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Defense Innovation Reform and Bureaucratic Incumbency: Limits of DARPA Emulation in South Korea

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Research Article

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Limits of DARPA Emulation in South Korea

Abstract

The U.S. Defense Advanced Research Projects Agency (DARPA) is widely treated as an organizational model for disruptive technological innovation, inspiring emulation across policy domains and countries. Its celebrated performance, however, may depend not only on portable design features but also on historically specific institutional conditions within the U.S. defense establishment. This article examines that tension through South Korea's Future Challenge National Defense Technology Development Programme (K-DARPA). South Korea's high and stable defense R&D investment and dense policy-learning ties with the United States made it unusually well positioned to emulate the model. Yet K-DARPA diverged substantially from its U.S. prototype. Drawing on documentary analysis and 22 interviews with defense officials, program managers, scientists, industry participants, and policy experts, the article identifies mechanisms of bureaucratic incumbent filtering. Once embedded within the Agency for Defense Development, established personnel regimes, hierarchical authority, deployment-oriented evaluation, and audit-driven risk aversion narrowed program-manager discretion, constrained external recruitment, reintroduced top-down planning, and weakened tolerance for failure. Incumbent actors adopted DARPA's visible features while subordinating them to existing governance routines. The findings show that, without comparable institutional protections for exploratory research, imported innovation agencies are domesticated rather than replicated.

Keywords: *Defense Advanced Research Projects Agency, defense innovation, open innovation, breakthrough technologies, diffusion of innovation, Agency for Defense Development*

1. Introduction

The defense sector in the United States has long been recognized as a wellspring of radically new technologies—ranging from the internet and personal computing to the Global Positioning System, electronic mail, unmanned aerial vehicles, stealth aircraft, and, more recently, quantum technologies (Cheney and Van Atta, 2019; Bonvillian and Weiss, 2015; Mazzucato, 2013; Flamm, 1988). These advances have not only reshaped the conduct of war and the organization of military power but also seeded entirely new sectors in commercial markets (Ruttan, 2006; Fong, 2001; Mazzucato, 2016). Periodically, clusters of such defense-originated technologies were accompanied by major shifts in military innovation and doctrines: for instance, improvements in reconnaissance, intelligence, communications, situational awareness, and precision strike collectively underwrote what defense analysts termed the Revolution in Military Affairs, enabling operational concepts such as network-centric warfare, the kill chain, and multi-domain operations (Grissom, 2006; Sauer and Schornig, 2012; Mahnken, 2011; Brose, 2020; Keefer, 2017; Jensen, 2017). Beyond the battlefield, these technologies have redirected technological trajectories at the frontier, destabilized incumbent markets, facilitated entry by new high-tech firms, and generated persistent economy-wide gains through cumulative innovation (Ruttan, 2006; Weiss, 2014).

At the center of this historical trend stands the U.S. Defense Advanced Research Projects Agency (DARPA), widely regarded in prior scholarship as the archetype of a state R&D agency capable of fostering disruptive technological change. DARPA's organizational design—marked by exceptional autonomy, flexible organizational structures and procedures, and systematic openness to civilian scientific communities—have been identified as critical to cultivating dynamic capabilities for exploring frontier technological opportunity spaces and nurturing early-stage research with far-reaching downstream implications (Kattel et al, 2022; Bonvillian, 2011; Fuchs, 2010). Notably, all of the transformative technologies referenced

above originated in DARPA-funded programs, reinforcing the agency's reputation as a paradigmatic "state-led disruptor" (Breznitz et al, 2018).

These observations raise broader questions about institutional design and cross-national transferability. Some scholars argue or imply that DARPA's success is inseparable from its embedding within the defense sector itself (Bonvillian and Van Atta, 2011; Ruttan, 2006; Weiss, 2014). Defense markets possess distinctive characteristics: the state often functions as a monopsonistic buyer capable of underwriting technological risk, generating demand for capabilities whose commercial viability remains uncertain, and thus acting as an early adopter of radically novel systems. Such conditions appear especially conducive to experimentation at the technological frontier.

On the other hand, scholarship emphasizing defense bureaucracy underscores historical durability of institutions that govern defense acquisition (i.e. procurement and Research, Development, Test, and Evaluation [RDT&E]). The defense innovation pipeline is idiosyncratically long, stretching from basic and applied research through prototyping, testing, incremental engineering, and system integration, and it therefore requires, as a baseline, extensive coordination within bureaucratic structures prone to rigidity and lock-in (Bonvillian and Weiss, 2015: 122–123). The long-term budget commitments and entrenched procedures that make such coordination possible simultaneously allow vested interests to congeal around established technological platforms. Two further conditions harden this incumbency: the fog of war—uncertainty about which technological parameters will ultimately matter—and the persistence of doctrines that have functioned "sufficiently well" (Alic, 2007). In such settings, administrative flexibility and openness are unlikely to emerge absent a critical juncture that temporarily empowers reformist coalitions. Seen in this light, "inserting" an exploratory organizational unit such as DARPA—however modest its share of total defense RDT&E, historically some 3–5 percent—is far more difficult than the agency's small footprint suggests.

Indeed, a substantial body of research finds that no advanced economy other than the United States has built a comparable unit dedicated to "exploratory research across the entire spectrum of potential military technologies" and capable of generating a public reservoir of ideas from which firms pursue commercial breakthroughs (Ziegler, 1992: 244; Weiss, 2014; Gholz and Sapolsky, 2021).

Whether the presumed “defense-sector advantage” travels across national contexts therefore remains an open question. Under what institutional conditions can newly established “state-led disruptor” agencies in the defense domain sustain exploratory research under conditions of extreme uncertainty? Can advanced economies outside the United States overcome structural disadvantages in disruptive military innovation by emulating a seemingly ready-made model? And when such efforts fall short, what mechanisms account for the divergence between formal design and actual governance practice?

This study addresses these questions through a comparative analysis of DARPA and its emulated counterpart introduced by South Korea’s defense establishment. Despite substantial fiscal commitments and the efforts of well-informed institutional entrepreneurs, the imported model was progressively reshaped to accommodate the interests, administrative routines, and evaluative logics of incumbent state actors. Several core elements of the DARPA model were either not adopted or implemented in highly constrained forms, thereby limiting the programme’s capacity to sustain exploratory and open-ended R&D management.

The Korean case of limited emulation is theoretically consequential for cross-national debates on institutional borrowing. South Korea combines relatively high levels of state investment in defense R&D with dense policy-learning networks linking its defense establishment to that of the United States—conditions typically associated with successful institutional transfer. The persistence of distortion under such favorable circumstances therefore demands explanation.

