence Impact	The fallout/consequences resulting from the potential future shock must be relevant to the CF; these should cover the full spectrum of

	conflict as well as the full range of CF capabilities but is in no way bound by current Canadian defence policy.
Plausibility	Try to be as credible and as realistic as possible; avoid creating scenarios that are not grounded in plausible future developments.
Balance	The shocks must be representative of the types of threats to Canadian interests versus exhaustive; these should reflect both internal and external hazards; discuss positive shocks and their potential effects to acknowledge that these do occur; conduct risk assessment on negative shocks and their implications for DND/CF; consider both sudden dislocations and evolutionary developments.
New Contribution to Literature	The list of shocks should avoid duplicating wildcards already commonly chosen and analyzed by other organizations; consequently, the list would make a new contribution to international literature by considering some new shock ideas. This does not mean that existing shocks research would be disregarded, simply that the intent of the FSE2 project is to provide new material to challenge existing thinking.

In addition to meeting these broad criteria, there are a number of other possible factors that the body of selected shocks as a whole could cover. Although it would be unreasonable to expect each shock to include all of the factors, careful selection of shocks could insure that the complete list was representative of the following factors in Table 3.

Table 3: Factors and Conditions Influencing the Selection of Future Shocks

Factor	Description
FSE1 Chapter Themes	<ul style="list-style-type: none"> • Economic/Social • Environment/Resource • Geopolitical • Science/Technology • Military/Security
Service Elements	<ul style="list-style-type: none"> • Land • Aerospace • Maritime • Special Operations Forces

	<ul style="list-style-type: none"> • Joint
DND/CF Missions	<ul style="list-style-type: none"> • Domestic • Continental • International
Range of Missions	<ul style="list-style-type: none"> • Combat • Maritime Interdiction • Humanitarian Operations • Non-Combatant Evacuation Operation • Peace Support (conflict prevention, peace-building, peace-making, peace-enforcement, peace-keeping)
Intensity of Missions	<ul style="list-style-type: none"> • Low • Medium • High
Scale of Missions	<ul style="list-style-type: none"> • Size • Duration • Force Structure (Joint, Whole of Government, Coalition, Comprehensive Approach)
Operating Environment	<ul style="list-style-type: none"> • Mountains • Desert • Jungle • Tropical • Maritime • Urban • Littoral • Extreme/Austere (weather, temperature) • Seasonal Factors

DFSA 2 planned to formally review and subsequently select future shocks based on the selection criteria for insertion into the FSE2 document. The results of the review and selection process were going to be communicated to senior management for their input and feedback. Ultimately, it was understood that the approval of the final list of future shocks for detailed analysis was to remain solely within the purview of senior leadership.

2.6 Survey of Opinions Concerning Future Shocks

A survey is one method used to facilitate the elicitation of expert opinion and to collect subjective data on particular aspects of study. A simple, straightforward survey was developed by DFSA 2 in an effort to capture the initial thoughts and opinions of a diverse range of external stakeholders on unexpected challenges in the future security environment.

The selection of the survey instrument as a technique to support FSE2 was motivated by several considerations. The consensus within DFSA was that the FSE2 process should reflect a broad and consultative process, and it was recognized that a survey was one tool that could achieve this objective. There was a desire to leverage the experience and expertise of the broader force development network by having them identify potential future shocks. It was hoped that using a survey instrument could unearth new information, unique insights, and innovative concepts with respect to future shock scenarios. A broader pool of expertise could be engaged by using a survey instrument. By using a structured data collection mechanism to organize and process the information that would be received from outside stakeholders, the information from the survey would help to inform the subsequent mapping and modelling work on future shocks that was being conducted at the time by DFSA 2.

Given the focused nature of FSE2, a purposeful sampling procedure was used to identify and select respondents to participate in the survey. A purposeful sampling procedure is used when a researcher needs to obtain high quality, information-rich cases for in-depth study.²³ By using this approach, DFSA 2 was able to capture the collective experience and expertise of a community of interest that had a strong background in environmental scanning and analysis. The purpose was not to generalize from the sample to a larger population, but to generate valid and meaningful insights that would illuminate the questions under study. Therefore, the target audience for the survey were primarily members of the Environmental Scanning and Practices Group (ESPG), the Combat Development Working Group (CDWG), and subject matter experts in Defence Research and Development Canada (DRDC).²⁴

A copy of the survey was distributed externally to members of the ESPG via email in Microsoft (MS) Word format on 2 July 2008. Respondents were asked to complete and return the attachment by 16 July 2008. In preparation for internal distribution, a web-based survey tool was designed (with the assistance of Decision Support Services) to automatically collect responses from participants. The web-based survey tool was identical to the MS Word survey. The reason for the two approaches was that, at the time of the survey development, DRDC CORA lacked a survey platform that would allow researchers to canvas respondents using internal (Defence Wide Area Network—DWAN) and external (Defence Research Network—DRENET) means. A hyperlink of the survey was distributed in an email to members of the CDWG and subject matter experts in DRDC on 1 August 2008. Respondents were asked to complete the survey by 15 August 2008. A total of thirty-four responses were gathered from the survey. A screen shot of the survey is provided in Figure 5 for illustration purposes.

²³ Michael Patton, *Qualitative Evaluation and Research Methods* (Beverly Hills, CA: Sage, 1990) p. 169.

²⁴ For a detailed discussion of the survey methodology and results, see Shaye Friesen and Jennifer Anderson, *A Survey of Trends and Shocks in Support of Future Security Environment 2 (Future Shocks)* DRDC CORA TM 2009-008 (Ottawa: Defence R&D Canada, February 2009).

