Preface

We live in an age where resources, knowledge and power are widely distributed, contributing to the emergence of new and often unexpected sources of disruptive innovation. Advances in science and technology and the convergence of multiple disciplines are driving what many have dubbed the Fourth Industrial Revolution. It is widely acknowledged that the US Department of Defense (DOD) has played a foundational role in the rise of transformational technologies – like mass production, aircraft, nuclear energy, semiconductors, the Internet, and space technology, to name a few – that are critical to the modern global economy. However, the very forces that are creating rapid change also present new challenges for military affairs in this modern age of distributed innovation. Both the military-industrial complex and commercial industry alike are subject to continuous business process and technology disruption, described by the futurist Ray Kurzweil as the Law of Accelerating Returns. Within this context, succeeding generations of technologies interact in a multiplicative manner to produce a cascading flow of future innovations. In particular, the defense enterprise, once an independent and substantial driver of technological innovation, must now contend with a spate of interdisciplinary breakthroughs and solutions emerging from the private sector. The same tools and technologies used in building complex defense hardware can be effectively reengineered and redeployed by nimble and sophisticated adversaries in record time, with potentially devastating impacts. In addition to managing and promoting internal innovation efforts, there is an urgent need to develop and apply new models that will accelerate the absorption and use of novel external solutions for defense applications.

Our experience at the intersection of emerging technology and the US national security apparatus coincided with the launch of the Defense Innovation Initiative in 2015. What began as a largely aspirational effort designed to reclaim the US military's global technology preeminence quickly manifested into a succession of innovation initiatives aimed at reinvigorating defense research and development in line with the democratization of technology and mobility of investment capital. The impetus for these efforts was the sense that the dynamics of rapid technology change transforming industries were increasingly incompatible with the industrial-age bureaucracy controlling new product development in the DOD. The reaction engendered by this belief was predictable: create expanded opportunities for the military to capitalize

on innovation in the commercial sector from sources like big tech, startups, national research universities, and even lone innovators. To date, the culmination of new innovation activities in the Office of the Secretary of Defense, the military services, and DOD agencies has been remarkable in its scope and resilience, surviving the transition from the Obama administration to the Trump administration, but still limited in its impact.

In many respects, the journey of the DOD to develop open, collaborative innovation as a core competence mirrors the experience of large, traditional firms in commercial industry struggling with the same objective. It is hardly surprising, for instance, that DOD launched a new outpost in Silicon Valley, the Defense Innovation Unit – Experimental, among its opening moves into the sphere of twenty-first century innovation practice. This step heralded a wave of related efforts like the MD5 National Security Technology Accelerator, situated in the Office of the Secretary of Defense, SOFWERX at the US Special Operations Command, AFWERX at the US Air Force, and the more recent Army Applications Laboratory, part of the new Army Futures Command. These outreach efforts combined with legacy small business funding programs like the Small Business Innovation Research, Small Business Technology Transfer, and Rapid Innovation Fund accounts make the DOD one of the largest venture capitalists in the world – and almost certainly the largest strategic venture capital investor. But like many leading firms in legacy sectors seeking to capitalize on the creative ferment of the venture economy, the results of these efforts have been uneven at best. At the same time, the DOD is differentiated from its business counterparts by a range of practical, structural and cultural considerations that not only present unique challenges but also make it a unique object of study in the field of innovation management.

Setting out to explore the phenomenon of defense innovation, we were initially struck by the general lack of scholarly research in this area. For a sector that has played such a foundational role in shaping the global high-tech economy, there is surprisingly little in the way of academic content on this topic in general and how it is distinct from the broader innovation economy in particular. Short of a major military disaster like Pearl Harbor, the fall of Saigon, or the unprecedented terrorist attacks on 9/11, all of which prompted exceptional responses in organizational structure and doctrine, the DOD lacks the kind of inherent feedback mechanisms that inform new product development trajectories in commercial industry. Instead, innovation decision making is driven by formal planning processes that reflect a vision of the future conflict environment based on the considered opinions of experts. While these opinions dictate what the DOD will build, they do not necessarily influence how new products are developed. The approach to product innovation in the DOD has remained substantially unaltered since World War II when Vannevar Bush articulated what Bonvillian and Weiss (2015) call the pipeline research

and development model. According to this model, basic research investments made by the military bureaucracy eventually trickle down to new military capabilities, an approach that benefited the DOD so long as it maintained a near monopoly on advanced technology development. Such is no longer the case.

The research we conducted for this book paralleled the development of a new wave of innovation practices in the DOD, which began some five years ago with the launch of the Defense Innovation Initiative. This period is remarkable for the fact that it represents the first broad-based effort to adapt how the US military innovates new capabilities since the earliest days of the Cold War. During this time, we were fortunate to have a front-row seat, as it were, to the action – initially as visiting research fellows at the Center for Technology and National Security Policy at the National Defense University, ironically an organization that was to be shut down shortly after our arrival even as questions of technology and policy started to take center stage at the DOD, and then as advisors to the US Army supporting the creation of a new innovation organization, the Army Futures Command. Our strategic positioning inside the belly of the beast afforded us access to some of the key voices, from the most senior decision makers to practitioners involved in shaping the future of innovation in the DOD. It also allowed us to gain a fuller appreciation for the truly monumental undertaking required to reinvent a core business system, like new product development, in an organization as large and heterogeneous as the DOD. While the internal barriers to such change are consistent in many respects with what one would expect to see in a large commercial firm (e.g. culture, incentives, competencies), exogenous factors specific to the national security context, like entrenched political and industry constituencies, introduce additional layers of complexity to the process of transformation.

In this book, we seek to describe the emerging paradigm for innovation in the DOD and identify additional opportunities to capitalize on innovation ecosystems to advance the DOD's capability development objectives. Based on our understanding of the changing technology landscape and the impacts that these changes represent to the roles, missions and functions of the US military, we invoke established innovation theory to analyze legacy approaches to defense product development successful in the Cold War and detail how these approaches can no longer be counted on to deliver a competitive advantage. Leveraging a combination of archival data, first-person observations, and interviews, we identify practices and themes characterizing the key trends in defense innovation, describe current organizational approaches in the DOD reflecting innovation in practice, and develop a theoretical framework that elucidates the competencies required to underwrite defense innovation objectives. Finally, we present a theoretically grounded perspective on the implications of

the changes currently being wrought inside the DOD for the future of defense innovation.

We wish to thank a host of collaborators and supporters both within the DOD and from the broader US and international defense communities who offered us their valuable insights in the furtherance of our research. We also wish to thank the Office of the Secretary of Defense, the National Defense University, and the Army Futures Command for providing us with access to the personalities, places and problems at the heart of the current defense innovation conversation. Special thanks to our student assistants Navil Zaman, Kay Khosbayar, Elizabeth Spach and Catherine Michelle Farnsler, all of whom helped in numerous ways with the research. Most importantly, we want to thank the brave men and women of the US armed forces whose selfless service and commitment to our country has provided both the impetus for the transformation of defense innovation itself, and the inspiration for our research.

Bharat Rao, New York University

Adam Jay Harrison, New York University

Bala Mulloth, University of Virginia