I argue that the failure to reproduce DARPA's exploratory capabilities reflects neither informational deficits nor weak political commitment, but rather the constraining effects of historically sedimented institutional structures that continue to privilege centralized control, downstream capability development, and acquisition-oriented performance metrics over upstream experimentation. In this sense, defense can be a sector in which the very organizational arrangements that enable rapid capability accumulation simultaneously inhibits institutional transplantation, rendering even fiscally committed and carefully studied models resistant to replication. Rather than functioning as a universally portable template, the DARPA model proves deeply contingent on the institutional ecology into which it is introduced.

2. DARPA Model: Organization and Historical Foundations

This section synthesizes prior research to clarify DARPA's core organizational elements, the distinctive role it has played within U.S. defense R&D, and the historical processes that enabled its formation. I argue that DARPA is best understood as a specialized state organizational arrangement designed to sustain exploratory technological search within the defense establishment. Marked by unusually high levels of *autonomy*, administrative *flexibility*, and structured *openness* to civilian scientific and technological communities, DARPA represents a historically constructed effort to embed dynamic capabilities into the U.S. defense establishment. Three mutually reinforcing organizational features are central: insulation from near-term service demands combined with a broad technological mandate (autonomy); flexible and discretionary managerial authority vested in program managers at the bottom of the agency hierarchy (administrative flexibility); structured permeability to civilian scientific communities (openness). Together, these elements allow the agency to explore broad technological opportunity spaces without being prematurely disciplined by short-term operational requirements within defense establishments.

DARPA's emergence and persistence were not accidental design innovations but the outcome of interacting historical processes rooted in the American experience of World War II and the Cold War. Wartime mobilization generated administrative precedents—flexible hiring authorities, extramural contracting norms, and the incorporation of elite civilian scientists into defense governance—that institutionalized openness and discretionary research management across the defense apparatus. By the late 1950s, these rules and practices were readily available within the organizational landscape. The Sputnik shock functioned as a critical juncture that consolidated these precedents, enabling scientist-administrators to establish DARPA as an autonomous organizational unit directly reporting to the CTO within DoD, which serve as defense-wide technological authority capable of shielding DARPA's exploratory research from procurement pressures.

2.1. DARPA's Organizational Distinctiveness within Defense Sector

The first defining feature of DARPA's organizational distinctiveness lies in the degree and form of its institutional separation from the military services. Unlike most defense R&D organizations, whose research agenda are shaped by service-specific operational *requirements* and thus locked into fixed acquisition cycle, DARPA occupies a position that allows it to operate at arm's length from service demand structures while maintaining channels of collaboration (Gallo, 2021: 8; National Research Council, 2005: 16–17). Reporting directly to the Under Secretary of Defense for Research and Engineering (USD(R&E))—a CTO role historically occupied by civilian scientist-bureaucrats to provide defense-wide oversight of RDT&E—DARPA is insulated from the pressures of near-term capability delivery that typically govern service-based R&D. This institutional positioning differentiates DARPA not only from service laboratories but also from other OSD-level agencies, such as the Missile Defense Agency[1], which has narrowly defined and fixed mandate to develop missile defense

[1] MDA's origin can be traced to when Ronald Reagan's administration established the Strategic

technologies. By contrast, DARPA's mandate is deliberately expansive, granting it wide latitude to define novel technological problems, assemble research portfolios, and terminate lines of inquiry without obligation to produce deployable systems.

Consistent with this mandate, DARPA's role is explicitly confined to the pre-deployment phase of the innovation pipeline. The agency funds and manages research only up to the point at which early-stage prototypes can prove technological concepts, leaving subsequent development, integration, testing, and procurement to downstream actors. This emphasis on prototype-driven exploration has enabled DARPA to generate radically novel technological capabilities that help the U.S. military offset adversaries' numerical or geographic advantages through technological "surprise" (Van Atta et al., 2003; DARPA, 2005). Rather than optimizing technologies for operational readiness, DARPA concentrates on envisioning and verifying unconventional technological concepts through portfolios of high-risk, high-reward research programs.

Second, beyond autonomy, DARPA is also characterized by an unusually high degree of organizational flexibility and operational agility (Kattel et al, 2022; Piore et al, 2019). Its deliberately lean (3-tiered) hierarchy—structured around a director, office director, and program managers—enables rapid decision-making and flexible allocation of resources to explore technological frontiers[2]. Program managers (PMs), who occupy the lowest formal tier of this hierarchy, are nevertheless grated extensive discretion over the planning, management,

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Defense Initiative in 1983 to consolidate and manage set of research in anti-ballistic missile. Another example of the agency tied directly to USD R&E, not to the services, is the Defense Innovation Unit, which was founded in 2015 to allow the defense establishments to tap into high-tech commercial technologies; but it is still an extremely small-scale and experimental unit that is hard to compare with DARPA.

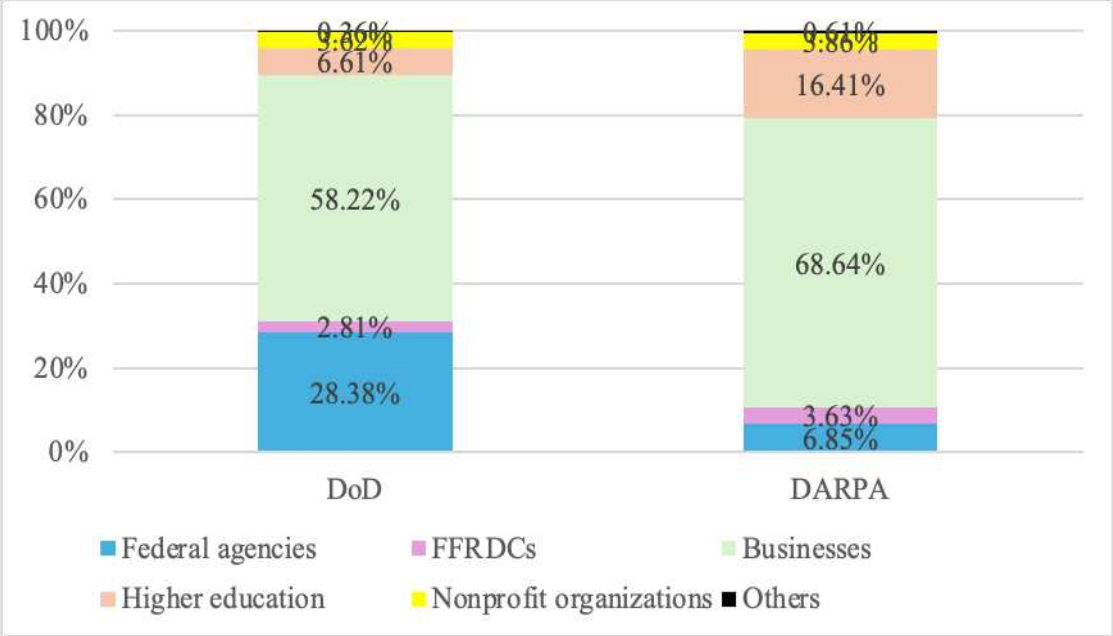
[2] Robert W. Taylor, then director of DARPA's Information Processing Techniques Office, recalled that it took roughly thirty minutes in an informal meeting with the agency director to pitch his idea and secure approval for funding ARPANET, a precursor to the Internet (Hafner and Lyon, 1996: 34; Jacobsen, 2015: 245–246). Similarly, a former DARPA program manager noted in an interview that final funding approval from the director could be obtained in approximately one hour, following multiple rounds of biweekly informal advisory discussions with the office director (interview with BY, 2/17/2025).