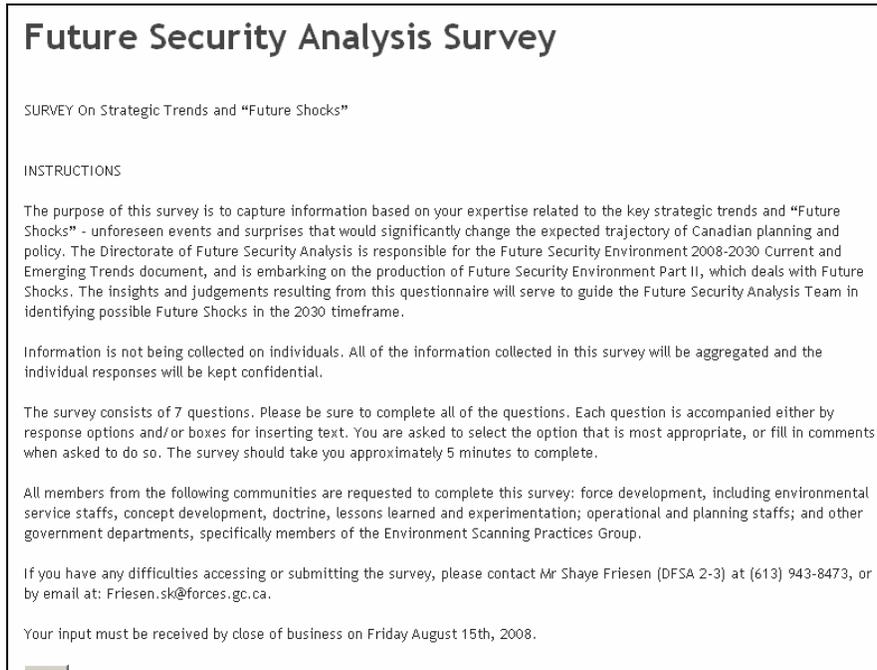


Figure 5: Screenshot of Future Security Analysis Survey

The survey included background information describing the purpose of the survey, the role of DFSA in the FSE2 project, why information was being collected, the number of questions, the approximate time to complete the survey, the target audience, and contact information. The survey itself consisted of a mix of both rating-type (structured) and qualitative (unstructured) questions. In terms of demographic data, respondents were asked to name their current affiliation (CF Member, DND Civilian, Other Government Department Civilian, or Other) and the select organization for which they worked (Strategic Joint Staff, Vice Chief of Defence Staff, Canada Command, Canadian Expeditionary Force Command, Canadian Operational Support Command, Canadian Special Operations Forces Command, Land Staff, Air Staff, Maritime Staff, Chief of Defence Intelligence, or other). Respondents were also asked to rate their level of familiarity with strategic trends and the future security environment (Very Familiar, Familiar, Somewhat Familiar, and Not at All Familiar). The information collected on respondents' background permits an examination of the differences in perceptions of risk among subgroups of the sample.

Respondents were then asked to characterize the risks of sixteen trends and possible shocks associated with the future security environment. The list of trends and shocks was compiled largely by data mining the current and emerging trends in FSE1. The responses to these questions were provided on a five point rating scale: Critical, Important, Minor, Negligible, and Not Applicable. In order to gain broader insight and information into what the external community thought about potential future shocks, respondents were asked to indicate their top three future shock scenarios that could pose a major problem in the future security environment of 2030. Respondents were also asked to identify the top three challenges and implications for Canada that could be encountered in these scenarios. The survey was reviewed, tested, and adjusted internally by the DFSA 2 Team prior to distribution.

The initial impression is that a survey is a useful mechanism for collecting information, facilitating input and feedback from a wider range of stakeholders, which can support research into future shocks. For the mid-to long-term, enhancements to the questions and survey instrument would lead to improvements in the identification and evaluation of future iterations of potential shock scenarios. The results of the survey were and published by DRDC CORA in February 2009.

2.7 Studying Historical Shocks

One way of demonstrating the utility of studying shocks is by illustrating the lessons learned and consequences of shocks that have occurred in history. There were a number of reasons for embarking on this exercise. First, even though there may be disagreement about what constitutes a shock, it is undeniable that shocks had occurred in the past. Second, many historical shocks were either predicted (often by people dismissed as naysayers prior to the event) or, in retrospect, had clear indicators prior to the actual event. Third, many historical shocks consisted of a series of events which culminated to create discontinuity. Ultimately, the point the study of historical shocks was meant to emphasize was that the beginnings of a shock might be imperceptible, and a shock may be occurring without the general populace knowing or understanding that it is already underway. This is consistent with one of the findings of the FSE1 project, which a new trend or a shift in existing trends may occur in such a manner as to be almost imperceptible to most observers. Fourth, and finally, it is useful to look to past shocks for common characteristics or identifiable trends, as this may not only help discern what the fallout of future shocks may be, but also broaden thinking with respect to the subtle triggers that might otherwise be overlooked.

To this end, it was decided that a number of examples of historical shocks would be chosen for inclusion in a single edited volume. The shocks would be chosen, for simplicity of understanding and commonality, along the broad themes of FSE1. Thus, the team would try to select a shock in each of the following categories: Economic and Social; Environment and Resource; Geopolitical; Science and Technology; and Military and Security. Each case study would adopt a “big picture” approach, focusing on strategic-level problems and outcomes in a concise format of ten to fifteen pages, sourced to an academic standard.

To help focus on the larger project, create uniformity, and keep the case studies short, an outline was created. It was decided that the papers would be structured along the following lines as depicted in Table 4:

Table 4: Outline For Historical Case Study Papers

Section	Description
Introduction	The introduction establishes the utility of the case under discussion.
Trend Analysis	If possible (dependent on subject), the convergence of factors leading to the shock is discussed.
Event Description	The shock itself is described in detail, including timelines.
Fallout and Effects	Each case study is structured to illustrate the fallout and effects of the shock along the same broad themes based on the chapter headings of the FSE1. This section includes a detailed examination of the first, second and third order effects. The primary goal is to demonstrate the complex relationship between these themes in the aftermath of a shock within each historical case study.
Relevance	If possible, outline the direct impact of the shock on the CF and/or Canada and its security posture.
Conclusion	The conclusion should provide broad based deductions on the implications of the event and re-iterate connections between the case studies if possible.

It was recognized that it would be impossible to provide more than a basic overview of each case study given space and time limitations. Also, it was understood that there would likely be criticisms from some quarters over the shocks chosen for illustration. However, the point was not to illustrate all shocks, or even necessarily the best examples, but rather to illustrate some that readers would be familiar with and help achieve the aims of the exercise. By doing so, readers would simply see the overall intent of the work, and focus on the larger FSE2 exercise rather than on debate over the historical examples.

A brainstorming session was held in August 2008 to help create a limited list of historical shocks. Examples within each theme were debated, and the following short list (Table 5) was created.

Table 5: List of Potential Historical Case Studies Considered

Theme	Description
Economic and Social	<ul style="list-style-type: none"> • 1929 Crash & the Great Depression • Epidemics: AIDS, Bubonic Plague, Spanish Influenza (1918), SARS • The Reformation • Emancipation of women • 1971 end of Gold Standard
Environment and Resource	<ul style="list-style-type: none"> • Oil Shocks 1973 and 1979 • Natural Disasters: Krakatoa 1883, Yellow River Flood (China 1931), 2004 Boxing Day Tsunami, drought and famines (1920-1921 USSR, India 1876-1878, Ethiopia 1984-1985) • Hurricane Katrina 2005 • Conversion from coal > oil > gas energy systems • Fluorocarbons and deterioration of ozone layer (1980s-1990s) • Air pollution and deforestation • Chernobyl disaster • Collapse of Grand Banks fishery
Geopolitical	<ul style="list-style-type: none"> • Collapse of Communism and end of bi-polar Cold War system of international relations • Political coups and/or revolutions: Taiping Rebellion (1851-1864), France 1789; Russia 1917; Iran 1979 • Mongol conquests
Science and Technology	<ul style="list-style-type: none"> • Invention of printing press • The internet • Power technologies (wind > steam > electricity) • Steel manufacturing and processing • Development of SONAR / RADAR • Development of radio
Military and Security	<ul style="list-style-type: none"> • 9/11 • Military exploitation of the railroad • Pearl Harbour • Launch of Sputnik (1957) • First World War submarine warfare • Manoeuvre warfare • <i>Levée en masse</i> • Development of Atomic weapons

Part of the criteria for the final selection was direct impact on military operations or force planning, direct applicability to the Canadian Forces or Canada in general, potential linkages between the historic shocks for each theme, and available research material. The case studies

selected for consideration in the historical shocks document included on paper for each theme, however at the time of writing not all papers were in a state that they could be published. For the geopolitical theme, the collapse of Communism was selected because it was readily obvious and there was an abundance of research material available. For the economic theme, the Great Depression was chosen because it could likely be explained somewhat easier than delving into the highly technical discussion required to illustrate the final end of the gold standard. For the social theme, the SARS crisis was chosen because research material was at hand and because there was statistical data available that could be employed in the analysis. For science and technology, the development of radar was chosen because of its wide-ranging military and civilian impact and because of internal expertise within DRDC. For the resource theme, the collapse of the Grand Banks fisheries in the 1990s was selected because it had both a Canadian and global impact, and because the CF was involved in policing Canadian interests in international disputes that arose from the collapse. It was also decided that this case study could represent the environmental theme as well. Finally, for the military and security theme, the development of atomic weapons was selected because it could be linked to the onset of the bi-polar system of international relations and therefore to the geopolitical theme case study of the collapse of Communism.

