HANDBOOK OF DEFENSE PROJECT MANAGEMENT

VOLUME 1

FOUNDATIONS OF DEFENSE PROJECT MANAGEMENT

Editors:
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Handbook of Defense Project Management

(*Volume 1*)

Foundations of Defense Project Management

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FOREWORD

In the unforgiving domain of defense, history has repeatedly demonstrated the cost of unpreparedness. General Douglas MacArthur captured the essence of failure in war with just two words: “too late.” Nations enter conflict with the capabilities they have on day one, not the ones they hope to develop later. This stark reality makes defense project management not just critical, but existential.

In today’s rapidly evolving world, where extraordinary technological advances continually redefine the boundaries of possibility, managing defense projects has never been more demanding, or more vital. The relentless pace of innovation transforms operational doctrines and renders yesterday’s breakthroughs obsolete, creating an environment of profound uncertainty. Success in this context requires unparalleled agility, precision, and the ability to adapt on an unprecedented scale. From my time in the Royal Canadian Air Force, I witnessed firsthand how innovative and strategic project management directly influences mission success and, ultimately, national security.

Volume 1 of the Handbook of Defense Project Management addresses some of the most pressing challenges in defense project management, including stakeholder engagement, decision-making under uncertainty, and the intricacies of contract management. These topics are explored with depth and clarity, reflecting the editors’ profound understanding of the defense sector’s unique demands.

Drawing from my experience in combat operations and defense modernization, I can attest to the indispensable value of meticulous planning, agile execution, and collaborative communication. These principles resonate throughout this work, making it an essential resource for project managers navigating the complexities of the defense sector while fostering innovation and resilience.

This handbook is more than a contribution to defense project management. It is a testament to the power of collective expertise and dedication. I commend the editors and contributors for their extraordinary efforts in advancing this critical discipline. Their vision has produced a resource that will empower defense professionals to confront today’s and tomorrow’s challenges with confidence and capability. It provides the building blocks for achieving and maintaining excellence across the defense project management lifecycle, which is fundamental to national security and prosperity.

This volume equips you with the essential principles of modern defense project management, ensuring that you are never “too late.” I congratulate the editors on this outstanding contribution to the defense community—a work of immense practical value for military professionals, industry leaders, and academia alike.

Major-General (Retired) Sylvain Ménard, MSM, CD
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PREFACE

The Handbook of Defense Project Management comprehensively explores the principles, strategies, and practices underpinning effective defense project management. Structured in two complementary volumes, it serves as an essential reference for academics and practitioners within the defense sector. While Volume 1 focuses on foundational principles, Volume 2 addresses advanced and specialized topics, offering an integrated perspective on the discipline. Together, these volumes form an indispensable resource for those seeking a holistic understanding of the discipline.

Volume 1—Foundations of Defense Project Management—brings together the core concepts and methodologies essential for successfully managing defense projects. It establishes a robust conceptual and operational foundation by integrating theoretical frameworks with practical tools and case studies.

This volume examines key topics, including the fundamentals of defense project management, encompassing security, regulatory compliance, and the necessity of adapting to evolving geopolitical landscapes. It also explores advanced strategies for risk mitigation, leveraging next-generation technologies, and executing large-scale initiatives. Readers will gain insights into the critical role of effective front-end planning in optimizing processes and controlling costs, the importance of decision-making frameworks in complex environments, and the fundamental impact of stakeholder engagement and collaboration.

Financial and contractual aspects, including harmonizing public policy with industry standards to ensure value delivery, are also discussed in depth. In addition, this volume addresses the best practices in technology transfer and strategic innovation, as well as the significance of knowledge-sharing in enhancing operational effectiveness. Emphasizing flexibility, governance, and political awareness, this volume equips readers to navigate the evolving defense environment with clarity and confidence.

We extend our deepest gratitude to the authors, whose expertise and commitment have made this handbook an invaluable resource. We trust that Volume 1 will provide both insight and inspiration, enabling readers to overcome challenges and seize opportunities in defense project management.

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Disclosure:

The similarities between the prefaces of Volume 1 (BMS-FDPM-2025-HT1-6936-1) and Volume 2 (BMS-ATDP-2025-HT1-6937-1) of the Handbook of Defense Project Management are intentional. They ensure consistency and reinforce the complementary nature of both volumes as a comprehensive resource on defense project management.

The opening section and acknowledgments are equal in both prefaces to provide a unified introduction and recognize the collective contributions of the authors. While the structure remains uniform, each preface highlights its volume's distinct focus—Volume 1 on foundational principles and Volume 2 on advanced topics. This parallel approach enhances clarity and underscores the handbook's integrated perspective.

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CHAPTER 1

Fundamentals of Defense Projects

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Abstract: Execution of defense projects demands principles, methodologies, and considerations distinct from civilian project management. This chapter provides an exploration of the fundamentals underlying defense projects, delving into the key factors that distinguish them within the broader realm of project management. From the complexities of security and classification to the dynamic nature of geopolitical influences, defense projects require meticulous planning, adaptability, and collaboration. The chapter examines varied aspects such as defense-specific institutional processes, stakeholder engagement, technology integration, and risk management specific to defense contexts. This chapter aims to offer insights into the challenges and best practices inherent to defense project management. From military aircraft development to military construction and infrastructure, understanding the fundamentals is essential to achieving project success in the defense sector.

Keywords: Adaptive project management, Artificial intelligence, Communication strategies, Cybersecurity, Defense acquisition processes, Defense project management, Geopolitical influences on defense projects, Military project planning advanced technologies, Mission-critical defense initiatives, Project lifecycle, Project management tools, Public-private partnerships, Regulatory compliance for defense, Risk management, Security measures, Stakeholder engagement, Team leadership.

INTRODUCTION

Definition of Defense Project Management

Defense project management is the tailored application of project management practices to meet the unique demands and challenges of defense sector projects (Kolodny *et al*., 2013). While still adhering to the basic principles and best practices of project management, defense projects have characteristics that require special consideration, including security and classification, a much larger and

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more diverse stakeholder community, geopolitical landscape impacts, long lifecycles, and the Department of Defense's unique funding and acquisition processes (Rodríguez-Segura *et al*., 2016).

Defense projects are as varied as civilian projects, from the mundane improvement of a shooting range to the decade-long development of a new class of nuclear submarines. Many larger projects typically involve the development and acquisition of defense systems, infrastructure construction, and logistical support, all of which contribute to national security and military readiness.

The significance of good defense project management lies in its ability to navigate the complex landscape of regulatory compliance, security, and classification requirements, while integrating advanced technologies, all within stringent budget and timeline constraints (Meier, 2008; Project Management Institute, 2017). It ensures that defense initiatives are executed efficiently, effectively, and securely, contributing to the nation's defense capabilities and strategic advantages (Kolodny *et al*., 2013).

The primary objectives of this introductory chapter on defense project management are to:

Introduce the Field: Provide an overview of defense project management, highlighting its unique challenges and requirements that differentiate it from civilian project management.

Outline Key Challenges: Detail the specific challenges encountered in defense project management, including security considerations, regulatory compliance, stakeholder engagement, and the impact of geopolitical factors.

Present Best Practices: Offer insights into the best practices for successful defense project management, covering aspects such as project initiation, planning, execution, and closure, as well as the integration of advanced technologies.

Discuss Tools and Technologies: Explore the tools and technologies that are reshaping defense project management, with an emphasis on artificial intelligence, data analytics, and cybersecurity measures.

Highlight Future Trends: Identify emerging trends in defense project management, preparing readers for the evolving nature of defense projects in response to technological advancements and changing global security dynamics.

By achieving these objectives, the chapter aims to equip current and aspiring defense Project Managers (PMs) with the knowledge, tools, and strategies needed

to navigate the complexities of the field, ultimately contributing to the successful realization of defense projects that safeguard national security.

Importance of Effective Project Management in Defense

The first and most important distinction of defense projects lies in their direct contribution to national defense. Whether it's developing advanced weaponry, enhancing communication systems, or constructing military infrastructure, effective project management ensures the timely delivery of important capabilities that have real-world implications for national security and preparedness. The stakes are high: a well-managed defense project can strengthen a country's ability to respond to threats, safeguard its citizens, secure a strategic advantage, and maintain sovereignty, while poor management can delay critical systems, waste taxpayer dollars, and put the nation at risk (Kolodny *et al*., 2013). PMs significantly impact national security in their ability to manage defense projects effectively. Their decisions impact not only budgets and military effectiveness but also lives on the battlefield, global stability, and civilian safety. In summary, effective project management in defense is not just about meeting deadlines; it is about safeguarding nations, optimizing resources, and ensuring readiness in an ever-changing world (Kolodny *et al*., 2013; Meier, 2008; Rodríguez-Segura *et al*., 2016).

Another distinction is that defense projects are often more complex and encompass a wider range of stakeholders than most non-defense projects, including military personnel, engineers, regulatory oversight, scientists, private industry, policymakers, and trade experts (Rodríguez-Segura *et al*., 2016). Each of these stakeholders has different interests in the project for which the PM must account. Budget managers and citizen watchdog groups care about how well the PM optimizes their resources, while military leaders want to keep any secret information and special technologies safe as well as ensure timely delivery (Kwak & Smith, 2009). Project optics, risk, regulatory compliance, integration, adaptation to changing requirements due to geopolitics, humanitarian and environmental implications, and ease of long lifecycle management are all factors that often exceed or are completely absent in non-defense projects.