and evaluation of their own programs. In developing their own programs, PMs articulate technical visions through sustained networking activities with dispersed scientific communities and prospective military users, synthesizing insights from basic and applied research while linking emerging technological opportunities to latent operational needs (Sen, 2017; Colatat, 2015; Carleton, 2010). During program management, they leverage flexible contracting authorities to iteratively refine objectives, pursue parallel experimentation to hedge uncertainty, and deploy seed funding and prototyping to continuously test feasibilities (Fuchs, 2010). Performer selection may bypass conventional peer review in order to avoid prematurely filtering out unconventional or complementary approaches (Goldstein and Kearney, 2024). High project-level failure rates are expected byproducts of frontier search within DARPA: by some estimates, 85–90 percent of the agency's programs do not fully achieve their original objectives (Ranka, 2019). Success is evaluated at the portfolio level rather than at the level of individual projects. In this way, flexibility, discretion, and tolerance for failure operate as mutually reinforcing mechanisms that institutionalize exploration within the defense bureaucracy.

Third, DARPA is distinguished by its systematic openness to external civilian scientific and engineering communities, effectively introducing an open innovation model into the defense establishment (Chesbrough, 2003; 2006; Heeren et al, 2024; Howell et al, 2021; Fuchs, 2010; Bonvillian, 2011). With the exception of its second director, DARPA has been led exclusively by civilian scientists and entrepreneurs—a leadership pattern that both facilitates access to cutting-edge expertise and further reinforces the agency's institutional autonomy from the services-based vested interests. Rather than relying on permanent civil servants or in-house research facilities, DARPA contracts out all research activities to external performers, predominantly civilian institutes such as universities (16.41%), private firms (68.64%), and other civilian laboratories (see Figure 1). More importantly, nearly two-thirds

of PMs are civilians, drawn primarily from industry (40.6%) and academia (15.6%). This permeability to civilian inputs is enabled by streamlined hiring procedures and exceptional personnel authorities that allow DARPA to offer compensation outside standard civil service pay scales and to deploy PMs rapidly. Appointments are strictly time-limited—typically four years—a rotation design that serves a dual function: it ensures continual inflows of fresh ideas from the civilian research ecosystem, while the steadily expanding network of PM alumni provides channels through which DARPA-born technologies transition into commercial and military application (Fong, 2001).

Figure 1. Share of RDT&E Performance by Different Institutional Backgrounds

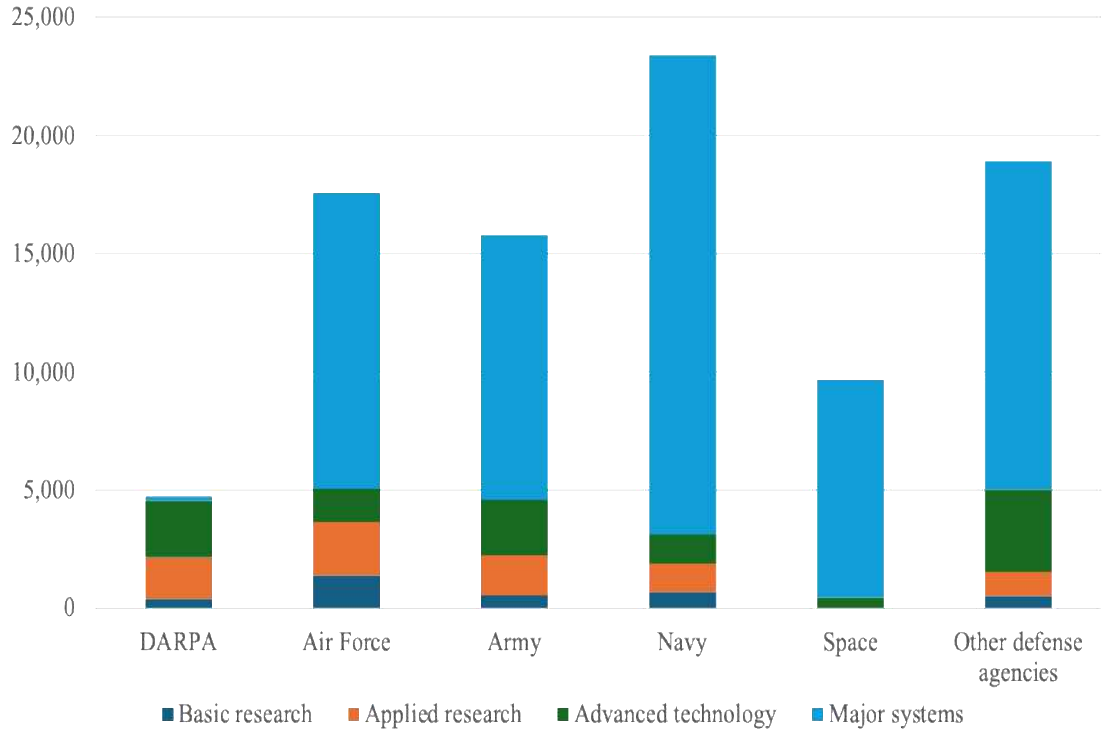


From a broader perspective, DARPA's organizational flexibility and autonomy can be considered as injecting a dynamic capability in the overall defense establishment to decouple itself from near-end service-specific priorities and acquisition logics, empowering it to pursue research trajectories that would otherwise be filtered out—either because they lack an immediate institutional sponsor or because they cut across organizational boundaries that fragment demand within the defense establishment. This decoupling, reinforced by flexible

budgeting and contracting authorities, allows DARPA to continually recalibrate program goals and resource allocations in response to a shifting technological frontier (Bonvillian and Weiss, 2015; Alic, 2007: 85).

This mission orientation is reflected in DARPA's near-exclusive focus on the "Science and Technology" (S&T) part of the Department of Defense's Research, Development, Test, and Evaluation (RDT&E) budget (see Figure 2). From the late 1990s through 2020, DARPA accounted for approximately 20-30 percent of total defense S&T expenditures, while representing only about 3-7 percent of overall DoD RDT&E spending during the same period (Gallo, 2021). This budgetary profile underscores DARPA's disproportionately large role in federal defense early-stage, exploratory research.