While there were myriad examples that could have merited inclusion in this volume, it was felt that those topics selected would adequately illustrate the points required to support the FSE2 project. Also, it was felt that these examples were less controversial and would avoid potential debate that would have likely resulted from the selection of other examples, such as the terrorist attacks on 9/11.

2.8 Annotated Bibliographies and Background Papers

One of the lessons learned from the creation of FSE1 was that space limitations would always be a constraint on how much discussion, and in what level of detail, could be provided on a given subject. To partially overcome this constraint, and to facilitate research, annotated bibliographies were compiled using open source government documents, national and allied military publications, think tank studies, and academic monographs and journal articles. Annotated bibliographies have been produced on cyber-terrorism, Diaspora and conflict, the Russian energy sector, and water scarcity. Separate bibliographies were also available for several previous shocks such as the Great Depression, the Chernobyl Nuclear Disaster, and the collapse of the Grand Banks fish stocks. The first two have been annotated. As well, DFSA 2 suggested the composition of full-length discussion papers as a means to more fully explore controversial issues or new trend developments. A list of potential topics for discussion papers was compiled, based on the contents of FSE1.²⁵

2.9 Liaising and Potential Stakeholder Participation

The experience of producing FSE1 demonstrated the drawbacks of writing products in isolation and highlighted the benefits and desirability of reaching out to stakeholders within the department to take advantage of their expertise and interest. Consequently, there was a strong desire to liaise with stakeholders outside DGFDA, collaborate with others conducting similar work, and establish a community of interest. Potential collaboration opportunities include initial brainstorming sessions, methodological discussions, exchange of research found and produced, mutual peer

²⁵ See Annex D “Potential Discussion Papers Further Exploring Future Security Environment Issues.”

review of documentation, and participation in working groups, workshops, symposia, seminars, or conferences. Liaising with a wider community will provide more ideas, and arranging formal collaboration could increase the number of people available to serve as researchers/writers. There are also benefits to reaching out to other government departments, allies, industry, and academia so as to tap into their expertise, research, and methodologies. A list of potential stakeholders who have interest in futures studies and have the expertise to produce similar scans of trends is provided in Annex E. Furthermore, DFSA 2 liaised and networked with from the Directorate of Land Concepts and Design in Kingston, the CF Aerospace Warfare Centre in Trenton. DFSA 2 engaged with international partners, specifically the Strategic Trends group at the United Kingdom Ministry of Defence's Development Concepts and Doctrine Centre at Shrivenham, and the Policy and Capability Studies Group in the Defence Science and Technology Laboratories at Farnborough.

2.10 Anticipated Production Process and Document Outline

Prior to the handover of FSE2 to FSAT, DFSA 2 had developed a production plan. FSE2 would be developed five stages leading to the production of five distinct publications, as depicted in Figure 6. After CDB review and publication through DRDC CORA, the individual products compiled under a CFD cover would have comprised the FSE2. Lessons learned from FSE1 suggested that a multi-staged publication and distribution process was required lengthy work stoppages caused by contentious chapters of the document. This process would allow faster distribution since earlier pieces were not contingent upon the final approval of the document. Secondly, CDB approval might be faster since the parts would be smaller.

**FSE Part 2: Future Shocks
Writing the Document**

- Conceptual Framework and Methodology Chapter
 - consult, write, circulate, revise
- Historical Case Studies
 - select, research, develop, peer review
- Selected Future Shocks List
 - liaise, preliminary selection, consult, revise, final selection
- Future Shocks Chapters
 - research, write, circulate, revise
- Implications for DND/CF
 - determine, write, circulate, revise

National Defence / Défense nationale Chief of Force Development / Chef du Développement des Forces Canada

Figure 6: Document Outline and Stages to Producing FSE2

Although not implemented, DFSA 2 developed a production plan that included the following steps. The first step would be the composition of the methodology chapter, which would outline the conceptual framework used to define and select strategic shocks. The next section of FSE2 would be the compilation of historical case studies. The next stage would be the selection of specific strategic shocks would make up the body of analysis for FSE2. The selection would be informed by literature research, consultations with the community of interest, and senior leadership engagement. Once topics were selected, work would begin on researching, analyzing, and writing the future shock vignettes. The final section of FSE2 would be a chapter articulating the specific implications for DND/CF. In order to ensure the maximum amount of buy-in, it would be necessary to consult the community of interest as much as reasonable, engage senior leadership as soon as possible, and properly staff the products throughout the department for the appropriate levels of endorsement that would expedite and enhance the documents' availability, circulation and credibility.

3 Conclusion

The purpose of this Technical Memorandum is to capture the methodological work and supporting material prepared for the development of the FSE2 document. An important lesson learned from the FSE1 project was that a rigorous and defensible methodology was imperative. With this knowledge DFSA 2 worked to construct a conceptual framework and methodology upon which to base the FSE2 project. In conducting this work, a consultative process was used as well as lessons learned, literature reviews, research and mapping tools, a survey instrument, historical case studies, annotated bibliographies and background papers. The authors contend that the tools, techniques and approaches outlined in this study constitute a rigorous and defensible methodology required for both future shocks and future security analysis work in general. In addition, this document presents a blueprint suitable for the development of FSE2.

Annex A Various Definitions and Methodologies from Literature Review

The following is a point form summary of various methodological approaches found during the literature search that could be applicable to the FSE2 project. Some sources provided definitions of relevance to the FSE2 work; these have been included in the summaries below as well.

Air University. *The World of 2020 and Alternative Futures*²⁶

Methodological Approach

- blend expert opinions, critical analysis, synthesis
- become educated about future by exposure to futurists and scientists' presentations

Steps in Preparing Alternative Futures Set

1. select important characteristics/drivers
2. Aggregate drivers into few key dimensions
3. Set range of values
4. Select number of scenarios to be studied
5. Designate indicators and trends
6. List important events
7. Prepare narratives

Colonel Joseph Engelbrecht et. al. *Alternate Futures for 2020*²⁷

Definitions

- Alternate Future: “a logical, coherent, detailed, and internally consistent description of a plausible future operating environment.”
- Driver: “a factor determined to be an important contributor to change affecting the future; factors which will drive major changes in the world in the next 30 years; physical or virtual forces or vectors which are expected to be a significant cause of, or contributor to, change.”