One of the interesting characteristics of defense projects is that they can be run completely internal to the Department of Defense (DoD), as a public-private partnership with industry, as a multinational collaboration, or completely external to the DoD (U.S. Department of Defense, 2009; 2018). For example, the U.S. Army Corps of Engineers can manage the construction of a barracks complex on a military base internally. However, when a private defense company develops a speculative product to market to the DoD, it is the nature of the technology and

CHAPTER 2

Planning of Defense Projects

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Abstract: Extant empirical research on the management and governance of major public projects generally focuses on the infrastructure or construction sector. There is a need to increase knowledge of the considerable portion of public spending efense projects, as these projects are subject to different conditions and characteristics. In this chapter, we present selected findings from 10 years of empirical research on defense project management at the Norwegian Defence Research Establishment (FFI). The research presented is based on analysis of data from the defense sector in Norway, as well as international data from NATO countries and agencies through international collaborative studies. Results show that improved planning for effective management of defense projects is essential for meeting security needs and managing resources wisely. Our findings emphasize key considerations for front-end planning of defense projects: early decisions are crucial, organizational aspects are vital for accurate cost estimation, and sustainability needs new top-down policies. Implement strong control, clear prioritization, data-driven decisions, and transparency to address principal-agent challenges and mistrust. Carefully consider acquisition forms; off-the-shelf *i.e.* Non-Developmental Items, solutions can reduce project risk if market and operational conditions allow. Additionally, be mindful of military cultural perceptions, as they can affect the feasibility of off-the-shelf options. Finally, we recommend six policy implications for improved planning of defense projects.

Keywords: Defense project management, Governance, Incentives, Off the shelf, Non-developmental item, Project performance, Project planning, Public projects, Sustainability.

INTRODUCTION

The original aim of project management was to achieve the successful delivery of major and complex projects (Project Management Institute, 2017), and projects with these characteristics are found in abundance within the defense sector. However, the majority of empirical literature on the management of projects concerns other parts of the public sector, such as infrastructure and construction

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(Adam *et al*., 2017; Annamalaisami & Kuppuswamy, 2022; Beste & Klakegg, 2022; Love & Ika, 2022), and empirical literature on defense projects is scarce in comparison. At the same time, some studies do cover defense projects and show that these projects have experienced challenges and failures (Berteau *et al*., 2011; Meier, 2010), and Norway is no exception (Andersen *et al*., 2016; Riksrevisjonen, 2024; Voldhaug *et al*., 2024). Defense projects experience severe failures that demand improvement in all stages of the project (Ergas & Thomson, 2011; Gideon & Wasek, 2015; Smirnoff & Hicks, 2008; Voldhaug *et al*., 2024). When new projects are initiated, the planning stage, which spans from early front-end to project execution, is crucial for project success (Edkins *et al*., 2013; Welde & Holst Volden, 2022; Williams *et al*., 2022). To create an effective plan, it is essential to have a thorough understanding of the defense context and empirical insights from historical projects.

There are many good reasons for the comparatively low amount of research on defense projects, a prominent one being security concerns as well as limited access to classified information and data. Still, from the project management perspective, the limited knowledge base on projects in the defense context can be a reason for concern. These projects have several unique features, such as market conditions, intangible output (insurance for peace in society), security constraints, and new inventions—the list is long. Given these unique features, the lack of knowledge from research means project managers have limited tools when considering what needs to be taken into account in the planning of these projects. Project management literature provides insights into many crucial aspects of project management, such as stakeholder and supplier management, cost and schedule management, procurement strategies, and sustainable project management (Adam *et al*., 2017; Castro Miranda *et al*., 2022; Eskerod & Huemann, 2013; Goodman *et al*., 2017; Love & Ika, 2022; Odeck, 2019), but what answers do we get in these areas when we apply empirical data from defense projects?

Empirical studies of defense projects often consist of single case studies (Goljan *et al*., 2021), or provide insight into cost and schedule performance through qualitative approaches (Callaway *et al*., 2018; Meier, 2010; Tishler *et al*., 1996). When it comes to deliveries in the form of operational effects and benefits management, the literature is even more scarce (Hobæk, 2022). The studies from the Norwegian Defence Research Establishment (FFI), many of which are presented in this chapter, therefore constitute a considerable part of the empirical research body on defense projects.

To contribute to the performance of defense projects through empirical research for improved planning, we let the following research question guide this chapter:

What considerations need to be taken into account in the planning of defense projects?

RESEARCH CONTEXT AND METHODOLOGY

Fig. (**1**) illustrates the different stakeholders involved in a project within the Norwegian defense sector. The figure also outlines the typical "lifespan" of a project. Projects are initially the responsibility of the defense staff of the Armed Forces during the front-end and initial planning stages before procurement agencies for either materiel or facilities take over during the actual project implementation. Finally, the Armed Forces operate and maintain the materiel once delivered, realizing the societal benefits throughout the lifespan of the acquisition. For all projects over a financial threshold of NOK 1 billion[1], the Ministry of Defence is the formal owner throughout all project stages.

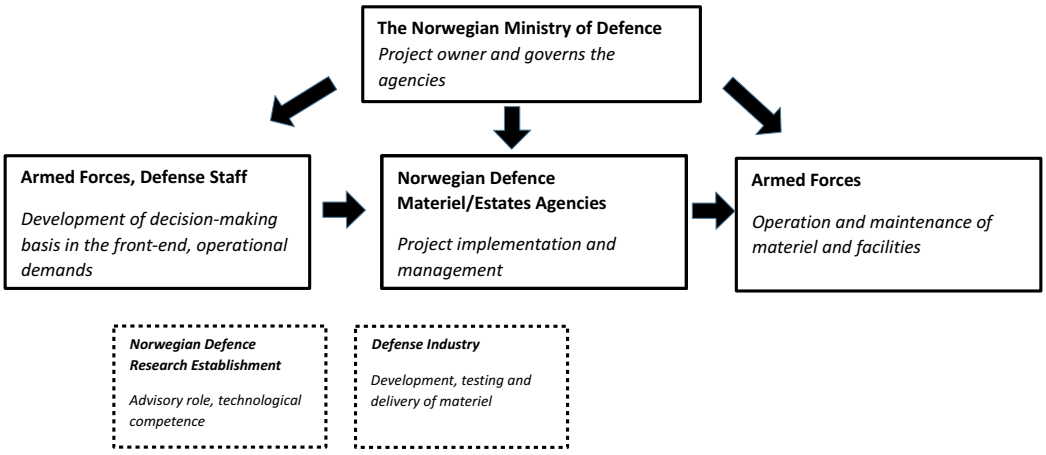

Fig. (1). Research context: Defense projects in norway.

Agents representing the private sector industry do not have a formal role in the project process, as they fall outside the jurisdiction of the Ministry of Defence. However, their expertise and facilities for testing new solutions and prototypes often lead to their involvement in various project stages. Additionally, the Norwegian Defence Research Establishment (FFI) can participate in projects due to its domain knowledge. As part of the defense sector, FFI can be assigned specific tasks by the Ministry of Defence.

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1 Equivalent to approximately 100 million USD

CHAPTER 3

Decision-making in Defense Projects

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Abstract: The management of defense projects entails a series of key decisions that are pivotal for achieving success when properly executed. However, these decisions are frequently made under limited information and analytical capacities, causing uncertainty and the chance of improper choices that could adversely affect the desired outcomes. This case is particularly pronounced in advanced defense projects, which involve research, development, or innovation endeavors. This chapter succinctly outlines the current state of the art regarding the informed decision-making processes aimed at attaining the project objectives in terms of performance, cost, and duration, while addressing potential obstacles that may hinder their achievement. Relevant examples and references are provided to unveil methods for mitigating the risks associated with inadequate decisions.

Keywords: Bounded rationality, Decision-making, Defence, Project management.

INTRODUCTION

The management of defense projects entails a series of decisions aimed at selecting the most advantageous course of action when faced with multiple alternatives. These decisions primarily revolve around key project milestones, where specifications, designs, developments, or tests are evaluated, and risks are assessed. Among these, decisions regarding the selection of candidate solution designs are particularly significant due to their potential impact on project performance, cost, or duration. However, challenges and opportunities emerge throughout the project life-cycle that may also necessitate decision-making. Well-informed decisions can facilitate the attainment of specified, desirable, or optimal outcomes, whereas inadequate decisions pose a risk to such achievements.

Decisions are irrevocable allocations of resources (Howard, 1966), implying that modifying an incorrect decision entails unrecoverable costs. In other words, poor decisions incur economic penalties in terms of labor or materials, potentially

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compromising the project's viability. Rectifying incorrect decisions requires additional effort and time, potentially leading to delays in project duration, particularly when critical-path activities are affected. Moreover, incorrect choices may undermine system or equipment performance, diminishing their operational value.

Many defence projects are characterised by their complexity in terms of functionality, design, dynamic behavior, life-cycle cost, or number of stakeholders. The choice of a potential alternative may have far-reaching, sometimes unintended, consequences. Such decisions have to be made in an adverse environment due to the scarcity or lack of good information about the problem to solve and the quality of candidate solutions, which raises uncertainty regarding the proper solution and the chance of wrong decisions. This explains why the more innovative projects (*e.g*., those based on emergent and disruptive technologies or what is known as deep technologies) are riskier and more subject to delays, cost overruns, or simply complete failure when the sponsoring organization loses patience and does not grant further financial support, since the solution is short of functionality or performance, while unplanned additional effort is requested to continue progressing. The failure of defence projects is pervasive, as different reports testify[1].

Other adverse circumstances include constraints on resources allocated for making choices[2] and the achievement of consensus among stakeholders. In this environment, relying solely on intuition or common sense is insufficient, and more formal methods based on sound engineering practices are necessary to systematically and objectively explore and find the most suitable candidate solution that better aligns with project goals.

There is extensive literature related to decision-making where such procedures are thoroughly described for any kind of decision[3]. This literature also covers the area of systems engineering, normally used in defence. For example, the ISO 15288 standard on *system and software engineering* dedicates section 6.3.3 to decision

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1 A seminal analysis of this old problem can be found in Marshall and Meckling (1959). A more recent report can be found in GAO (2020).