Figure 2. R&D Budget Activities by Institutions within DoD



*S&T budget = Basic research (Budget Activity 1) + Applied research (BA 2) + Advanced technology (BA3)
**Major systems budget = Advanced component development and prototypes (BA4) + System development and demonstration (BA5) + RDT&E management support (BA6)

From a security perspective, DARPA's emphasis on early-stage prototyping reflects one of the two strategic orientations through which the U.S. DoD has historically sought to manage problems stemming from technological uncertainty—namely, uncertainty "about the enemy and about the costs and benefits of new technologies [that] make it impossible to identify the single best route to innovation" (Rosen, 1991: 243). In addition to flexible force strategy (Type I flexibility), which involves the deployment of costly multipurpose weapons systems capable of addressing a wide range of contingencies (e.g., aircraft carriers that can deploy diverse aircraft rather than single-purpose cruise missiles), the DoD has relied heavily on prototyping as a distinct mechanism of Type II flexibility. Prototypes generate relatively low-cost, observable information about technical feasibilities and the trade-offs across competing technological options. By deferring large-scale procurement while maintaining a diverse portfolio of prototypes, defense elites can explore a broad range of technological possibilities, clarify their relative-tradeoffs, hedge against unanticipated developments, and remain positioned to exploit complementarities between emerging capabilities and existing systems—combinations that may ultimately yield the breakthroughs they seek[3] (Rosen, 1991: 243-249; Mowery, 2010: 1710-1711).

[3] Relatedly, DARPA has not merely served as a passive evaluator of technological options but has at times played an active role in envisioning and advancing integrative defense concepts that recombine existing weapons systems with emerging technologies. Drawing on its accumulated knowledge of previously developed technological components and its anticipatory understanding of emerging technological trajectories, DARPA has been able to articulate novel system-level concepts—particularly when these efforts aligned with, and were supported by, higher-level political authorities such as the Under Secretary of Defense for Research and Engineering (USD R&E), to whom the agency directly reports and with whom it interacts frequently. A canonical example is the Assault Breaker program, through which DARPA sought to realize a full standoff precision-strike capability. The program originated in a joint concept-development study with the Defense Nuclear Agency, which convened panels of technologists and defense strategists to explore non-nuclear strategic alternatives for NATO in response to perceived Soviet conventional superiority. Through this process, DARPA identified the strategic significance of standoff precision strike and subsequently built upon the study by integrating its conceptual insights with emerging technological trajectories, proposing the Integrated Target Acquisition and Strike System (ITASS). This concept recombined previously disparate developments in target sensors, airborne radar, automatic target recognition, and long-range precision-guided munitions into a coherent system architecture (Van Atta et al, 1991: V-9-V-10). The initiative gained decisive momentum following the appointment of William Perry as USD R&E. Drawing on his background in

2.2. DARPA and Historical Development of Defense Innovation Governance

DARPA's openness to elite civilian scientists—from universities as well as private industry—together with the exceptional autonomy granted to program managers, reflects a longer institutional precedent initiated during World War II and consolidated in the early Cold War. This trajectory was marked by the rapid expansion of formal channels through which civilian scientific actors were incorporated as research performers under large federal contracts, administrators, and advisors within the defense state. The Office of Scientific Research and Development (OSRD) played a foundational role in this transformation by recruiting leading scientists to fund, coordinate, and manage wartime research in areas such as radar and nuclear weapons (Stewart, 1948; Geiger, 1992; 2004). OSRD institutionalized extramural contracting as the dominant mode of defense R&D, contracting directly with universities and private firms rather than individual scientists, and covering full program costs, including indirect expenses (Daniels, 1983: 426-442; Stokes, 1997). The scale of OSRD funding constituted a major exogenous shock, catalyzing regional research clusters with enduring effects on high-technology entrepreneurship and employment (Gross and Sampat, 2023). While wartime constraints compelled OSRD to rely heavily on universities due to limited upstream research capacity of private firms, by the time DARPA began recruiting technical staffs, DARPA could draw heavily on private-sector scientists as program officers —an unconventional but feasible practice within the defense establishment (Richard J. Barber Associates, 1975: II-26).

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defense electronics and surveillance systems, Perry endorsed the precision-strike vision, articulating its strategic objective—"to be able to see all high-value targets on the battlefield at any time; to be able to make a direct hit on any target we can see, and to be able to destroy any target we can hit"—and consolidated a broad political coalition spanning Service Chiefs, senior OSD decisionmakers, and Congress. This support translated into a substantial expansion of DARPA's resources, including a doubling of its budget between 1977 and 1981 (Perry testimony, SCAS, 3 March 1979, 5599; Jensen 2016: 73–74; Van Atta et al. 2003: 10; Keefer 2017: 586–590).

Just as importantly, OSRD secured statutory authority to hire technical personnel outside conventional civil service rules through personal-service contracts negotiated on a "no-profit–no-loss" basis, thereby establishing an early precedent for flexible compensation and discretionary recruitment in defense R&D (Stewart, 1948: 145). These arrangements were subsequently institutionalized—through the enactment of Public Law 313 in 1947, which authorized the military services to create specialized positions for critical research functions, appoint personnel without competitive examination, and compensate them at market rates. It helped normalize temporary public service among elite scientists and contributed to the emergence of a professional expectation that participation in defense research administration constituted a legitimate extension of scientific careers (National Academies of Science, 2001). By lowering barriers to lateral entry and permitting remuneration outside standard pay scales, Public Law 313 strengthened the state's capacity to attract high-level technical expertise while preserving administrative flexibility[4].

DARPA inherited this institutional infrastructure. For example, by the time the agency began assembling its technical staff, the recruitment of civilian scientists into defense management roles no longer appeared anomalous but rested on an established legal and organizational foundation. What might otherwise have been interpreted as an unconventional governance arrangement—entrusting programmatic authority to externally recruited scientists—was thus rendered administratively feasible by earlier wartime innovations in personnel policy (Barber Associates, 1975). In this sense, DARPA's celebrated openness should be understood less as a set of entirely novel organizational elements than as the assemblage of historically constructed civilianized defense administrative rules, procedures, and practices littered around the organizational landscape, and one sustained by scientist-

[4] Another example prior to the founding of DARPA that exploited this legal authority heavily to recruit highly qualified scientists from universities was the Office of Naval Research (Sapolsky, 1990: 34).

bureaucrats who leveraged wartime precedents to institutionalize flexible hiring, discretionary authority, and porous boundaries between the state and the scientific community.