Methodological Approach

- Analyzed current trends
- Studied works/methods of futurists/scientists
- Discerned impact of wild cards
- Analyzed drivers
- Linked futures to today

Steps in Alternate Futures Process

1. Select drivers
2. Define drivers
3. Create strategic planning space
4. Name and select world of interest
5. Describe features of each world

²⁶ *The World of 2020 and Alternative Futures* (Maxwell Air Force Base: Air University, June 1994).

²⁷ Engelbrecht, Colonel Joseph et. al. *Alternate Futures for 2020: Security Planning to Avoid Surprise* (Washington, DC: Air Force 2025 Project, April 1996).

6. Develop plausible histories

Elements of Each Future

- Plausible history
- Nature of actors
- Nature of international politics
- Nature of national security strategy
- Nature of humanity
- Nature of technology
- Nature of environment
- Nature of defense budget
- Capabilities
- Implications
- Summary

Scientific Methods Identified

- Analyzing trends
- Researching topics
- Interviewing futurists/scientists
- Using affinity diagrams

Non-Scientific Methods Identified

- Creative thinking
- Brainstorming

National Intelligence Council. *Mapping the Global Future*²⁸

Methodological Approach

- Futurist guest speakers discussed work and methodologies
- Reviewed studies
- Met with international counterparts
- Organized various conference on all topics (experts, academics, business, government, NGOs)
- Wrap-up workshops to narrow final list of scenarios

Jack Smith. “S&T Foresight”²⁹

Definitions

- Shock: “wild card, high impact, low probability event that alters fundamentals.”

Methodological Approach

- Foresight Process Overview
 1. Define project topic
 2. Review current situation
 3. Identify key lenses
 4. Answer challenge questions

²⁸ National Intelligence Council, *Mapping the Global Future* (Washington, D.C.: U.S. Government Printing Office, December 2004).

²⁹ Smith, Jack (Office of the National Science Adviser), “S&T Foresight for Canadian Insight and Strategic Preparedness,” PowerPoint© Presentation, November 2006.

5. Identify change drivers
6. Select critical drivers
7. Identify scenarios
8. Populate each scenario
9. Backcast to present
10. Synthesis and produce recommendations

John Stewart. “Methods for Developing Alternative Futures”³⁰

Definitions

- Alternative Future: “description of a possible future state of events relevant to the planning object.”
- Prediction: “statements or opinions about what will happen in the future.”
- Projection: “a contingent statement ... [resting] on a series of state or implicit assumptions.”
- Scenarios: “hypothetical sequence of events constructed for the purpose of focusing attention on casual processes and decision points

Methodological Approach

1. Define key drivers (variables) in the environment under construction
2. Gather current and historical data on each key variable as the basis of the long-range forecasts
3. Formulate alternative futures
4. Define organizational goals for each alternative future
5. Assess goals iteratively against the alternative futures formed
6. Develop policies to meet the goals of all futures
7. Select preferred set of alternative policies
8. Monitor progress through another feedback loop

SVG. *Diagnosing the Future*³¹

Methodological Approach

Sources to Consult

- previous studies
- history
- future experts
- intelligence community

Darlene Weingand. “Futures Research Methodologies”³²

Methodological Approaches

- Trend Extrapolation: “the analysis of trends is based on empirical examination of a phenomenon with repeated measurements taken across time”; underlying assumption that “present conditions will not change substantially”
- Cross Impact Analysis: “analyze one trend or event in the light of the occurrence or non-occurrence of a series of related events”

³⁰ John Stewart, “Methods for Developing Alternative Futures and Long-Range Planning,” in *Creating Strategic Vision* (Washington, D.C.: National Defense University Press. 1987).

³¹ SVG, *Diagnosing the Future: Patterns, Trends, and Shocks*, PowerPoint© Presentation, August 2007.

³² Darlene Weingand, “Futures Research Methodologies: Linking Today’s Decisions with Tomorrow’s Possibilities,” paper presented at the 61st International Federation of Library Associations and Institutions Annual Conference, August 1995.

- Delphi Method: “an anonymous series of iterations and feedback which solicit and report expert opinion until general consensus is reached”
- Scenarios: “envisioning positive [and negative] images of the future”
- Environmental Scanning: “collecting information about the external environment”; examines political, economic, social, technological, psychographic, demographic areas

United States Commission on National Security/21st Century. *New World Coming*³³

Methodological Approaches

Shell Method

- Identify key decision or focal issue
- Identify key factors influencing focal issue
- Identify driving forces and major trends
- Rank factors and drivers according to degree of uncertainty
- Combine trends and uncertainties, produce path along which future could unfold
- Develop scenarios
- Draw implications
- Identify indicators and signposts

Systems Approach

- Deductive method
- Describe future in aggregate terms
- Distill general notions and organizing principles
- Link present with future construct

Deductive Engineering

- Create multiple futures
- Engineer futures back to present
- Provide desired scenarios

Quantitative Approach

- Evaluate probabilities of wild card events
- Begin with set of descriptors

Zalmay Khalilzad. *Sources of Conflict in the 21st Century*³⁴

Definitions:

- Wild Card: unforeseen events that could cause a major discontinuity or fundamental changes in US national security objectives and/or the role of the US military in pursuing them.”

United States Department of Defense³⁵

According to the US, this technique offers a framework from which key stakeholders can visualize, prioritize and develop mitigation strategies against future shocks. In mitigating the

³³ United States Commission on National Security/21st Century, *New World Coming: American Security in the 21st Century*, September 1999.

³⁴ Zalmay Khalilzad and Ian Lesser, *Sources of Conflict in the 21st Century: Regional Futures and US Strategy* (Santa Monica: RAND Corporation, 1998).

³⁵ Forces Transformation Chairs Meeting, *Visions of Transformation 2025—Shocks and Trends*, 12-13 February 2007, Naval Postgraduate School Transformation Chair, 21 February 2007.

future shocks, it was noted that emphasis be placed on those shocks that have high probability, high defence implication scores. In the US Office of Strategic Futures, several “categories of trends” and possible future shocks have been mapped on a decision matrix. Figure 7 displays the rankings of future shocks against two criteria: their probability of occurrence (horizontal axis) and their defense implications (vertical axis).