2 See on this issue Simon (1945, 1959), where the principle of bounded rationality which means that human beings will not try to obtain the best solution, when they have to decide due to the constraints of time or resources for such activity, but one that is "satisficing". In other words, one that is "good enough".

3 Academic literature on this topic is, for example, available, in Decision Analysis or the Journal of Multi-Criteria Decision Analysis.

management. Blanchard and Blyer (2016) address this theme in section 2.1 of Appendix B. Sage and Rouse (1998) describe procedures in chapters 18, 27, and 28, while INCOSE (2023) comments on this issue in Decision Management. Finally, Parnell *et al.* (2011) have crafted a comprehensive book to tackle this problem, many of whose ideas are sustained in this chapter.

Whilst a detailed description of all the works and methods related to decision-making would be of little use, the author has preferred to focus on describing sound and practical methods with demonstrated quality in the field of defence. Issues and potential remedies related to the execution of these methods will also be commented on. Proper references will be provided for those wanting further details.

There are four main activities related to decision making: problem definition, design of different solutions, decision-making, and implementation of the chosen alternative. This chapter will concentrate on the first three, excluding the implementation process, namely planning, execution, monitoring, and controlling, and the problems and opportunities that can arise when adverse trends are identified, since they are well described in other project management handbooks. The chapter ends by providing some conclusions that decision makers should consider when they have to decide.

PROBLEM DEFINITION

The first step in the decision-making process is the correct and complete definition of the problem to solve, since an improper understanding, based, for example, on false assumptions, could lead to choosing an inadequate solution. It is recommended to perform this task before attempting to develop any solution.

Any good definition that provides an accurate picture of the problem requires the collection of enough information from all stakeholders who have (vested) interests in the project. Stakeholders can be many, as for example: system operators, maintainers, owners, users, program offices, research organizations, manufacturers, subcontractors, or regulatory agencies. Identifying all stakeholders ensures that their views are captured and taken into account, enabling a broader definition of the problem.

The definition will establish the frame or scope of the problem, clearly identifying its boundaries. This task is challenging since stakeholders may have different and partial views on the nature of the problem and its suitable solution. It should encompass the stakeholder needs, wants, or desires, the system functionality, and

CHAPTER 4

Stakeholders and Communication in Defense Project Management: The Human Factor

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Abstract: All the Gantt charts in the world will not lead to project success unless you have defense senior leadership and major stakeholders committed, and keep them informed and involved with meaningful communication. Identifying stakeholders in defense projects can be even more difficult and politically important than in other private sector projects due to classification, interests of the industrial base, visibility to Congress, and potential for international participation.Once identified, those same factors can make unified messaging challenging. However, effective communication is a key ingredient in making the people impacted by the project, from senators to soldiers and sailors, feel involved, heard, and respected. Stakeholders who are engaged are more likely to be committed to the project goals, leading to improved performance and outcomes.This chapter identifies best practices in both stakeholder identification and analysis, as well as stakeholder engagement and communication within the defense project management field, and challenges to these practices, along with ways to overcome them.

Keywords: Communication strategies, Defense project management, Stakeholder engagement, Stakeholder identification.

INTRODUCTION

Gantt charts alone can not ensure the success of defense projects. The real key is the dedication of the top leaders in national security and other significant participants. Their ongoing involvement, driven by clear communication, is essential (Nidiffer & Dolan, 2005). Identifying who should be involved in defense projects can often be more complex than in non-defense work. This is due to factors like secrecy levels, industry interests, attention from Congress, and possible international participation. These factors also make it challenging to maintain a shared understanding among all parties.

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Nevertheless, it's important to keep everyone connected and informed. This ensures everyone feels part of the project and valued, from Senators to sailors. Defense projects are more than Work Breakdown Structures (WBS) and procedural checkboxes. They are about people collaborating, sharing ideas, and supporting one another in the mission (Project Management Institute, 2017). When everyone is actively involved, they are more dedicated to the project's goals, which leads to better results (Nidiffer & Dolan, 2005). A defense project is a collective effort where everyone's views and roles are important, and even just making them feel heard builds trust to help align everyone (Rodríguez-Segura *et al*., 2016). This chapter will examine the importance of engaging with all parties involved.

The chapter will also cover identifying stakeholders, recognizing their needs, keeping them informed effectively, and developing effective plans for engaging with stakeholders that are clear, adaptable, and timely. As a professional in this field, navigating the complex terrain of defense project management demands a nuanced understanding of the human element—the dynamic interplay between individuals, teams, and organizations.

IMPORTANCE OF STAKEHOLDER ENGAGEMENT

Stakeholder Theory

Originating from the influential work of scholars such as Freeman (2010), the heart of stakeholder theory simply proposes the narrative that an organization's success is tied to its attentiveness to the interests of all stakeholders. This theoretical framework is complemented by insights from organizational psychology, which suggest that stakeholders, when genuinely engaged, are more inclined to commit to the project's objectives (Conte & Landy, 2016). Such commitment is often reflected in enhanced project performance and the attainment of desired outcomes.

Many perceive defense project management to be a rather cold series of engineering tasks: technical specifications, material science, milestones, and critical path analysis (Rodriguez-Segura *et al*., 2016). There is no doubt that all those things are an integral part of defense project management, but at their heart, these projects are focused on people (Mazur *et al*., 2014). They start with creative ideas from people, aim to meet the needs of the people in harm’s way, are used to defend the citizenry, and are brought to life through the dedication and skill of the project team. A Project Manager’s (PM) ultimate success depends heavily on handling the people-related aspects of the project well (Project Management Institute, 2017). Good PMs blend the technical sides of project management with a strong focus on human elements.

Many business case studies support the theory that organizations that adopt stakeholder-oriented strategies achieve better overall performance, reputation, and sustainability (Huzzard, 2020; Mazur *et al*., 2014).

Psychological and Organizational Benefits

Psychological Benefits

When stakeholders are actively involved and their input is valued, it fosters a sense of trust and commitment to the project's goals (Conte & Landy, 2016). This trust is the cornerstone of cooperative relationships and can greatly reduce resistance to change, particularly important in defense projects' dynamic and often unpredictable world.

Additionally, the act of engaging stakeholders enhances their motivation and morale (Yang *et al*., 2011). Feeling heard and seeing their contributions influence the project can lead to a heightened sense of ownership and motivation. This is not only beneficial for the project outcomes but also contributes to a more positive organizational culture (Conte & Landy, 2016). In such an environment, open communication, collaboration, and mutual respect are the norms that have a lasting positive impact on the organization (Nidiffer & Dolan, 2005).

Another psychological benefit of effective stakeholder engagement is the reduction of anxiety and resistance (Conte & Landy, 2016). Keeping stakeholders well-informed and involved helps alleviate uncertainties and fears arising from being excluded or uninformed (Galli, 2019). This leads to smoother project execution and a more harmonious project environment.

Engaged stakeholders are also typically more adaptable and flexible. Understanding the project's vision and being part of the process makes them more willing to accommodate changes, which is important in defense projects where requirements and circumstances can change rapidly (Steger & Weiss, 2019).

The psychological impact of stakeholder engagement extends to job satisfaction and retention among project team members (Colquitt *et al*., 2019). When team members feel that their work is meaningful and have a say in project decisions, their job satisfaction increases, leading to higher retention rates.

The compounding benefits of trust, adaptability, motivation, satisfaction, and reduced resistance all make a powerful case for PMs to ensure their planning encompasses a robust communication and stakeholder engagement campaign (Galli, 2019; Steger & Weiss, 2019).

CHAPTER 5

Defense Contract Management

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Abstract: Every project, to some extent, involves the outsourcing of supplies or services in support of the project's objectives. This outsourcing involves the planning, awarding, and administering of procurement contracts. As projects become more complex and technologically advanced, the degree of outsourcing supplies and services in support of the project also increases. It can be said that contracting is the language of defense acquisition projects (Rendon & Snider, 2019). Defense acquisition project managers, both on the buying side as well as on the selling side, use contract management processes, concepts, and terms to manage and describe the activities and events that occur in defense acquisition projects. This chapter presents an overview of contract management processes, concepts, and terms that are used by defense acquisition project managers, defense organizations, and defense contractors in managing defense acquisition projects. The focus will be on the contract life cycle, encompassing pre-award, award, and post-award phases and activities, as performed by both buyer and seller organizations. The primary goal of this chapter is to present contract management as not only an essential business function (Burt, Petcavage, & Pinkerton, 2010) but also an essential part of project management (Kerzner, 2017) and specifically, an essential part of defense project management (Rendon & Snider, 2019). Although the focus of this chapter is on the contract management processes, concepts, and terms used by the ministries of defense and their contractors, our discussion is equally applicable to any organization, government, or industry that contracts for supplies and services needed for accomplishing the organization's mission.

Keywords: Contracting, Contract management, Contract management standard.

INTRODUCTION

Every project will require some degree of outsourcing. The project effort will require products or services that are only available from outside the organization and thus must be procured from the marketplace. The more technically complex the project effort, the greater the need for procuring technologically advanced products and services to support the project. In most defense projects, such as weapon system acquisition, the majority of the project effort (*e.g.*, research and

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development, testing, production, deployment, sustainment) will be performed by a company selected from the market (*i.e*., a contractor). The project may involve a contractor team consisting of a prime contractor, for example, building an aircraft air vehicle, and lower-tier subcontractors, for example, building the aircraft propulsion system, avionics, and navigation systems. On the other hand, the project may involve a team of companies consisting of several prime contractors working on separate areas of the project effort. As the role of contractors in a project increases in importance, the importance of the contract management aspect of the project will also increase. Every aspect of the project may entail some aspect of contracting. Thus, contract management can be considered the language of defense projects (Rendon & Snider, 2019).