The organizational structures and practices that embodied DARPA's flexibility and openness were sustained by political and policy support from a cohort of elite scientist-bureaucrats that emerged during World War II and combined technical authority with administrative experience and dense network ties to defense policymaking. Herbert York, John S. Foster, and Harold Brown—three prominent protégés of Ernest O. Lawrence—illustrate how such elite scientific networks shaped DARPA's early institutional orientation. Lawrence, an accelerator physicist central to the Manhattan Project's uranium isotope–separation effort and the founder of what later became Lawrence Livermore Laboratory, actively brokered the entry of younger scientists into elite defense policy circles, enabling their movement from laboratory research into senior national security roles. After serving in the Manhattan Project and the early years of Lawrence Livermore Laboratory, York, Foster, and Brown entered the U.S. defense elite and played pivotal roles in founding and anchoring DARPA and its surrounding governance structure (Jacobsen, 2015: 23-25; Keefer, 2017). York served as DARPA's first chief scientist and as the inaugural Director of Defense Research and Engineering (DDR&E) within the Office of the Secretary of Defense; Brown succeeded York as DDR&E and later became the first scientist to serve as Secretary of Defense during the Carter administration; and Foster followed Brown, serving as DDR&E under two presidents. Collectively, they advised and supported DARPA's early, deliberate commitment to funding high-risk basic and applied research aimed at generating technologies with potentially far-reaching consequences rather than immediate military applications (Richard J. Barber Associates, 1975: 253). Brown's later role as Secretary of Defense further reinforced this orientation: his articulation of the Offset Strategy relied heavily on DARPA as a vehicle for technological leverage, including expanded RDT&E funding, support for

programs such as Assault Breaker and stealth aircraft, and the adoption of "technology-limited" contracting that allowed flexible reprogramming of funds in response to technological uncertainty (Keefer, 2017: 852; see also footnote 3 of this paper).

Although the institutional elements that later defined DARPA—e.g. discretionary recruitment of elite scientists and extramural reliance on civilian research performers—had emerged incrementally from wartime precedents, they were not automatically consolidated into a durable organizational form. Their assembly required a catalytic moment. The launch of Sputnik in February 1958 provided precisely such a critical juncture. Framed by political opponents and public media as evidence of American technological complacency, the event was interpreted as a national security crisis that demanded structural reform in advanced defense research.

In response, newly appointed Secretary of Defense Neil McElroy and Presidential Science Advisor James Killian—both civilians—advocated the creation of an organizational unit insulated from near-term service interests and endowed with administrative flexibility sufficient to mobilize the nation's scientific "centers of excellence" (Richard J. Barber Associates, 1975; Schmid, 2018; Weinberger, 2017). Their proposals also resonated with President Eisenhower's aversion to the inter-service rivalries in R&Ds. Sputnik thus did not generate entirely new institutional capacities; rather, it activated and consolidated existing precedents into a self-sustaining organizational unit. DARPA's founding marked the moment when dispersed administrative innovations were assembled into a coherent institutional architecture capable of governing frontier research within the defense state.

DARPA was also a product of the Cold War not merely in historical terms but in organizational logics. Its organizational design aligned with a strategic environment characterized by uncertainty, prolonged temporal horizons, and the absence of decisive battlefield feedback. Unlike earlier wartime periods, in which R&D agencies were pressured

to deliver weapons whose effectiveness could be rapidly evaluated against identifiable enemies, Cold War rivalry was structured by great-power stalemate and technologized competition unfolding over long durations and across multiple proxy conflicts (Mowery, 2012: 1705; Alic, 2007: 85; Brooks, 1986: 119-167). Military threats were therefore diffuse, long-term, and continuously co-evolving with adversaries' technological capabilities, rather than immediately testable in combat. This strategic context reduced the premium on short-term performance and instead favored high-risk, exploratory R&D pursued across broad portfolios, where failure at the project level could be institutionally tolerated so long as long-run technological advantage was secured. DARPA's now-canonical contributions to early information-processing technologies—including ARPANET, electronic mail, and the graphical user interface—illustrate this logic: they emerged from a mandate to radically improve command-and-control systems under nuclear threat, coupled with office-level structural autonomy that allowed program managers to define how to pursue this mission technologically rather than prescribing specific solutions from top to down (Weinberger, 2017: ch. 7).

3. Research Design and Data Collection

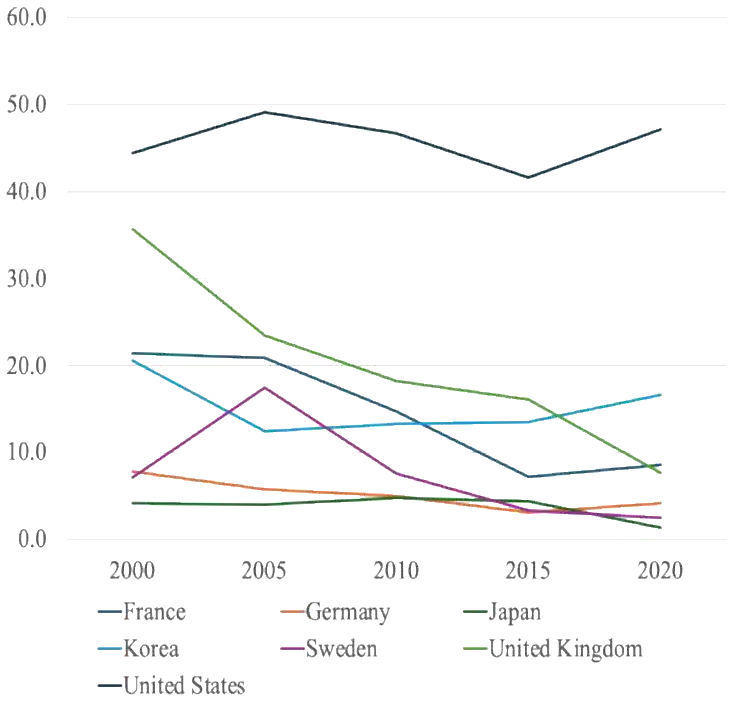
3.1. Research Design

This study employs a qualitative case-study design to examine the institutional domestication of the DARPA model within South Korea's defense sector. The analysis centers on the Future Challenge National Defense Technology Development Programme (hereafter K-DARPA), a defense R&D programme initiative explicitly modeled on the U.S. Defense Advanced Research Projects Agency (DARPA). Rather than evaluating policy outcomes per se, the empirical focus is on reconstructing the processes through which the imported DARPA template interacted with—and was reshaped by—the interests, authority structures, and

administrative routines of incumbent defense agencies. Particular attention is devoted to three core organizational dimensions central to DARPA's exploratory capacity: autonomy from near-term demand/requirement pressures, flexible and discretionary program management, and structured openness to civilian scientific communities. Throughout the analysis, I compare between the K-DARPA programme and DARPA to clarify points of convergence and divergence and to illuminate the institutional mechanisms underlying deviation.