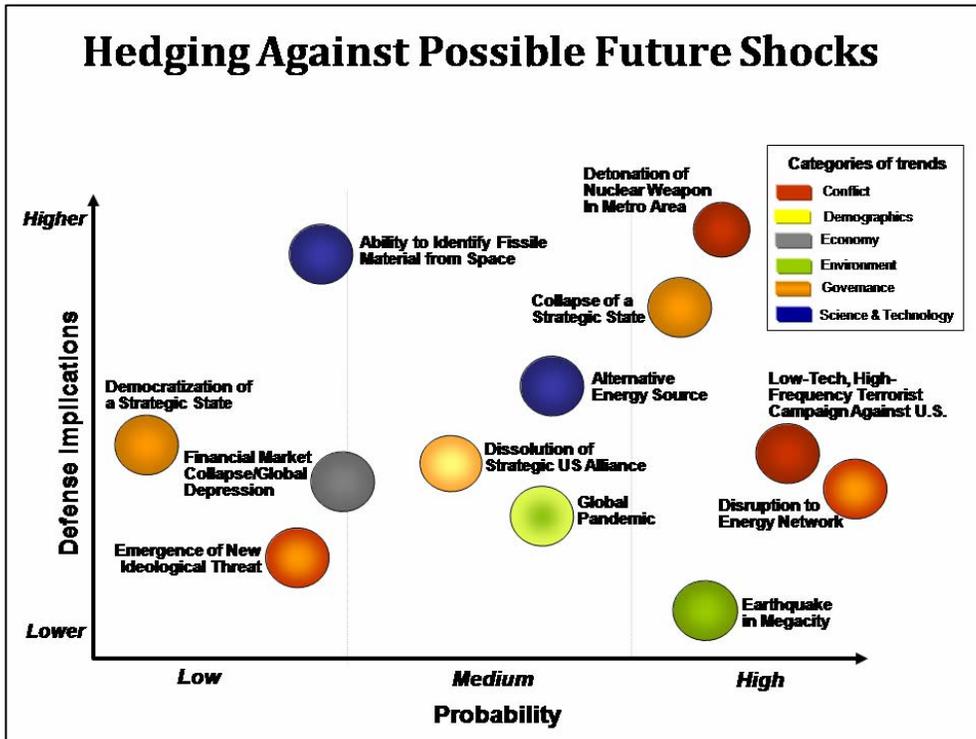


Figure 7: Risk Assessment Matrix of Possible Future Shock Outcomes

Annex B Shocks From Literature Review

Many of the works discovered during the literature review proposed actual shocks that could be worth considering. These shocks have been listed below, firstly by source and secondly by trend category.

Shocks Proposed in Each Source

Robert Costanza. “Visions of Alternative (Unpredictable) Futures”³⁶

- Population pressure leading to space colonies
- Warm fusion reducing global fossil fuel burning
- Air pollution eliminated
- Reversal of greenhouse gases
- Easy oil extraction exhausted; prices increase
- No cheaper energy alternatives
- Greenhouse effects continue and worsen
- Climate and ecological systems in shambles
- Pollution crisis
- Rising sea levels
- Stock market crash
- Airborne virus epidemic; kills 25% population
- Wars over water and other natural resources
- World run by transnational corporations
- Most people living in makeshift shelters
- Meltdown of French fission breeder reactor
- High taxes on fossil energy
- Devastating hurricane
- Equitable income distribution

Colonel Joseph Engelbrecht et. al. *Alternate Futures for 2020*³⁷

- Terrorist attacks at 2002 Utah Olympics
- Turkey-Kurdish problems
- China unravels; 15 new states
- Kurdish armistice
- African wars
- 297 members in UN
- Asteroid threat
- Computer-nerve interface
- Angola-Zaire border dispute

³⁶ Robert Costanza. “Visions of Alternative (Unpredictable) Futures and Their Use in Policy Analysis,” *Conservation and Ecology*, Vol. 4, No. 1, 2000.

³⁷ Engelbrecht, Colonel Joseph et. al. *Alternate Futures for 2020: Security Planning to Avoid Surprise* (Washington, DC: Air Force 2025 Project, April 1996).

- Safe nuclear fusion
- Chemical weapon terrorist attack
- Genetics breakthrough; abundant food
- High energy radio frequency attack destroys Wall Street's databases
- Collapse of Mexican economy
- 20 nations have WMD
- Influenza kills 30 million
- UN dissolves; regional conflicts
- Under-water exploitation
- Mexican recession, immigration to US
- US recession
- Stocks crash; US depression
- Asian colossus
- Balkans re-explode
- California earthquake
- Russian Confederation
- Castro dies; Cuban repatriation
- China seizes Spratly Islands
- EU expands east
- Iraq splits; Kurd state
- Turkish unrest
- Ukraine closes border with Russia

Jim Gorman. "Future Shocks"³⁸

- 40 mile long mudslide
- 80 foot high tsunami
- 6.5 magnitude earthquake
- 195mph hurricane
- Climate change disrupting North Atlantic Sea

Zalmay Khalilzad. *Sources of Conflict in the 21st Century*³⁹

- US withdraws from world stage; global competition to fill vacuum
- Islamic Crescent vs West; new Iron Curtain
- German dominated central European block in competition with Russia
- NBC war in Asia
- Korean unification and resulting internal Asian dynamics
- Typhoon strikes coastal African city
- South Asian cities struck with nuclear weapons from India and/or Pakistan
- Internal conflict in Saudi Arabia, Mexico, Egypt, or Cuba

³⁸ Jim Gorman. "Future Shocks: Think Mother Nature has Dealt Us Her Worst?" *Popular Mechanics*, October 2006.

³⁹ Zalmay Khalilzad and Ian Lesser, *Sources of Conflict in the 21st Century: Regional Futures and US Strategy* (Santa Monica: RAND Corporation, 1998).

- Environmental Shocks
- Lethal airborne virus
- Asteroid/comet on collision course with earth
- Earthquake in California
- Temperature increases; crops failures; coastal flooding

Political-Cultural Shocks

- Economic depression in US
- Regional ally lost – revolutionary collapse and disorder
- Fundamentalist in power in a nuclear-armed country
- Cold war: Islam vs West

Techno-Scientific Shocks

- Clean, inexpensive, limitless energy source developed
- Revolutionizing technology (akin to aircraft and computers)
- New technology cuts cost of launching payloads into earth’s orbit
- Sensor technologies render oceans transparent

National Intelligence Council. *Mapping the Global Future*⁴⁰

- Radical religious identity politics
- Proliferation
- Pandemic
- Terrorist attacks
- Radical take-over of Muslim country
- Terrorist groups acquire biological agents
- Transnational insurgency
- Acquisition of nuclear device
- Bioterrorism
- Cyber-attack

Gopal Ratnam. “New DoD Policy Office Studies Strategic Shocks.”⁴¹

- Violence over cartoons of prophet Mohammed in Danish newspaper
- Surprise electoral victory in Palestinian elections
- Taiwanese president angered Beijing by dissolving key unification body

SVG. *Diagnosing the Future*⁴²

- Democratization of strategic state
- Oil shock where US access cut by 10-15%
- Financial market collapse/global depression

⁴⁰ National Intelligence Council, *Mapping the Global Future* (Washington, D.C.: U.S. Government Printing Office, December 2004).

⁴¹ Gopal Ratnam, “New DoD Policy Office Studies Strategic Shocks,” *National Defense News*, 6 March 2006.

⁴² SVG, *Diagnosing the Future: Patterns, Trends, and Shocks*, PowerPoint© Presentation, August 2007.