This chapter presents the contractual aspect of managing projects. The discussion will focus on the contracting life cycle phases and activities within each phase. Because contract management involves the activities performed by both parties to the contract (*i.e*., the buyer and the seller), our discussion will present the contract life cycle phases and activities from both the buyer and seller perspectives. We first begin with a brief theoretical foundation emphasizing the importance of the contract life cycle phases; we then discuss each of the contract life cycle phases and related activities, and conclude with a discussion of emerging trends in contract management.

THEORETICAL FOUNDATION

We start our discussion of contract management with a brief overview of one of the many foundational theories that inform contract management. There are many theories that serve as the foundation for contract management, but the theory that we will focus on in this chapter is principal-agent theory (Eisenhardt, 1989). Principal-agent theory can be applied to the contractual relationship between the principal (*e.g*., government) and the agent (*e.g*., contractor) (Rendon, 2015). The principal contracts with the agent to perform a specific project task, such as developing and producing a tactical fighter aircraft. In this relationship, the principal's objectives include procuring the aircraft at the right quality, quantity, source, time, and price (these are known as the five purchasing rights). (Monczka *et al*., 2016). In government contracts, the government also has the additional objective of ensuring that the jet fighter is procured in accordance with public policy and statutory requirements, such as promoting competition, negotiating a fair and reasonable price, and providing procurement opportunities for minority and disadvantaged businesses (Rendon, 2015).

On the seller side, the agent's objectives are to sell the aircraft to the government while pursuing the company's objectives of earning profit, ensuring company

growth, maintaining or increasing market share, and improving cash flow, just to name a few. As we can see, the buyer and seller have conflicting objectives in the contractual relationship. Additionally, in defense projects that involve higher levels of uncertainty and risk, such as the development and production of a technologically advanced weapon system, the information available to both the principal and agent is asymmetrical. For example, the principal (buyer) may have more information concerning its agency's mission, the procurement requirement, and the available budget, while the agent (contractor) may have more information concerning its technical capability, cost drivers, and return on investment requirements (Rendon, 2015).

Because of the conflicting objectives and asymmetrical information between the principal and agent, each party is motivated to behave in a specific manner during the phases of the contract life cycle. During the pre-award phase, the agency theory problem of adverse selection results from each party trying to hide information from the other party. During the post-award phase activities, the problem of moral hazard results from each party trying to hide behavior from the other party. Agency theory is concerned with the conflicting goals and asymmetrical information between the principal and agent in obtaining their respective contract objectives and the mechanisms used to mitigate the problems of adverse selection and moral hazard (Rendon, 2015).

Thus, how contracts are planned, structured, awarded, administered, and closed out (*i.e.*, the contract life cycle) has its basis in principal-agent theory (Rendon, 2015). Project managers and contract managers for both the buying and selling organizations must understand the contract life cycle phases and activities, and how each phase supports their project effort. The next section will present the contract life cycle phases and related activities from both the buyer and seller perspectives.

CONTRACT LIFE CYCLE

The contract life cycle can be defined as having three phases that encompass activities related to the planning, structuring, awarding, administering, and closing out of the contract. This chapter's discussion of the contract life cycle is based on the National Contract Management Association (NCMA) Contract Management Standard (CMS) ANSI/NCMA ASD 1-2019 (R2022). The CMS™ is an American National Standards Institute (ANSI)-approved standard that describes contract management in terms of the processes created through the integration and interaction of job tasks and skills and the purposes they serve. An American National Standard is a document established through the consensus-based activities of an accredited, authoritative organization. The common and repeated

CHAPTER 6

Knowledge Management in the Defense Sector

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Abstract: Knowledge management includes identifying, capturing, evaluating, retrieving, and sharing knowledge and experiences in organizations. It is a concept from the late 80s in the previous century, because modern information technology has raised the options and scope for these processes. While the core tasks of the organizations in the defense sector and particularly of the armed forces are focused on warfighting, a lot of support assets, activities and people are needed to enable it. A good knowledge management is one of them. Especially, management knowledge in complex operational/military environments should enhance the effectiveness of situational awareness systems. Four approaches to knowledge management in the defense sector are exposed: lessons learned capabilities, publications, libraries, and cooperation with the academic sphere. The chapter reveals a deficit in the concept of defense management; it does not include the formal knowledge adopted outside the organizations in the education system. Therefore, the professional military education and its (dis)advantages are also discussed to show the importance of proper PME management and its connection to knowledge management.

Keywords: Defense , Information economics, Knowledge management, Knowledge, Organization, Organizational learning, Professional military education.

INTRODUCTION

As early as the end of the 1960s, Drucker (1968 in Nonaka, 1994, p. 14) and later other authors noted that society was gradually transforming into a "knowledge society." He also coined the term "knowledge worker" (Schütt, 2003). It is difficult to define knowledge. As Nonaka (2014, p. 15) writes, it is a multifaceted concept with a multi-layered meaning. However, Nonaka follows traditional epistemology in his essay and adopts a definition of knowledge as "justified true belief". Nowadays, knowledge is one of the most important resources in every institution and profession, including the defense sector—or at least it should be. The defense sector is not a monolith; it is a conglomerate of different

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responsibilities and tasks, which entails the need for very different expertise, knowledge, and competencies. The education of defense and particularly military personnel can be centralized, *e.g*., at military academies, or decentralized, organized through various educational channels. We can also use the dichotomy of divergent and convergent education. When we talk about divergence and convergence, we mean tendencies. In the case of divergence, the military and society are moving further apart; the military has its own characteristics, processes, values, habits, structures, knowledge, relationships, *etc*., that differ from those of society. In the case of convergence, the military and society move closer together and become similar in their characteristics, processes, values, habits, structures, knowledge, relationships, *etc*. (see more in Caforio, 2000; Garb, 2017).

Education is important because expertise, knowledge, and skills are crucial in the defense sector. Errors in the defense sector, especially in decision-making, can have serious consequences for human lives, equipment, finances, or, more generally, for the security of the state and the safety of the population. Besides the formal education that employees and organizations produce, they also generate, store, and use knowledge through their work. Organizational management considers this increasingly important.

All these conditions, from the heterogeneity of knowledge to the importance of the sector, point to the considerable complexity of knowledge management and education in the defense sector. While it should be noted that the term is not yet fully established in practice, there are various definitions of what knowledge management means. Perhaps the most widely accepted and simplest definition is the following: a discipline that promotes an integral approach to identifying, retrieving, evaluating, and sharing the enterprise's tacit and explicit knowledge assets (derived in part from the US Army's definition in Byrne and Bannister, 2013, p. 107).

This chapter outlines the concept of knowledge management, summarizes the background theories, introduces knowledge management in the defense sector, and promotes some important approaches that are also used in the defense sector. The study reveals that the existing concept of knowledge management overlooks formal education. Thus, the chapter also discusses some key challenges and complicating factors of professional military education as an overlooked but important factor that should be considered in knowledge management in the defense sector.

KNOWLEDGE MANAGEMENT

According to Koenig (2018), who explains knowledge management on the KMWorld portal, the term knowledge management was "apparently first used in its current context at McKinsey in 1987 for an internal study on their information handling and utilization." When applied in an organization, it should result in an

information environment with rich, deep, and open communication and access to information, deploying it broadly throughout the organization. Furthermore, the "role of knowledge management is to create capability for the organization to establish excellent situational awareness and consequently make the right decisions" (Koenig, 2018). Put simply, knowledge management "refers to identifying and leveraging the collective knowledge in an organization to help the organization compete" (Becerra-Fernandez and Leidner, 2014, p. 6). Namely, "the company's overall performance depends on the extent to which managers can mobilize all the knowledge resources held by individuals and teams and turn these resources into value-creating activities" (von Krogh, 1988, p. 133 in Becerra-Fernandez and Leidner, 2014, p. 6).

Wiig (1997, p. 8) writes about Knowledge Management (KM): "Simply stated, the objectives of KM are: 1. To make the enterprise act as intelligently as possible to secure its viability and overall success. 2. To otherwise realize the best value of its knowledge assets. To reach these goals, advanced organizations build, transform, organize, deploy, and use knowledge assets effectively. Stated differently, the overall purpose of KM is to maximize the enterprise's knowledge-related effectiveness and returns from its knowledge assets and to renew them constantly. KM is to understand, focus on, and manage systematic, explicit, and deliberate knowledge building, renewal, and application – that is, manage Effective Knowledge Processes (EKP)."

The Gartner Group definition is as follows (see Koenig, 2018): "Knowledge management is a discipline that promotes an integrated approach to identifying, capturing, evaluating, retrieving, and sharing all of an enterprise's information assets. These assets may include databases, documents, policies, procedures, and previously uncaptured expertise and experience in individual workers." According to McCampbell *et al*. and Gao *et al*. (in Smaliukiene and Giedraityte, 2018, p. 143), "knowledge management includes the creating, finding, collecting internal knowledge and best practices, then sharing and understanding those practices so they can be used, as well as adapting and applying those practices to new situations."

The elements of knowledge management are people, processes, and technology, all of which are integrated into the organizational culture (Gorelick and Tantawy in Ažman, 2013, p. 118). Koenig (2018) mentions the following elements: content management, location of expertise, lessons learned, and communities of practice.