Two structural features strengthen the methodological leverage of the Korean defense case. In cross-national perspective, Korea's defense R&D commitment is substantial rather than marginal. As of 2020, defense R&D ranked second among OECD countries in absolute terms after the United States and third in terms of its share of total gross domestic expenditure on R&D (16.6%), following the United States and the United Kingdom (OECD, 2025). Moreover, this share has remained above 10 percent since 2000, demonstrating remarkable stability over two decades. When measured by the standard deviation of annual defense R&D shares between 2000 and 2020, Korea exhibits one of the lowest levels of fluctuation among comparable countries (see figure 3). Neither underinvestment nor volatility plausibly explains the divergence of K-DARPA from its U.S. counterpart. The Korean defense sector satisfies a key structural condition commonly associated with DARPA's success: sustained and politically stable R&D commitment.

Figure 3. Cross-country comparisons of recent defense R&D shares of total GOVRD



	Avg (2000-2020)	SD (2000-2020)
United States	45.30%	2.8
Korea	14.50%	1.9
France	15.20%	8.3
Germany	4.90%	1.4
Japan	3.80%	1.1
Sweden	9.50%	6.6
United Kingdom	20.60%	8.2

Second, successful institutional diffusion requires detailed knowledge of the model to be emulated. Where adopters lack accurate information about organizational structures, internal procedures, or governance linkages, selective interpretation and distortion become more likely (e.g. Dolowitz and March, 2000; Weyland, 2007). Yet the Korean defense sector appears an unlikely setting for informational deficit explanations. Despite DARPA's reputation for institutional opacity, Korean defense organizations have long been embedded in dense alliance-based learning networks with the United States.

Since the 1970s—when Korean agencies relied extensively on U.S. technical assistance, training programs, technical data packages, and foreign military sales arrangements to build defense-industrial capacity—the alliance has institutionalized continuous channels of knowledge transfer (Koo S-H, 1998; Kim J-H, 2014: 300-307). Even after free technical aid declined, U.S. acquisition methods, military doctrines, and R&D governance practices remained primary reference points for Korean defense planners, reinforced by interoperability

requirements and limited access to comparable non-U.S. models (Cho S-H, 2008; Kim J-H, 2014: 300-307; interviews with BK, 6/12/2024; BG, 5/27/2024). Through formal liaison roles and informal exchanges, defense attachés and related intermediaries routinely gathered and translated U.S. procurement regulations, administrative procedures, and emerging operational concepts for rapid dissemination within the Ministry of National Defense and the services (interviews with BK, 6/12/2024; CA, 2/20/2025) [5]. Several interviewees within ADD and DAPA had direct exposure to DARPA personnel through exchanges or collaborative projects.

Some of the Korean officials that I have interviewed—three from ADD and two from DAPA—have had experience of interacting with DARPA personnel either through a formal exchange or collaborative projects. The following interview excerpts illustrate a rare incidence where the inner workings of DARPA were exposed to a Korean Defense Acquisition Attache:

> There was one time [when I served as Attache when] the internal organizational process [of DARPA's program development and management] was revealed... DARPA's [redacted – internal unit] built a simulator with us, and they wanted us to be closely involved in collaborative research... To collaborate, you have to be open…(CA, 2/20/2025)

Taken together, these conditions—high and stable defense R&D investment, strong fiscal commitment to K-DARPA, and unusually dense policy-learning networks—render South Korea's defense sector a favorable case for successful DARPA emulation. If the

[5] The following quote from interviews with BK(6/12/2024) substantiates this point:

> The information diffuses through the Defense Attaché. The Defense Attaché stationed in the U.S. primarily collects U.S. acquisition procedures, immediately gathers and summarizes any defense industry laws or defense industry-related strategy documents as they are released, sending them to the Korea's Ministry of National Defense. Then, for example, if the Attaché belongs to the Navy, they also get sent to the Office of the Chief of Naval Operations. Information is gathered this way. If, say, the U.S. Pacific Command changes Army combat doctrine, it gets sent... Anyway, the biggest characteristic of our military is that materials from the U.S. are translated and utilized extremely quickly. Whether we understand the concept or not doesn't matter. For instance, if a multi-domain operations seminar is held in the US, within a few months, the Korean Education Command will likely hold a seminar on it.
> ...Korea excessively views the American model as an ideal... as if it were the truth. One fundamental reason for this is that the US fundamentally conducts a lot of wars. We aim to gain that know-how, even indirectly.

DARPA model were transferable on the basis of fiscal commitment and informational access alone, the Korean defense establishment would appear exceptionally well positioned to approximate it. The persistence of divergence under these favorable conditions therefore sharpens the analytical puzzle. The question is not whether Korea lacked resources or knowledge, but why organizational reform was filtered through incumbent governance structures in ways that altered the core logic of the imported model.

3.2. Data Collection

The analysis draws on 22 semi-structured interviews with 22 individuals selected from a larger corpus of 67 interviews conducted for a comparative study of ARPA-type programs across four Korean ministries: defense, industry, science and technology, and health. Restricting the present analysis to defense-sector informants permits detailed reconstruction of the organizations and decisions surrounding K-DARPA while retaining the broader project as contextual knowledge. Interviews were conducted between February 2024 and February 2025 and focused on program formation, organizational design, recruitment, project planning, evaluation, and oversight. Table 1 summarizes the relevant interview coverage.

Data collection proceeded in stages and combined administrative documents, academic and policy literature, and elite interviews. Documentary research first identified the program's formal governance arrangements, statutory authorities, evaluation rules, budget trajectory, and the organizations involved in planning and implementation. This evidence also situated K-DARPA within longer debates over Korean defense acquisition and technological catch-up. Interviews were then used to reconstruct informal authority relations and organizational processes absent from

public documents, including how actors interpreted the DARPA model, why the implementing unit was reorganized, and how recruitment and selection rules operated in practice. They also clarified the identities and roles of some evaluative and performer organizations concealed by defense-sector confidentiality.

Access began through an intermediary at the Korea National Defense University and proceeded through snowball sampling from senior officials to mid-level administrators, program managers, industry participants, and policy advisers. Sampling followed positions implicated in the program rather than an effort to represent the defense establishment statistically. The sequence was necessary because formal organizational charts revealed little about how authority was negotiated, how established procedures were applied to the new initiative, or which actors could corroborate a disputed account. Later interviews therefore tested mechanisms and organizational episodes identified in earlier conversations.

Table 1. List of interviewees in the defense sector

Institutional affiliation	Interviewee list
Policy researchers and advisors (RAND, Korea National Defense University, etc)	AA, BF, BG, BK
Korea Defense Acquisition Program Administration (DAPA)	AC, AF, AM, AN, CF
Korea Agency for Defense Development (ADD)	AO, AR, AQ, AP, AV, CH, CA
Program managers for Future Challenge National Defense Technology Development Programme (K-DARPA)	AQ, AS, AV, BS
Program managers for U.S. DARPA and ARPA-E	BR, BY
Defense industry professionals/managers in Korea	CF, CG, CH

* Some interviewees have experience in more than one institutional context.
** A total of 22 interviews were conducted with 22 individuals. In some cases, two people participated in a single interview; some interviews were conducted on the same day but at different times.