- Emergence of new ideological threat
- Ability to identify fissile material from space
- Detonation of nuclear weapons in metro area
- Collapse of a strategic state
- Global pandemic
- Earthquake in mega-city
- Disruption of energy network
- Low-tech, high frequency terrorist campaign against US
- Space-based strategic warning failure
- Non-state actor with WMD
- Proliferation regime collapse
- Alternative energy source
- Bio-engineered weapon breakout
- Anti-US alliance
- Strategic state becomes hard-line Islamist
- Cyber attack on US critical infrastructure

United States Commission on National Security/21st Century. New World Coming⁴³

- US-Islam clash
- Asian recession, political-military struggles
- Fragmented China, assertive Japan
- Political upheaval
- Financial disaster
- Technological break-through in superconductivity

Categorization of Shocks

Negative Shocks/Dislocations

Economic and Social

- Stock market crash
- Recession in US
- Depression in US
- Collapse of Mexican economy
- Global depression
- Epidemic, pandemic

Environmental and Resource

- Worsening climate conditions
- Temperature increases, crops fail, coastal flooding
- Devastating hurricane or cyclone
- Rising sea levels
- War over natural resources

⁴³ United States Commission on National Security/21st Century, *New World Coming: American Security in the 21st Century*, September 1999.

- Earthquake on west coast of North America
- Avalanche or mudslide
- Disaster in a mega-city
- Collapse of fish stocks
- Depletion of oil reserves, prices rise
- Access to oil is cut by 10-15% for super power/regional powers
- Disruption of energy network

Geopolitical

- Turkey-Kurds war or armistice
- War in Africa
- Rise of Asian Superpower
- US withdraws from world stage
- Anti-US alliance
- Islam vs US/West
- China vs Japan
- Korean unification
- Nuclear strike by Pakistan or India on Asian city
- Russia-China-India alliance against US
- Russia invades East European state
- China annexes Taiwan
- US loses superpower status
- Fundamentalist government takes power in nuclear-armed country
- Radical takeover of Muslim country
- Collapse of a strategic state
- Increased numbers in NATO or UN
- Dissolution of UN

Science and Technology

- Computer-nerve interface
- Break through makes accessing space cheaper
- Sensor technologies render oceans transparent
- Surreptitious exploitation of nanotechnology

Military and Security

- Terrorist attacks during Olympics or summit
- Terrorists acquire CBRN
- CBRN terrorist attacks
- High energy radio frequency attach on Wall Street databases (also economic)
- Twenty nations with WMD
- Cyber attack
- New ideological threat
- Non-state actor acquires WMD
- Proliferation control regime collapses
- Cyber attack on US or UK infrastructure

Positive Shocks/Dislocations

- Fossil fuel replacement/alternative energy source
- Improvements in climate change, reversal of greenhouse gases, air pollution eliminated
- Genetics breakthrough results in food abundance
- Democratization of strategic state
- Develop genetic treatments to prevent effects of aging
- Democratic China

Recent Shocks Showing Surprise, Impact, and Variety

- Collapse of Soviet Union, end of Cold War
- Fall of Berlin Wall
- Nuclear disaster at Chernobyl
- 11 September 2001
- Violence over cartoons of Mohammed in Danish newspapers
- Tsunami in Asia/SE Asia/Indonesia
- Cyclone in Burma
- Earthquake in China

Annex C Potential Discussion Papers Further Exploring Future Security Environment Issues

Economic and Social

- Globalization (positive and negative outcomes)
- World economic trends
- Economic disparity
- Security of oceans
- Canada's trading patterns and partners
 - Ground trade
 - Sea trade
 - Electronic transactions
- Migration
- Population displacement
- Urbanization
- Mega-cities
- Infectious diseases and pandemics
- World poverty
- Religious extremism
- World demographic trends
 - Youth bulges
 - Aging populations
 - Canadian trends

Environmental and Resource

- Climate change
 - Positive effects
 - Negative effects
 - Impacts when trends converge
 - Arctic issues
 - UNCLOS
- Water scarcity
- Food scarcity
- Desertification
- Energy
 - Established oil powers
 - Rising oil powers
 - Peak oil
 - New oil deposits
 - Alternative fuels
 - Impacts of using land for bio-fuels
- Strategic minerals, metals

Geopolitical

- Future of multilateral organizations
 - In general
 - Specific institutions
 - Less friendly organizations
- United States super power status
- China as rising power (checks and catalysts)
- India's potential as rising power
- Russia's hopes to re-emerge on world stage
- Regional relationships in Central America, South America, Caribbean Basin
- Regional relationships in Maritime South-East Asia and Oceania
- Regional relationships in Middle East
- Regional relationships in South-Central Asia
- Failed and Fragile States
 - In general
 - Specific country studies

Science and Technology

- Nanotechnology
- Information technology, computing technology, sensors
- Biotechnology
- New energy technologies
- Cognitive, behavioural, social sciences
- Risks of future technologies

Military and Security

- Non-State actors
 - NGOs
 - Problematic actors (militias, war lords, rebels, terrorists, criminals, private military firms)
 - Meta-nationals
- Asymmetric warfare
- Insurgency and counterinsurgency
- Terrorism
- Proliferation of weapons
 - Conventional arms
 - Small arms
 - CBRN
 - Novel/upcoming technology
- Militarization of space
- CF roles and missions
- Comprehensive Approach
- Spectrum of Conflict/conflict models
- Any new development in security environment

Annex D Potential Stakeholder Contact Information

FSE1 was circulated for department review to the Capability Development Board (CDB) and to the Joint Capability Requirement Board (JCRB). This review process identified people (civilians and military personnel) who had expertise and knowledge in areas relevant to the FSE exercise. Some individuals used the opportunity to express their interest in the work and to offer participation and request notification of subsequent future security environment projects. The list below has been compiled as an initial list of people to potentially invite to brainstorming sessions, working groups, workshops, symposia, or conferences. It is believed that input and advice from a wider circle of expertise across the department can only strengthen the documents produced. It is also hoped that earlier feedback and actual participation might create stakeholder buy-in and reduce pushback during the review and approval process.

Gave Feedback During CDB Review November 2007

ADM (Policy)

Directorate of Policy Development

Canada Command

Deputy Commander

Chief of Air Staff

Directorate of Air Strategic Plans

Chief of Force Development

Directorate of Strategic Guidance

Chief of Land Staff

Directorate of Land Concepts and Designs

Chief of Maritime Staff

Directorate of Maritime Strategy

Strategic Joint Staff

DG Coordination

Gave Feedback During CDB Review February 2008

ADM (Infrastructure and Environment)

IE Compt

ADM (Policy)

Directorate of Policy Development

ADM (Policy)

DG Policy Planning

ADM(Public Affairs)
Chief of Staff

Canadian Operational Support Command
Sp Analysis and Design

Canadian Special Operations Forces Command
Commander

Chief of Air Staff
Directorate of Air Strategic Plans

Chief of Defence Intelligence
DGIP

Chief of Land Staff
Directorate of Land Concepts and Designs

Chief of Maritime Staff
Directorate of Maritime Strategy

Chief of Military Personnel
Directorate of Military Personnel Strategy and Coordination

Other Interested Stakeholders

ADM (Human Resources-Civilian)

ADM (Science and Technology)

Canadian Defence Academy-Canadian Forces Leadership Institute

Other Government Departments With Similar Expertise

- Communications Security Establishment
- Department of Foreign Affairs and International Trade
- Environment Canada
- Environmental Scanning Practices Group Membership
- Finance
- Industry Canada
- Public Safety Canada
- Royal Canadian Mounted Police
- Statistics Canada

Other Sources of Similar Expertise

- Industry
- Academia

- Military allies
 - United States
 - United Kingdom
 - France
 - Germany
 - Australia
 - New Zealand
 - NATO

Annex E Lessons Learned for Research Methodology

Whether producing an FSE product or writing concepts, the methodology must be rigorous and accommodating of the time needed for thorough research. Researchers must use authoritative sources, take advantage of subject matter experts, and conduct wide consultation to ensure the products' quality and credibility. The following are lessons that were learned during FSE1 production and Domain Concept work within DFSA: these suggestions are based on approaches that worked, on methods that would have been helpful in hindsight, and on recommendations provided by peer reviewers.