Does knowledge management only refer to knowledge within the organization? There are definitions that only associate organizational knowledge with knowledge management (see definitions above). However, Koenig (2018)

CHAPTER 7

Transfer of Technology and Management of Intellectual Property in Defense Manufacturing

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Abstract: The defense industry is at the forefront of technological innovation, relying heavily on the transfer of advanced technologies and the management of Intellectual Property Knowledge (IPK) to maintain strategic superiority between countries and international defense conglomerates. The concept of Transfer of Technology (ToT) enables nations to fulfill their specific needs more efficiently, economically, and swiftly compared to developing products from scratch. The process typically involves transitioning from Fully Formed (FF) equipment to Semi Knocked Down (SKD) kits, then to Completely Knocked Down (CKD) kits, and finally to Licensed Manufacturer (LM) status within the transferee country. Numerous challenges hinder ToT, including safeguarding Intellectual Property Rights, affordability of cutting-edge technology, technological disparities between parties, and policy complexities. It also faces a significant challenge in effectively incorporating the latest advancements of developed nations into the products of developing countries due to political and cross-border arrangements. This chapter explores the complex dynamics and critical considerations associated with technology and effective IPK management within the defense sector and related documentation. It helps in managing challenges and innovative strategies, providing a comprehensive resource for stakeholders in the defense landscape and serving as a reference guide. It also explores legal frameworks defining IPK protection and taxonomy, encompassing issues of ownership, disclosure, and adherence to international agreements. It serves as a valuable resource for policymakers, defense professionals, and researchers seeking to navigate the intricate nexus of technology transfer and IPK management in defense.

Keywords: Intellectual property, Knowledge management, Strategic management, Technology management, Technology transfer.

INTRODUCTION

The undeniable truth, as extensively documented, is that technology catalyzes national wealth creation (Boskin and Lawrence, 1992). The power of the state is

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traditionally based on military capacity, and without a strong technological development, military power cannot be sustained in the long term. Technology is therefore seen as power, and all states with ambitions to play a part on the international stage make great efforts to ensure they have it. Advanced technology not only enables the Armed Forces to safeguard their sovereignty but also extends their influence and capabilities. Transfer of Technology (ToT) involves the exchange of innovations, ideas, knowledge, and techniques between organizations or countries through various means such as assistance, investment, licensing, trade, or training. Historically, a niche segment of researchers has reviewed this topic to explore the challenges, strategies, and implications associated with these processes. Various studies have highlighted the significance of ToT in enhancing military capabilities, promoting international collaborations, and facilitating defense industrialization (Kaiser, 2018). However, the process is not without challenges. Issues such as security concerns, export controls, intellectual property rights, and regulatory frameworks often complicate technology transfers (Lee *et al*., 2020). Effective management of intellectual property knowledge is equally critical in defense. Intellectual Property (IP) assets, including patents, copyrights, trademarks, and trade secrets, play a vital role in maintaining competitive advantage and safeguarding classified information. Scholars emphasize the importance of robust IP management strategies to protect sensitive defense technologies while fostering innovation and collaboration within the defense industry (Cohen, 2019).

Furthermore, the advent of digitalization and cyber threats has introduced new dimensions to intellectual property knowledge management in defense. Safeguarding against cyber espionage, ensuring data integrity, and implementing secure information-sharing mechanisms are pressing concerns for defense organizations (Sims, 2021). The set of documents used in any ToT agreements between two organizations predominantly includes:

a. Intellectual Property License Agreement
b. Domain Knowledge Agreement
c. Cooperation Agreement
d. Allocated Workshare Agreement
e. Data Management Agreement

LEGAL FRAMEWORK

Subsequent paragraphs explain legal frameworks defining IPK protection, taxonomy, encompassing issues of ownership, disclosure, and adherence. Various definitions used in those agreements have been explained.

Intellectual Property (IP) License

The term "Licensed IP" refers to drawings, technical information, engineering data, software, manuals, records, specifications of materials, and other tangible intellectual property specifically outlined and owned by the licensor, concerning which the agreement came into effect as of the effective date of the Agreement. This agreement grants the licensee a non-exclusive, non-transferable license to utilize the Licensed IP for the defense system for the specified program within the designated territory and for the agreed-upon term. The licensee is authorized to provide a non-exclusive limited user license (at no cost) to specific customers or customer groups for utilizing the Licensed IP in integration, assembly, operation, maintenance, repair, training, and interfacing activities. Unless with the express written consent of the licensor, the licensee is not permitted to grant sub-licenses or use the IP in any other way under this Agreement. If the licensor allows the licensee to sub-license the manufacturing (either in full or in part) of the product, the licensee must not disclose any confidential information of the licensor to the sub-licensee without the explicit written consent of the licensor. The Licensed IP excludes any IP or information concerning manufacturing or other technical processes that are general or supplementary to the licensed product, as these are considered part of the Product Capability.

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The term "Licensed IP right" encompasses rights in any jurisdiction under patents (including applications, registrations, extensions, re-examinations, reissues, continuations, or renewals), copyrights (including applications, registrations, or renewals), design rights (whether registered or unregistered), trade secrets, trademarks (including applications, registrations, and associated goodwill), rights in trade, business, or internet domain names, service marks, trade secret rights, trade dress, topography, and any other property rights or intellectual property rights with similar effects worldwide. The Licensee agrees and acknowledges that the right to acquire title or interest will be subject to this Agreement, and it is required not to engage in any activity that could jeopardize the validity of any part of the Licensed IP. If the Licensee becomes aware of any infringement or misuse of the Licensed IP, it must promptly notify the Licensor and provide all relevant details within its knowledge. The Licensee must also assist the Licensor as requested in any infringement actions that the Licensor may initiate. The Licensor is not obligated to take action against any infringements or misuse of the Licensed IP, but if it chooses to do so, it will bear the costs, and any recoveries will not be claimed by the Licensee. If the Licensor decides not to pursue legal action, it must provide the Licensee with all relevant information free of charge to assist in any legal action the Licensee may wish to pursue. Any damages or costs awarded in

CHAPTER 8

Technological Integration in the Aerospace Industry: A Strategic Approach Using the Adaptive Dynamic Strategic (ADS) Model

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Abstract: The Adaptive Dynamic Strategic model (ADS) outlined in this chapter was conceived and designed to support strategic decision-making in organizations operating within Complex Products and Systems (CoPS). The dynamics of innovation require an initial focus on technological development in the aerospace sector. Growing expectations regarding future demand for new technologies guide the technology strategy, directing Research and Development (R&D) investments. Failure to align with this approach significantly elevates the level of risk exposure. By adopting Dynamic Capabilities (DC) as a theoretical framework and using new business models as a unit of analysis, this research unveils Embraer's evolutionary trajectory, transitioning from technological development to the integration of new business models. Specifically, the chapter emphasizes the progression of Embraer's efforts as a Prime Contractor from the AMX program to the KC program. The chapter also highlights the e-VTOL program, evolving from a new business model for a new organization named EVE, a subsidiary of Embraer. This chapter explores how ADS Model may contribute to risk mitigation by enhancing the coupling between sensing, seizing, and transforming when applied to the context of the innovation process in CoPS. The approach advocates exploring opportunities to improve the balance between integration and proprietary strategies within the industry value stream.

Keywords: Adaptive Dynamic Strategic (ADS) Model, Complex products and systems (CoPS), Coupled processes, Dynamic capabilities, Technology readiness level.

INTRODUCTION

In an era marked by rapid technological advances and increasing complexity in product and system development, organizations operating in the domain of Complex Products and Systems (CoPS) face significant challenges that can

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impact their competitiveness and innovation strategies (Utterback & Abernathy, 1975, Utterback, 1994, Hobday, 1998). This chapter explores the ability to make strategic decisions under conditions of uncertainty (Keynes, 1936, Simon, 1957a,1957b, Penrose, 1959, Simon, 1979,1986, Keynes, 2004, Marchau, Walker & Bloemen, 2019, Lempert, Syme, Mazur, Knopman, Ballard-Rosa, Lizon, & Edochie, 2020), and presents the Adaptive Dynamic Strategic (ADS) model as a robust framework developed to meet the growing demands of the industry (Leite, 2021, Leite & Chagas, 2022). The chapter focuses on how the aerospace industry is developed against the backdrop of innovation's dynamic nature, highlighting the role of technological development and its integration into organizational strategies. This context seeks to improve understanding of the multiple dynamics of innovation, where technological advances are driven by intrinsic development needs and shaped by future requirements (Porter *et al*., 2004; Gordon, Ramic, Rohrbeck, & Spaniol, 2020).

The chapter relates the specificity of technological strategy with dynamic capabilities and their impacts on organizations' competitive advantage (Teece & Pisano, 1994; Teece, Pisano & Shuen, 1997) through the analysis of two development cases related to Embraer, a Brazilian aerospace industry company. Through the lens of new business models, the chapter highlights Embraer's transformative journey, from technological development to integrating new business models. The chapter emphasizes the progression of Embraer's efforts as a prime contractor from the AMX program to the KC-390 Millennium and the e-VTOL programs. Evolving from a new business model, a new organization called EVE is a subsidiary of Embraer. The KC-390 Millennium program is Embraer's most crucial defense program today. It is the largest aircraft developed by the company, capable of landing on unpaved runways and performing different missions such as search and rescue, transportation, in-flight refueling, cargo and parachute drops, and fighting forest fires, among others. It has contributed to the development of multiple cutting-edge technologies (Francelino, 2016).

The chapter highlights the importance of the ADS model in enhancing organizations' responses and sustainability in complex and uncertain environments. The case studies evaluate the impacts of the ADS model on capturing emerging opportunities and exploiting and transforming them into sustainable organizational practices.

BACKGROUND AND LITERATURE REVIEW

Dynamic Capabilities (Inside-out Strategy)

Dynamic capabilities are “the organizations' ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing

environments" (Teece *et al*, 1997). Resource reconfiguration, learning, and integration are the main processes that make up dynamic capabilities (Eisenhardt & Martin, 2000; Teece, 2007).

The concept gained importance when addressing how organizations can deal with increasingly dynamic, complex, and uncertain markets, anticipating changes (Eisenhardt & Martin, 2000; Teece, 2007). In this way, dynamic capabilities allow for a better understanding of the different paths that organizations define to ensure competitive advantage (Chagas Junior, Leite & Jesus, 2017). The secret to the competitive advantage of some successful organizations lies in a strategy that favors capturing opportunities (Eisenhardt & Sull, 2001; Dong, Garbuio & Lovallo, 2016).