Interviewees came from DAPA, ADD, K-DARPA program management, U.S. DARPA and ARPA-E, Korean defense firms, and policy research organizations including the Korea National Defense University and RAND. This distribution supplied perspectives from policy design, implementation, project management, external performance, and comparative practice. Several informants had occupied more than one institutional position, enabling comparison of accounts across organizational boundaries and over different stages of the program's development.

DAPA, ADD, and K-DARPA informants provided evidence on the interpretation and implementation of the imported model. U.S. program managers were used to cross-check descriptions of DARPA's internal practices rather than to treat public accounts of the agency as a frictionless benchmark. Industry participants clarified established state-firm relations, while policy researchers situated the program within longer trajectories of Korean defense acquisition. Analysis proceeded through chronological reconstruction and comparison across organizational positions. Claims about contested decisions were retained when supported by convergent accounts, by an informant directly involved in the episode, or by documentary evidence; contrary interpretations were used to distinguish formal rationales from the organizational effects observed here.

Defense research imposed substantial access and confidentiality constraints. Electronic devices were prohibited in DAPA and ADD facilities, and more than three-quarters of interviewees declined recording; these conversations were documented through detailed notes prepared immediately afterward. All interviewees are anonymized, and sensitive performance targets, project details, and internal unit names

have been omitted at informants' request. The evidence is consequently better suited to identifying organizational mechanisms than to estimating their frequency or technological effects. Triangulation across positions, documents, and the U.S. comparison reduced reliance on any single retrospective account, but secrecy necessarily limits independent verification of some program-level details.

4. Korean Defense R&D in Institutional and Historical Context

The organizational actors responsible for introducing and implementing the K-DARPA initiatives are embedded within a historically constructed defense innovation system shaped by state-led industrialization, security imperatives, and centralized state governance. Understanding the limits of institutional emulation therefore requires situating contemporary reform efforts within the deeper political economy of Korea's defense sector.

The Agency for Defense Development (ADD)—the primary R&D agency whose internal organizational subunit is dedicated to managing and conducting K-DARPA programmes—was established in 1970 amid escalating security tensions on the Korean Peninsula. A series of North Korean provocations, including the capture of *USS Pueblo*, assassination attempts against President Park Chung-hee (1963-1979), and repeated cross-border incursions, coincided with the announcement of the Nixon Doctrine in 1969—post-Vietnam foreign policy doctrine that laid out principle for self-defense of its allies and thus could lead to withdrawal of American military stations in South Korea. Together, these shocks constituted a critical juncture that prompted the Park administration and its economic secretariat, O Won-chul, to pursue an industrial strategy deliberately linking defense industrialization with the nascent heavy and chemical industries, explicitly conceived as dual-use (Rhyu, 2010; O, 1994; Kwon, 2024).

4.1. Centralization of Defense Research and Developmental Logic of Defense Innovation

Two institutional transformations that followed proved especially consequential. First, the creation of ADD consolidated end-to-end authority over weapons development within a single public research institute. Established under presidential directive through the Agency for Defense Development Act, ADD was tasked with leading weapons R&D, supporting contractors, verifying quality, and managing final assembly (Kwon, 2020; Kwon, 2024: 172). Functions typically distributed across multiple agencies—both in vertical and horizontal sense—in other countries were thus concentrated within a single organization, granting ADD central control over the entire weapons development cycle.

This institutional arrangement positioned ADD as the dominant actor vis-à-vis private firms. Given the initially weak industrial base, defense contractors were largely confined to licensed production. ADD retained authority over systems design while simultaneously performing supervisory and developmental roles, setting quality standards and diffusing technical knowledge acquired through foreign assistance and reverse engineering. The resulting division of labor entrenched a hierarchical structure in which the state internalized core technological developmental capabilities while the private sector remained production-oriented. Moreover, in order to accelerate technological catch-up, ADD scientists and engineers prioritized systems integration over basic research, relying on the absorption and recombination of existing technologies through reverse engineering, application of foreign technical data packages, and joint research with U.S. firms.[6]

Second, the Special Law on the Promotion of the Defense Industry (1973) triggered a rapid expansion of defense acquisition and industrialization. The government undertook an aggressive expansion of defense acquisition to accelerate military modernization. The

[6] A frequently cited illustration is ADD's development of a guided surface-to-surface missile ("Polar Bear") within seven years—achieved through personnel exchanges with the U.S., partial design transfers from U.S. contractors, and document-theft, despite the absence of an independent basic research base (Kwon, 2024: 202-206).

acquisition budget increased nearly fourfold within a single year (Lee and Nam, 2020: 185), reflecting the urgency of capability building. To facilitate rapid deployment and industrial scaling, the state designated specific weapons systems and components and granted selected firms exclusive production rights, complemented by financial subsidies and preferential credit. These measures were considered necessary to overcome capital constraints, prevent duplicative investment, realize economies of scale, and ensure stringent quality control for items difficult to procure through market mechanisms (Moon, 1991; Choi et al., 2010).

Although these arrangements proved effective for accelerating the pace of defense sector's catch-up industrialization and early weapons deployment, they simultaneously produced a concentrated, state-led production regime that privileged efficiency, control, and reliability over experimentation. The early institutional logic that closely aligned with the imperatives of rapid deployment would exert a durable influence over subsequent reform trajectories.

4.2. Retrenchment and Institutional Persistence

The political momentum that had driven the founding of ADD and the expansion of Korea's defense industrial base slowed markedly in the early 1980s. The Chun Doo-hwan administration (1980–1988), having seized power through a military coup, sought to consolidate its fragile legitimacy by reinforcing security ties with the United States. This strategic recalibration entailed abandoning prior ambitions in nuclear weapons and long-range missile development and shifting administrative authority over defense R&D and acquisition from the presidential office to the Ministry of National Defense. Organizational retrenchment followed: more than one-third of ADD personnel were dismissed, and defense R&D expenditures declined sharply (Kang et al., 2020: 82–85; Chae et al., 2024: 133–136).

Although subsequent administrations introduced modernization initiatives and attempted to incorporate elements of more advanced R&D systems, the institutional architecture forged during the 1970s and consolidated through retrenchment in the 1980s proved durable. Organizational authority, industrial structure, and research capabilities remained tightly concentrated within a centralized state-led framework. Later reforms layered new programs and participation mechanisms onto this structure but rarely displaced its core governance logic. As a result, institutional change proceeded through incremental adaptation rather than structural transformation. The sequence of early expansion followed by political retrenchment thus produced a path-dependent defense innovation system whose underlying orientation toward centralized control and acquisition discipline persisted over time. From this trajectory emerged three enduring legacies.