Stages:

1. Initial Higher Direction
2. Research
3. Consultation (interviews and workshops)
4. Writing
5. Review
6. Revision
7. Higher Review
8. Final Promulgation and Publication

Methods for Gaining Expertise:

1. Research
2. Conferring with Counterparts (individuals and/or organizations)
3. Work Shops
4. Risk Assessments/Experimentation/Modeling
5. Electronic Discussion Sessions

Selecting the Final Deadlines and Interim Milestones

- research, consultation, review, revising, and incorporation of comments all need time
- writing team members also have other work demands on time (administrative matters, management responsibilities, other simultaneous projects)
- arbitrary and short deadlines only hurt the final product by not leaving enough time to research, consult, review, revise, incorporate comments thoroughly; hence, what is accomplished is simply what could be done in the short period of time
- deadlines should not dictate the methodology used; instead, deadlines should be built around the time needed for each stage of the rigorous methodology process

Composing the Writing Team

- all members need to understand how to research thoroughly and how to recognize credible/authoritative sources
- composed of in-house DFSA members and external subject matter experts (defence scientists/strategic analysts, military analysts; civilian academics)
- the inclusion of outside subject matter experts brings in expertise that could not be gained by the writing team in the short periods available for research; these experts already have knowledge of sources, analysis, implications, networks, etc

- share the writing burden; have DFSA Team Lead as editor for final coherence and one voice

Conducting the Research

- of methodologies used in the discipline
- of content written on the topic
- national and international literature; of allied counterparts and academics

Reaching Out for Consultation

- writing teams make preliminary selection of material (from literature research stage)
- consult with other groups in DND that have expertise in this area
- consult with other government departments that have expertise in this area
- consult with industry and academia that have expertise in this area
- consult with military allies
- conduct interviews with counterparts to discuss, share, and refine findings
- organize workshops and invite counterparts to discuss, share, and refine findings

Writing the Product

- writing team composes the first draft, based on research and consultation
- writing team conducts risk assessment, experimentation, and or modeling (collaboration where appropriate)
- writing team revises draft accordingly, based on risk assessment/experimentation/modeling findings

Reviewing and Revising the Product

- electronic discussion sessions of draft's chapters/sections (separate session for each topic); invite experts from civilian/military/academic communities of interest
- External review and comments (other government departments, academia, industry); revise accordingly
- CDB review and comments; revise accordingly
- JCRB review and comments; revise accordingly
- DEM (Defence Executive Meeting), DMC (Defence Management Committee), DM (Deputy Minister), CDS (Chief of the Defence Staff) approval

Annex F Timeline for Next Future Security Environment Trends (Part One) Production

One of the greatest challenges of any research project is putting forward a timeline that is realistic. There needs to be sufficient time in order to create a well-researched and credible product. Nevertheless, the product needs to be completed in a timely fashion to meet the department's requirements. From experience, it is all too easy to shorten production timelines by reducing the amount of time allocated for research and writing and to skip some steps such as having the document reviewed by peers or superiors in an effort to try to complete the drafts sooner than projected. It is also all too easy to under-estimate time needed for committee and peer review and for revisions and additional research. Experience with FSE1 also demonstrated that no time was gained by "cutting corners" and that overly optimistic time projections were usually wrong, thus meaning that time for extra research, reviews, and revisions had to be added in anyway.

It is always difficult deciding how much time should be allocated to research and writing because there is always the tendency to want to gather more material and be as thorough as possible. Sufficient time needs to be set aside, but the time allotted must also fit the time parameters of the entire project: what must be done in order for the document to be rigorous and credible, and what *could* be left out and not really affect the outcome in the grand scheme of things? This is the balance that must be achieved. By creating the largest writing team possible, the labour can be divided and research and writing on different areas can occur simultaneously.

It is also very challenging to discern how much time reviews will take. Drafts normally require review by multiple levels before external distribution. Hence, sufficient time for review must be accounted for when developing project schedules. However, experience has shown that review deadlines may not be met by the reviewers, for any number of reasons, delaying the project timelines. Consequently, reminders of these deadlines need to be circulated while waiting for responses, especially as the due date nears. Those creating the timelines may simply expect delays to occur at this stage, if they want to accept and consider all feedback submitted, both timely and late. The review process can also be set back by requests for additional research and analysis, rather than simple minor revisions.

Based on the experience of writing FSE1, the following timeline was put together for future iterations of FSE1. It takes into consideration all the steps for review that had to be in the process, and it tries to ensure enough time is allotted for initial research and for later revisions. If no delays occurred anywhere in the process, the document would take 22.5 months⁴⁴ to produce, from start to finish; nevertheless, delays must be expected. In the case of FSE1, the DM and CDS have not signed the document yet as expected because of additional concerns expressed by ADM Policy

⁴⁴ 22.5 months sounds like a long time, but the timeline below reflects the time we had to build-in for internal review and for incorporating comments. It also reflects the lessons learned from experience about not allotting enough research time and not doing any early consultations with other stakeholders before CDB and JCRB review. In actual fact, 22.5 months is comparable (and a little shorter) than the 24+ months it has taken to get this FSE1 version ready for the September 2008 DMC and subsequent publication (this estimate is based on DFSA beginning work on the FSE with the September 2006 draft under LCol C. Kilford).

after DMC endorsement. Consequently, publication and distribution is on hold until these issues are resolved. This was unanticipated in all time estimates.

This timeline is described to give some idea of the time and steps needed to produce FSE2.

Producing Initial Draft: (6.5 Months)

- Literature scan to inform FSE topic selection (four weeks)
- Consultation with DND/CF stakeholders to receive their input on topics of interest (two weeks)⁴⁵
- Writing Team brainstorming session(s) to make actual selection of topics (two weeks)
- Review and approval of Table of Contents (two weeks)
 - DFSA (two days)
 - DGFDA (three days)
 - CFD (one week)
- Writing Team begins researching topics and writing Draft One (sixteen weeks)⁴⁶
 - literature review
 - networking with international counterparts, academia, departmental experts
 - workshops for information exchange, development of/feedback on deductions and implications
 - writing Introduction, Five Body Chapters, Conclusion

Reviewing and Revising the Draft: (12 months)⁴⁷

- Internal review and approval of Draft One (four weeks)
 - DFSA (one week)
 - DGFDA (one week)
 - CFD (two weeks)
- Writing Team makes necessary revisions (two weeks)
- Draft One to CDB for review and comment (six weeks)⁴⁸
- Writing Team incorporates comments from CDB and produces Draft Two (four weeks)
- Internal review and approval of Draft Two (four weeks)
 - DFSA (one week)
 - DGFDA (one week)
 - CFD (two weeks)
- Writing Team makes necessary revisions (two weeks)
- Draft Two to JCRB for review and comment (six weeks)⁴⁹

⁴⁵ Consultations with others groups doing FSE work can begin during the latter stages of literature review, once the writing team has a solid grasp of potential topics for inclusions; hence all the allotted time may not be necessary in the end.