Dynamic capabilities can be classified into three categories, called micro-foundations (Teece, 2007, 2014):

- Sensing: the ability to detect and shape opportunities.
- Seizing: the ability to take advantage of opportunities.
- Transforming: the ability to maintain competitiveness through improvement, combination, protection, and adequacy of resources.

This chapter develops and presents a model that aims to show that better coupling between sensing and seizing positively affects the management of R&D investments and decision-making under conditions of uncertainty.

Knowledge construction and capability development characterize the research phase (TRL 1-2-3). It represents the discovery, exploration, and understanding phase, and therefore, the capture of opportunities (sensing). Taking advantage of opportunities (seizing) lies in the development of prioritized technologies (TRL 4-5-6), which can generate a competitive advantage in the organization with the application of technology to the product (transforming) (TRL 7-8-9). In the ADS model, detailed in a specific item in this chapter, sensing and seizing make up the technological strategy, and transforming is the application of technology in a product (Leite, 2021) (Fig. **1**).

Organizational Responses in Conditions of Uncertainty

Organizations must prepare for prospects by adapting to uncertainties. Under these conditions, traditional strategic planning approaches can lead the decision-maker to perceive uncertainty as a binary path: precise predictions or completely unpredictable situations, which makes capturing opportunities challenging (Courtney, Kirkland & Viguerie, 1997).

CHAPTER 9

Applying Agile Program Management Principles to Defense Research and Development

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Abstract: Scientific research can be notorious as an innovative process with inefficient procedures. Often, project management develops as part of a mentorship model, where individuals learn how to run laboratories or oversee experiments based on what they observed from various mentors. This characterization is also true of defense research, which likely involves more complex projects and more real-world applications than scientific research in other domains. As such, there is immense potential to enhance the efficiency and quality of defense research by applying lessons learned from formal project management techniques. Here, the primary goal is to explore Agile project management values and principles for possible implementation into defense research laboratories. Overall, there is considerable opportunity to apply these principles to defense research, even though they were created for software development. However, there are several unique challenges in defense research compared to software development, including defense research laboratories being part of the national security apparatus, properly scoping the projects involved, and appropriately aligning roles when government and contractor personnel are involved in the research process. Through lessons learned and best practices derived from both Agile training methods and defense research experience, this exploration produces several items (*e.g.*, the Defense Research Agile Checklist) that could be valuable for any defense research facility seeking to produce greater efficiency in their processes and ultimately create better end products for service members.

Keywords: Agile, Defense, Military, Project management, Research, Waterfall.

INTRODUCTION

Defense research institutions and their myriad collaborators are often tasked with exploratory or scientific research for defense applications. Unfortunately, the scientific process is notorious for inefficiency. Research and development regularly encounter cost overruns and inaccurate estimations that delay timelines and exceed budget projections (Hofbauer *et al*., 2011). Although typically associated with engineering or other major defense acquisition programs, such as

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developing a new joint strike fighter, the problem could also affect smaller-dollar research projects that focus on mobile app development or human subjects research. One potential reason for this problem is the development of project management techniques within the scientific community. Project management styles are rarely taught in any formal sense, and even well-managed projects can proceed down a course of development that yields only a dead end. The combination exposes all scientific research to a variety of potential inefficient procedures, but given the scope of defense research, there is a compounding potential for inefficiencies to grow into a troublesome burden. As such, a continuing goal should be to develop novel techniques that might avoid waste and enhance the efficiency of research and development.

Agile program management is one possibility that could increase efficiency within scientific research and development. In essence, this process utilizes iterative work to emphasize speed and collaboration while reducing waste. The end state is a more efficient process intended to deliver greater value to the customer while reducing ineffective processes and procedures along the way. On the surface, it appears to be a viable program management approach that, if properly integrated into defense research laboratories, could enhance the efficiency of the scientific research process. However, the base ideas were created primarily for software development. This intended use remains highly effective for many defense research programs with complicated software delivery burdens; yet, for scientific exploration, its application is not often a simple plug-and-play implementation. Agile principles offer excellent ideas to enhance the research and development process, but these ideas must be tempered and adjusted to properly integrate them into a scientific research environment.

The goal here is to explore concepts associated with Agile project management as well as some parallel ideas with the intended end state of enhancing efficiency in defense scientific research. Foremost, the discussion will begin with some background exploration and comparison of project management techniques, most notably Waterfall and Agile. Next, the discussion will walk through the 12 Agile principles to see how they apply to scientific research and what, if any, principles can be utilized to increase efficiency in defense research. Finally, these techniques will be challenged by several assumptions particular to the defense research environment. The summary will include some lessons learned from Agile project management, with several paths forward and supplemental tools for laboratories considering how to increase the efficiency of their internal processes.

PROJECT MANAGEMENT STYLES AND BACKGROUND

Waterfall Project Management

Project management can vary greatly in defense research between different projects. Principal investigators often develop their individual techniques through mentorship and experience rather than formalized learning and implementation. As such, there is enormous opportunity to utilize structured project management techniques developed as best practices from other sectors of business and industry. One especially well-known technique is the Waterfall method (Hass, 2007; Royce, 1987). According to this traditional approach, projects advance throughout a series of predictable steps with stages such as requirements gathering, which progresses into design, then construction, and eventually testing prior to delivery and operational maintenance. The key component involves a predictable series of steps that must be completed in a particular sequence—hence the Waterfall moniker. Of course, the Waterfall model does not have a prescriptive series of stages since every task implementation will be slightly or even significantly different based on the context and work demands. Its key elements involve a series of prerequisite steps that demand each preceding step be completed before moving on to another step. At the best possible speed, some steps could be completed in parallel, yet there remains a critical progression that limits how fast the team can move forward on a given project.

Several assumptions underlie its potential operation that prove crucial to its implementation, namely the presumed predictability of project steps, their structured sequence, and the value of planning early in the process (Laufner, 2015; Saynisch, 2010). Specifically, careful planning increases success because it avoids waste from a predictable process, much as organizing a travel plan in advance permits better options than last-minute scheduling during the trip. These requirements place restrictions on how quickly a project can progress, yet they also create high reliability. This characteristic may be especially important for certain contexts. For example, drug testing would never advance to human trials without first completing all the necessary safety investigations required before giving a pharmaceutical to a human, and aerospace development would never put a human into a test aircraft for a real flight without enormous development and evaluation. The sequential steps become a tool to maximize certainty and reliability, which becomes especially important when rapid progression through testing and development could have dangerous consequences for a faulty final product.

Waterfall functions as a viable method for defense research applications due to the strict nature of the sequence involved. For example, human subjects research

CHAPTER 10

Program Management and Building Partner Capacity: A Tangled Thicket

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Abstract: This chapter explores how the U.S. Department of Defense plans and executes Building Partner Capacity projects in lower-middle and low-income partners. U.S. planners and practitioners rarely understand the effective preconditions that influence partner security apparatus and infrastructure. Consequently, security capabilities provided to the partner are rarely sustained and provide questionable security to the affected population. The U.S. Department of Defense employs a three-part approach to building security in partnership: training and equipping, developing institutional capacity, and monitoring and evaluating. U.S. security planners should manage all three parts concurrently to produce a security capability that the partner uses and sustains, thereby lessening pressure on the U.S. This chapter will take the reader through a brief background on U.S. security exports, current U.S. DOD program planning and management principles, with particular attention given to security assessments and how getting those assessments right or wrong contributes to success or failure in the implementation of the security project.

Keywords: Assessment, Building partner capacity, Institutional capacity building.

INTRODUCTION

This chapter examines the current U.S. DOD planning construct for building partner capacity, principles, and processes. It discusses areas of concern that, if addressed, could increase U.S. success in security building in complex environments. It will identify the central processes of building partner capabilities and discuss some problems in the current activities.

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Darli Vieira, Alencar Bravo & Geraldo Ferrer (Eds.)

Security Sector Space

The U.S. Department of Defense's building partner capacity is a subset of the security sector assistance space. That space is crowded with many actors, and the vocabulary can be confusing. Typically, for the United States Government (USG), the term security assistance refers to all government activities with partners that include institutions that have the authority to use force abroad and at home, including the oversight of those institutions and forces (DSCA, 2024). While many, if not most, federal agencies have some forms of partner assistance programs, the Department of State (hereafter State) and Department of Defense (hereafter DOD) are usually associated with partner security assistance. State and Defense dominate the USG security assistance field in terms of scope and budget.

The State Department approves and prioritizes its own Security Assistance programs in its three main portfolios: Foreign Military Financing (FMF), International Military Education and Training (IMET), and Peacekeeping Operations (PKO). All three are funded by Title 22 authorities. The first two are directed by the State Department but managed by the Department of Defense Security Cooperation Agency, so FMF and IMET blur across the lines as both security assistance and security cooperation (SAMM, 2024).

The DOD further defines Security Cooperation (SC)as all interactions, programs, and activities with Foreign Security Forces (FSF) and their institutions to build and apply their capacity and capabilities consistent with US defense objectives (JP 3-20, 2024). Further, DOD policy states that State security assistance programs administered by the DOD are considered security cooperation (JP3-20, 2024). The takeaway is that these terms, while heavily prescribed, are still flexible and permeable. The various programs slide and flow through each definition. The BPC project manager needs to understand the concepts and be comfortable with how each audience may use the terms.

What is BPC?

Building Partner Capacity is a concept made real by the tools and their limitations provided to the DOD by the authorities created by Congress. While the DOD has administered State-funded programs going back to the 1960s, it was in the 1980s that Congress began providing funds directly to DOD for building partner capacity (Serafino, 2016). After 9/11 and beyond Afghanistan and Iraq, the DOD sought, and Congress granted a new authority to quickly deploy material support to partners engaged in conflict that also benefited the U.S. Most importantly, this latest security cooperation authority was meant to avoid the cumbersome and lengthy security assistance framework of foreign military financing and sales (Serafino 2, 2013).

In the 2017 NDAA, Congress and the DOD undertook a major reorganization of the SC nomos into Chapter 16 of Title 10 (CRS 1, 2017). The Secretary of Defense was granted the authority to deploy U.S. forces, *i.e.*, money, to train, advise, and assist foreign military forces (10 U.S. Code § 333, 2024). §333 is used for training and equipping a unit, while §332 is used to advise and assist a partner at the ministerial level to develop the management capacity to employ the capability provided by §333. Fig. (**1**) illustrates how §333 Train-and-Equip activities are linked to institutional capacity-building and M&E mandates. Congress has also authorized women, peace, and security activities with §1208. Congress also requires assessment, monitoring, and evaluation in §383, but this does not come with its own funding. Congress then enacted the Evidence Act in 2018, and the Office of Management and Budget (OMB) has operationalized the learning organization methodology with various guidance (OMB, 2021). The DOD followed suit with the Learning and Evaluation Agenda for Partnerships (LEAP) in 2022, which codifies evidence-based policymaking for Defense programming (DOD, 2022).

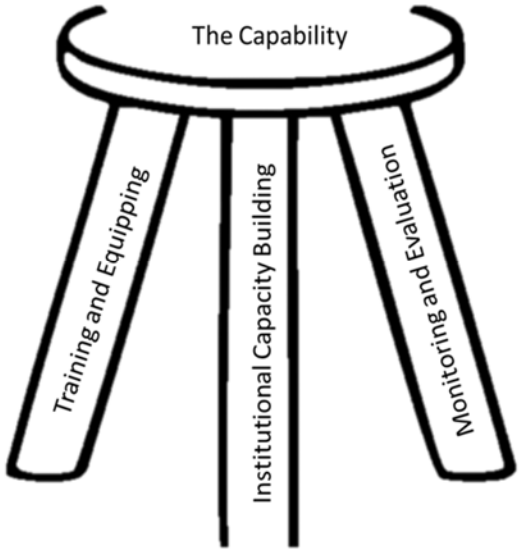

Fig. (1). U.S. law requires each Train and Equip activity funded by S333 have a corresponding institutional capacity building effort. Another statute requires monitoring and evaluation.

In practice, BPC is largely understood to be the International Security Cooperation Programs (ISCP) account, which houses funds from §333 and §332. Congress typically creates larger named funds to address near-peer and great power competition issues, like the Ukraine Security Assistance Initiative (USAI),

CHAPTER 11

Taking Political Risks in Defense Project Management Seriously: Lessons from the Canadian F-35 Procurement Case

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Abstract: The Lockheed Martin F-35 Lightning II Joint Strike Fighter (JSF) has become a core weapons system for the Armed Forces of multiple countries. In some respects, the Tier development program rolled out by the U.S. for this platform has been highly successful; for example, it has reduced per-unit production costs and maintained relatively high and consistent delivery numbers. However, serious issues have also emerged: the real figure to maintain and frequently update a fifth-generation F-35 throughout its lifetime (sustainment costs), for example, is much higher than the acquisition cost. We argue that the purchase of equipment of this kind, designed to be the backbone of an integrated military apparatus for many decades, is more than a strictly technical or military issue, and its political dimensions also raise significant management issues for those in charge of procurement. In particular, any misalignment of political and strategic military visions has the capacity to undermine even the best project management.

Keywords: Alignment, Canada, Climate change, Defense , F-35 fighter, Management strategy, Megaprojects, Military platforms, Procurement management, Procurement, Project management.

INTRODUCTION

Problems with Megaproject Procurement Management and the Canadian F-35 Fighter Purchase Case

The tendency for megaprojects to come in late and well over budget is well known. As Bent Flyvbjerg (2005) has argued in his oft-cited work on the subject, chronically poor procurement administration and management processes,

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featuring consistent underestimation of the funds required to actually procure a product, along with a penchant for a 'conspiracy of optimism' informing decision-making, are characteristic of large-scale 'megaproject' contracting.

Of course, project managers are aware of these risks and are concerned about avoiding them. Where possible, for example, they often promote lifetime platform accounting, in lead times, and otherwise attempt to discourage over-optimistic cost projections and project timelines, as well as incentivize schedule maintenance. However, as Flyvbjerg's work notes, the delays and cost overruns he chronicles occur *despite* these efforts.

The argument made here is that this is often due to the fact that beyond the many technical problems faced by large-scale projects, there is another category of project risk that is more volatile and difficult to manage, but no less omnipresent. This is the category of '*political risk*' in which projects or purchases can become politicized and embroiled in partisan debate and controversy, essentially turned into a political 'football' to be kicked about by contesting political actors, with highly deleterious results in terms of project outcomes. When this occurs, it can lead to project cancellation and other kinds of mid-project changes, from redesigns to rebidding, which contribute directly to the emergence of many of the pathologies of megaproject planning Flyvbjerg outlined.

Why some projects become politicized in this way and what can be done about it by project managers are the subjects of this chapter. As is argued below, however, it should be noted at the outset that this kind of politicization is not always a risk with all kinds of procurement but is an especially high one in the case of long-term, large, high-cost, and often one-off projects ('megaprojects'), which commonly suffer from this kind of uncertainty given their higher political profile and costs (Migone *et al*., 2022). Further, the chapter argues that the danger from the politicization of such projects increases if there is a gap or 'misalignment' between user and payer plans and wishes for a particular product, opening up a space in which politicization may take root and undermine both cost and time budgets and projections (Migone *et al*., 2023b).

That is, any fundamental misalignment between purchasers and users exacerbates the risks entailed in the class of projects Flyvbjerg investigated, making such projects more difficult to manage than less expensive or short-term projects, where fixes of the more technical or accounting-based kind may prove relatively effective. While some aspects of this particular kind of project may not be correctable by purely administrative action, project managers need to be aware of the special risks that exist with such projects and their very serious nature and potential impact on ultimate project success and failure. Completion of a project of this kind is less likely to be a relatively simple, straightforward, technical task,

and political risks need to be recognized and dealt with effectively as much as possible if project management is not to run astray (Migone *et al*., 2023b; Howlett *et al*., 2023).

These misalignment and politicization problems have plagued recent Canadian military equipment purchases, and the Canadian experiences provide excellent case study material illustrating the sources of the project management risks and suggested routes for managing risks on projects of this large and expensive kind. In the Canadian defense sector, it has commonly been the case that the federal government's policy approach to purchases and the military's strategic priorities differ substantially, thus allowing electoral and other political concerns to override service doctrine and undermine project costs and schedules.

This misalignment often occurs ostensibly over the pursuit of cost savings but is often pursued by project proponents and opponents largely in the effort to obtain electoral advantage, either in opposing costs or promoting savings (Collins, 2021; Migone *et al*., 2023a). It is difficult to argue against the idea that Canadian military procurement has often been highly politicized in this way (Migone *et al*., 2023b; Howlett *et al*., 2023; Migone *et al*., 2024; Nossal, 2021) and that this has negatively affected purchasing decisions as well as the timeliness and cost-effectiveness of the equipment acquired for the Canadian Armed Forces (CAF) (Migone *et al*., 2023a Migone *et al*., 2023b purchasing replacement aircraft for its existing CF-18 fleet.

In fact, unlike in other countries where military and political elites are better aligned, and similar equipment has been procured more or less on time and on budget, for example, in Australia (Migone *et al*., 2023b), politicization has been the 'normal' state for Canadian military procurement from the 1980s onward and, as the F-35 case shows, continues to pose an ongoing risk to military procurement efforts. The country's last successful and non-partisan purchases, namely the *Halifax*-class frigates, *Iroquois*-class destroyers, and Leopard tanks, occurred in the late 1970s and 1980s when government and service goals were more closely aligned and levels of politicization and conflict were lower. As Dempster (2020, p. 335) argued, these weapons system procurements occurred during the last time in which Canada showed "political support and interdepartmental coordination, potent leadership, industrial engagement, a competitive procurement process, and positive outcomes" in this area.

In what follows, we look at how the management side of military procurement has been affected by this state of affairs in the F-35 case. We demonstrate how high-level misalignment has had a significant negative effect on contemporary Canadian military procurement and major project management. Following

CHAPTER 12

Organizational Change in the Army: The Spanish Case

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Abstract: The Spanish Army has experienced a profound transformation during the last three decades. Recent academic literature has identified the key elements of the historical background, operational experience, and professionalization of forces. Based on 24 personal interviews with military personnel, this chapter examines how the Spanish Army has evolved and the various planning activities undertaken to prepare forces for future operating environments. The chapter provides a theoretical background on military change as applied to the Spanish Army. This perspective will allow us to study (1) the main drivers of change, (2) operational and organizational transformations in the Spanish Army, and (3) current change initiatives to adapt land forces to the future operating environment in 2035. Conclusions include several recommendations to improve military performance and identify key lessons learned from expeditionary operations of the Spanish Army since 1991.

Keywords: Military operations, Organizational change, Operating environment, Spanish Army.

INTRODUCTION

The specialized literature sometimes points out that armies are rigid and bureaucratic institutions, extending the idea that they are organizations reactive to change (Gallo, 2018). However, their functions and internal structure have been adapting to the different contexts in which they have developed. The military has sometimes acted as factual powers capable of vetoing political decisions, interfering in political processes, and, on occasion, conducting repressive policies against opposing sectors. Their presence in political systems is inherent to the State itself, as it constitutes the central institution capable of exercising violence; in democracies, they have the necessary legitimacy for its exercise (Weber, 2012).