⁴⁶ Two months for researching, two months for writing for each chapter. This can be accomplished in sixteen weeks only if there are enough members on the writing team to divide the work evenly and have separate teams researching/writing one chapter at a time so all the chapters are being produced simultaneously. If there are too few people and if any chapters have to be produced consecutively rather than concurrently, then an additional four months needs to be added for each chapter lacking a dedicated writing team.

⁴⁷ Timelines can be shortened if internal review and subsequent revisions take less time than allotted.

⁴⁸ Sent to CDB two weeks before committee meeting when on agenda; four weeks to review and return comments.

⁴⁹ Sent to JCRB two weeks before committee meeting when on agenda; four weeks to review and return comments.

- Writing Team incorporates comments from JCRB and produces Draft Three (four weeks)
- Internal review and approval of Draft Three (four weeks)
 - DFSA (one week)
 - DGFDA (one week)
 - CFD (two weeks)
- Writing Team makes necessary revisions (two weeks)
- Draft Three to ADM (Policy) for sensitivity review (three weeks)
- Writing Team incorporates comments from ADM (Policy) and produces Draft Four (one week)
- Internal review and approval of Draft Four (four weeks)
 - DFSA (one week)
 - DGFDA (one week)
 - CFD (two weeks)
- Writing Team makes necessary revisions (two weeks)

Publishing and Promulgating the Final Product: (4 months – to be confirmed)

- Secure copyright approval of graphics (two weeks – to be confirmed)
- Professional editing (four weeks – to be confirmed)
- Review of edited copy (one week)
- Draft Four to DMC for approval (two weeks)⁵⁰
- Translation (four weeks – to be confirmed)
- Review of translation (one week)
- Await final signature (unknown)
- Printing (two weeks – to be confirmed)
- Final product in hand for distribution

⁵⁰ Sent to DMC two weeks before committee meeting when on agenda.

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List of symbols/abbreviations/acronyms/initialisms

Acronym	Meaning
CDB	Capability Development Board
CDS	Chief of Defence Staff
CDWG	Combat Development Working Group
CF	Canadian Forces
CFD	Chief of Force Development
CORA	Centre for Operational Research and Analysis
DCDC	Development, Concept, and Doctrine Centre (UK Ministry of Defence)
DEM	Daily Executive Meeting
DFSA	Directorate of Future Security Analysis
DGFDA	Director General Force Development Analysis
DM	Deputy Minister (of Defence)
DMC	Defence Management Committee
DND	Department of National Defence
DRDC	Defence Research and Development Canada
DRENET	Defence Research Establishment Network
DWAN	Defence Wide Area Network
ESPG	Environmental Scanning and Practices Group
FSE	Future Security Environment
FSE1	Future Security Environment Part 1: Current and Emerging Trends
FSE2	Future Security Environment Part 2: Future Shocks
FSE3	Future Security Environment Part 3: Alternative Futures
JCRB	Joint Capability Review Board
NGO	Non-Government Organization
OGD	Other Government Department
PER	Performance Evaluation Report
SARS	Severe Acute Respiratory Syndrome

Glossary

Term	Definition	Usage
Brainstorming	A method of eliciting knowledge, opinions, and generating ideas through often loosely structured discussions	DFSA 2
Delphi Method	A structured process for collecting and distilling knowledge from a group of experts by means of a series of questionnaires interspersed with controlled opinion feedback ⁵¹	
Future Security Environment	For force development planning purposes, the plausible forecast of the types and scale of threat likely to be encountered by the Canadian Forces out to the end of the horizon three timeframe.	CFD Handbook
Futures Wheels	A method of organizing research material, particularly information generated through brainstorming that arrays trends or events in the centre, with spokes radiating outward to link primary, secondary, and further effects. The effects are represented as concentric circles, beginning with primary, and the effects are linked through additional lines as necessary. The goal is to illustrate the cumulative effects of a given trend or event in a manner that is understandable. The utility of this tool is dependent on the quality of inputs.	DFSA 2
Horizon One	For force development planning purposes, the timeframe from the present to five years in the future. This is considered the business-planning horizon.	CFD Force Development Cycle
Horizon Two	For force development planning purposes, the timeframe from five (the end of horizon one) to fifteen years in the future. This is considered the conceptual planning horizon.	CFD Force Development Cycle
Horizon Three	For force development planning purposes, the timeframe from fifteen	CFD Force Development

⁵¹ <http://www.iit.edu/~it/delphi.html>, accessed 16 December 2008.

	(the end of horizon two) to thirty years in the future. This is considered the future environment analysis and planning horizon.	Cycle
Methodology	A system of methods used in a particular area of study or activity	Oxford Dictionary
Strategic Shock	An event that precipitates a discontinuity in trends and fundamentally challenges the basis of existing policies.	DFSA 2

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This Technical Memorandum outlines the methodological work conducted by Defence Scientists embedded in the Directorate of Future Security Analysis 2 on Future Security Environment Part 2: Future Shocks (FSE2) between Fall 2007 and Fall 2008. The goals of this Technical Memorandum are to present a methodological foundation for FSE2 and to provide intellectual continuity in the pursuit of the FSE research agenda. It covers the links to FSE1 and the methodological steps taken in conducting FSE work (e.g., lessons learned, mission statement and common lexicon, literature reviews, research and mapping tools, selection criteria, survey instrument, historical case studies, annotated bibliographies and background papers, and liaising and stakeholder participation, and production process). The authors contend that the tools, techniques and approaches outlined in this study constitute a rigorous and defensible methodology required for the conduct of future security analysis.

Ce document technique décrit le travail méthodologique qui a été effectué par les scientifiques de la Défense intégrés à la Direction de l'analyse de la sécurité future 2 (DASF 2) pour travailler sur le projet ESA2 (Environnement de sécurité de l'avenir, partie 2 : Chocs du futur), de l'automne 2007 à l'automne 2008. Ce document technique a pour but de présenter la méthodologie qui a été utilisée pour le projet ESA2, et de justifier sur le plan intellectuel la poursuite des recherches sur l'ESA. Il couvre les liens avec le projet ESA1 et les outils méthodologiques qui ont été utilisés pour faire le travail (ex. : leçons apprises, énoncé de mission et lexique, analyses documentaires, outils de recherche et de projection, critères de sélection, instrument de sondage, études de cas, bibliographies annotées et documents d'information, outils de liaison et d'intéressement des intervenants, et processus de production). Les auteurs soutiennent que les approches, les techniques et les outils décrits dans ce document constituent une méthodologie valable et rigoureuse qui est nécessaire pour la conduite des futures analyses de sécurité.

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Future Security Environment; Future Shocks; Methodology



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