However, in democratic countries, military forces must be understood as a bureaucratic institution that is part of their administration (Esterhuyse, 2007). This

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has allowed the proliferation of security studies from the perspectives of public policy, public management, and organizational change.

The organizational transformations of armies often occur due to operational experience. This element is key to understanding how armies evolve and adapt to operational conditions and future challenges. Despite having been defined as large, bureaucratic, hierarchical, and traditional organizations, all armies have had to experience change at some point in their history (Burr, 1998; Pape, 2009; Gallo, 2018). In the case of the Spanish Army, it can be seen how an organization with a long historical tradition has undergone a profound transformation process in the last thirty years. It is a military organization that has changed its organizational nature, with clear reflections on its performance in expeditionary operations developed outside the national territory.

This chapter synthesizes recent research on military change in the Spanish Army. It is an opportunity to bring to the academic community of military studies the transformational experience that the organization has undergone, analyzing it from a perspective that combines the analysis of operational performance with the influence of organizational culture. In this sense, the chapter seeks to reflect on the main drivers of change and the organizational and operational transformations of the Spanish Army. The research identifies the professionalization of the forces, participation in international missions, and the multidimensionality in the origins of change as key vectors.

The research is based on articles previously written by the authors on the Spanish Army. Based on the analysis of organizational transformation (López-Rodríguez, 2022), military experience in expeditionary operations (López-Rodríguez, 2022b), and lessons learned specifically in SFA missions, both at the level of training local forces (López-Rodríguez, 2023) and micro-cultural interactions (López-Rodríguez & Durán-Cenit, 2023), the chapter seeks to analyze the impact of different key trends on military organization. The results obtained in the research provide interesting findings from a process perspective that show the importance of past events for the achievement of organizational change.

The chapter provides a general approach to the main theories on contemporary military change, reflecting the importance of organizational culture and historical experience, as well as adaptations in operations and the role of the military structure itself in facilitating or avoiding change. The first section of the analysis focuses on identifying the main drivers, followed by an analysis of the major transformations that the Army has undergone and the current initiative to transform the Army for the Future Operating Environment 2035. This research combines results obtained through personal interviews with Spanish military

personnel and includes some participant observation elements obtained by the researcher after his experience as an analyst in 2018 in the Spanish Army Training and Doctrine Command.

MILITARY CHANGE PROCESSES

Despite the positive connotations usually associated with the concept of change, it should be taken into account that it implies transformation and does not necessarily imply an improvement of what already exists. This element is key to understanding the caution of many political decision-makers when they must authorize change proposals from the military organization, and even more so when it is the political decision-makers who promote them. The specialized literature identifies that changes are often slow, mostly based on progressive readjustments along the organizational experience. Armies need to prove that the changes promoted are efficient and effective. Unlike other public or private organizations, armies must be cautious in promoting change, as an inappropriate decision can easily result in human casualties. The military profession, unlike others, is one of the few in which lives can be lost in the pursuit of assigned objectives (Smith, 2008).

The literature has extensively analyzed military change from the perspective of what is known as military innovation. There are multiple studies in this regard, analyzing both Western armies, such as the American (Jordan, 2017) or British (Adamsky, 2010), as well as forces such as the Israeli (Lopez-Rodriguez, 2020) or Japanese (Lopez-Rodriguez, 2019b), since these are countries that experienced, at different times in their history, rapid, novel transformations that led to a significant improvement in their performance. Military innovation has been understood as a process of profound change with a defined scope that improves the ability of a military force to operate, mainly in combat environments (Grissom, 2006). Both theoretical and applied studies have reflected the importance of combat to test transformations, and the intensity of operations has been a conditioning factor for their modification.

The main theories of military innovation focus on the origin of change in organizations. Who promotes it and who has the initiative have been key elements that have helped shape a solid theoretical perspective on which to subsequently analyze almost any military force. Since the first studies with top-down approaches that paid attention to political decision-makers as drivers of change (Posen, 1984) and to senior military leaders (Rosen, 1991), the academic perspective has enriched the literature on organizational change in the military. Other perspectives have focused on military innovation from the incorporation of new technology (Van Creveld, 1991), adaptations in areas of operations that shape

CHAPTER 13

The Dispersed Leadership of the National Shipbuilding Strategy: A Governance Review

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Abstract: The National Shipbuilding Strategy, initiated in 2010 and referred to as "the Strategy," consists of three portfolios of projects aimed at renewing the fleets of the Royal Canadian Navy and the Canadian Coast Guard while promoting the country's marine industry and generating economic benefits for Canada. With an estimated value of nearly $100 billion and spanning over four decades, the Strategy represents one of the largest portfolios of projects in the history of the federal government for the acquisition of goods and services. While existing literature on the Strategy remains limited and typically focuses on specific projects or management issues, such as policy and procurement, this chapter diverges by examining leadership within the various governance structures. The governance landscape is understandably complex, given the scale of the investments and the stakeholders involved. Each actor has its own governance structure, in addition to intersecting committees. Furthermore, each organization involved must advance its own objectives alongside those of the Strategy. We argue that this complexity gives rise to dispersed leadership, influencing the dynamics of decision-making and leading to ambiguity, and even tensions, particularly when overarching and specific objectives compete for precedence.

Keywords: Canadian coast guard, Governance, Leadership, National shipbuilding strategy, Procurement, Project management, Royal canadian navy.

INTRODUCTION

Launched in 2010, the National Shipbuilding Strategy (referred to as "the Strategy") is comprised of three portfolios of projects aimed at renewing the fleets of the Royal Canadian Navy (RCN) and the Canadian Coast Guard in a timely and affordable manner while developing the country's marine industry in a sustainable manner and generating economic benefits for Canada (Government of Canada, 2024a).

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The Strategy is comprised of the following three portfolios of projects:

- Construction of large vessels (more than 1,000 tonnes of displacement);
- Construction of small vessels (less than 1,000 tonnes of displacement);
- Vessel repair, refit, and maintenance projects.

This chapter focuses on the large vessels portfolio of projects, including two combat and seven non-combat megaprojects (defined as projects valued at over a billion dollars, according to Flyvbjerg and Gardner, 2023). Additionally, it includes another project approaching the billion-dollar threshold. The current estimated value of this portfolio stands at $87 billion, spanning over four decades (Government of Canada, 2024a). Notably, this valuation excludes two other significant megaprojects, the polar and program icebreakers, which could contribute an additional $12 billion (Canada Office of the Auditor General, 2021; Davie 2023), pushing the portfolio's total value beyond the $100 billion mark.

Providing leadership in the governance of this portfolio of megaprojects is inherently complex, given the scale of the investments and the multitude of stakeholders involved. Under the Strategy, leadership is distributed among federal departments, central agencies, privately-owned shipyards, and numerous subcontractors, each operating within its own governance structure, seeking to fulfill its own objectives alongside those of the Strategy. As such, this portfolio represents the most expansive shipbuilding initiative since the Second World War in terms of its scope, budget, and complexity (Government of Canada, 2023a).

The Strategy offers a compelling case study for examining its governance and dispersed leadership. In contrast to most off-the-shelf acquisitions, the government oversees the majority of the project lifecycle, including key activities taking place within its territory. Furthermore, this subject has received scant attention in the scientific literature, as highlighted by Esposito & Terlizzi (2023: 142), who state that “large military platform procurement is an understudied empirical setting among the policy literature on megaprojects.”

This raises a pertinent research question: how does this complex network of interconnected stakeholders assume leadership, shaping the dynamics of decision-making in this portfolio of megaprojects?

To address this question, this chapter provides a three-part demonstration: firstly, a literature review on the strategy, governance, and leadership in megaprojects; secondly, a description of the portfolio megaprojects, the participating organizations, and their governance structures; and thirdly, a content analysis of five key variables: strategic alignment, relationship with shipyards, procurement,

project management, and risk management. The chapter concludes with a discussion regarding the impact of dispersed leadership on the delivery of the strategy's outputs and outcomes.

The research methodology relies on secondary data, mainly through a comprehensive literature review and a content analysis. This involved scrutinizing various sources, such as public documentation and data acquired through the Access to Information Act, totaling more than 3,000 pages. Additionally, other sources such as studies and analyses were examined to provide a comprehensive understanding of the subject matter. This research is principally based on a qualitative approach, enabling in-depth exploration, and understanding of the research questions. Data is used to measure the various concepts under investigation while also providing additional context and insight into the decision-making process among actors of the Strategy.

LITERATURE REVIEW

Despite the importance of the Strategy for national defense, the Coast Guard, the naval industry, and, to a specific extent, federal public administration, a scoping review of the scientific literature demonstrates that these portfolios of projects have received little attention from a governance and leadership perspective thus far. A few authors have studied various components of the Strategy, whether it be a specific project or theme, such as procurement.

For instance, Migone, Howlett, and Howlett recently authored two articles (2023; 2022) pertaining to the Strategy, with a particular focus on the Canadian surface combatant megaproject. Their thesis centers on the misalignment between military doctrine and the political orientations of past and current governments. Meanwhile, Lajeunesse conducted a specific examination of the Arctic Offshore Patrol Ship project in two articles (Lajeunesse 2021; 2018), which trace the project's history and defend the controversial choice of vessel from a multi-mission perspective.

From the broader perspective of the Canadian Armed Forces, Williams (2006), a former Assistant Deputy Minister (Materiel), offers an insider's view of the defense procurement system, described as a "bureaucratic muddle" with a notable deficit of accountability. In this regard, he proposes the creation of Defence Procurement Canada under the responsibility of the Minister of National Defence. Similarly, Nossal (2016) also focuses on the procurement function, redirecting attention towards politicians (both within the cabinet and shadow cabinet) to explain past and present shortcomings.

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