4.2.1. Legacy 1: ADD as a Central Actor in Defense Research Performance and Governance First, ADD continues to function as the central node of Korea's defense innovation system. Although policymakers since the early 2000s have attempted to reorient the agency toward "covert and strategic" technologies while expanding participation by civilian high-tech firms (interview with AF, 2/13/2024; Moon and Lee, 2008; Steindl, 2022), the redistribution of technological role and authority has been incremental. As of 2020, ADD still executed 61.5 percent of national defense RDT&E—down from over 80% in the early 2000s yet still markedly divergent from the United States, where private firms alone accounted for 58.2% of defense R&D performance as of 2023 (Ha and Lee, 2020: 3; Mowery, 2012).

The agency's influence extends beyond budgetary dominance into program-level governance. The agency led 43.4% of core technology projects in 2024 (Song D-H, 2025) and

59.3% of weapons systems development projects in 2018 (Yu, 2018)[7], indicating that it not only retains lion's share of defense RDT&E but also over the governance of collaborative research[8]. Taken together, these patterns suggest that, despite formal efforts at decentralization, Korea's defense innovation system remains structurally anchored around ADD. In effect, organizational layering has occurred without meaningful displacement—a pattern consistent with incremental institutional adaptation rather than structural transformation.

4.2.2. Legacy 2: Development- and Deployment-Centered Orientation Second, Korea's defense acquisition strategy has been shaped by the imperative to meet the military's urgent need for rapid deployment in response to North Korea's conventional advantage. Because the armed services prioritized the early deployment of weapons platforms, R&D efforts concentrated on technologies that enabled the swift acquisition and integration of complete systems. By contrast, research on critical components and subsystems—often requiring longer development cycles—was frequently pursued through foreign sourcing, including licensed production and parts imports (Moon and Baek, 1985).

The procurement-centered logic is institutionalized in the planning, budgeting, and evaluation frameworks governing defense R&D. With the exception of the focal case of this

[7] Weapons systems development and core technology programs together accounted for 61.6 percent of Korea's defense RDT&E budget in 2019. Core technology initiatives are intended to secure foundational capabilities prior to weapons development, particularly in domains subject to foreign technology restrictions and therefore prioritized for indigenization. Many of these areas—including artificial intelligence, quantum technologies, and autonomous systems—originate within civilian innovation ecosystems but are increasingly incorporated into defense planning (Song D-H, 2025). Systems development constitutes the final stage of the weapons R&D cycle, encompassing detailed design, prototyping, and both developmental and operational testing for production-bound platforms.

[8] Project-level governance formally distinguishes between ADD-led and civilian-led initiatives. In systems development projects categorized as ADD-led, the agency directs core technological development while contractors primarily undertake prototype fabrication. In civilian-led projects, by contrast, firms assume responsibility for systems design, specification drafting, and logistics support under the oversight of the Defense Acquisition Program Administration's Integrated Project Teams (IPTs) (Yu, 2019). In practice, however, technical authority within IPTs often remains concentrated among ADD personnel due to capability asymmetries vis-à-vis DAPA staff (interview with AD, 2/7/2024), thereby reinforcing centralized control despite the appearance of organizational delegation.

paper's interest—Future Challenge National Defense Technology Development Programme (K-DARPA)—weapons and defense technology programs cannot proceed unless the military formally articulates an operational requirement. Korea's defense R&D budget is structurally embedded within the broader defense acquisition account, limiting the state's ability to secure stable, long-term funding for foundational scientific and technological research (Ha and Lee, 2017). Moreover, unlike the United States, Korea lacks an equivalent to a defense-wide technological authority—such as the Under Secretary of Defense for Research and Engineering (USD R&E)—that can function as a system-level "CTO" and provide political support for exploratory R&D across ADD, DAPA, and the Ministry of National Defense.

Evaluation practices further reinforce this orientation. Early deployment functions as the primary performance indicator within the Defense Acquisition Program Administration (interview with BK, 6/12/2024). Subordination to politically visible procurement outcomes constrains independent, forward-looking research planning. As a result, Korea's investment in basic research, applied research, advanced development, and core component technologies accounts for only 16.7 percent of total RDT&E spending—substantially lower than the roughly 40 percent observed in the United States (Ha and Lee, 2017). This imbalance contributes to persistent capability gaps in key components, subsystem technologies, and next-generation weapons architectures, including those associated with emerging network-centric warfare concepts such as C4ISR (Kim J-H, 2010).

The industrial composition of defense RDT&E reflects this same orientation. Manufacturing sectors—particularly general machinery and transportation equipment—account for approximately 83 percent of activity, while service-based domains such as software development constitute only about 10.2 percent (Baek and Kwon, 2016). Taken together, these patterns indicate a defense innovation system structurally geared toward production and system integration rather than upstream technological exploration.

Although the Joint Chiefs of Staff and individual services increasingly recognize the importance of a technology-push approach—where emerging technologies proactively shape future capability requirements—such a transition is widely viewed as a long-term endeavor and thus often neglected. In practice, the services remain primarily focused on accelerating deployment timelines, thereby reinforcing an R&D strategy centered on the rapid acquisition of complete weapons systems rather than the cultivation of frontier technological capabilities (interview with BK, 6/12/2024).

4.2.3. Legacy 3: Segmented Industrial Boundaries and Weak Civilian Entry To secure early and stable procurement channels and enforce stringent quality control, the Korean government introduced policies during the 1970s and 1980s that deliberately restricted market competition in the defense sector. While effective in stabilizing supply, the long-term persistence of these arrangements hardened organizational boundaries—both between defense and civilian industries and between private firms and the state. The consequences were substantial. Barriers to entry discouraged technologically advanced non-defense firms from entering the sector, dampened incentives for incumbent contractors to invest in research, and marginalized universities and other basic research actors (Moon and Paek, 2010; Steindl, 2022). At the elite level, these policies reinforced separation between governmental and private-sector networks, further limiting cross-sector knowledge flows.

Institutionally, the government granted designated firms exclusive mass-production rights under the Defense Industry Designation System (1973). Subsequent reforms in the 1980s categorized military supplies by technological characteristics and assigned development responsibilities to specialized prime contractors and component suppliers. These firms received preferential status in contractor selection for defense R&D and technology-import projects (Choi S-B et al, 2010; Moon and Paik, 2010: 198-200). Although these designation

systems were formally abolished in 2009, their effects have proven durable. For example, an analysis of defense contractors in 2016 shows that their R&D intensity—measured as R&D expenditure relative to sales—stood at 2.81 percent, notably lower than the national manufacturing average of 3.63 percent (Ha and Lee, 2017: 175). Moreover, defense firms accounted for only 7.3 percent of total government RDT&E spending that year (Jang et al., 2019: 20). Entry by technologically advanced non-defense firms has likewise remained limited. Within the core technology development program discussed above, approximately 94 percent of the budget allocated to projects led by defense contractors was awarded to incumbent firms. Although the share of projects led by universities and public research institutes has increased, these patterns suggest that incentives for civilian firms possessing advanced technologies to enter the defense sector remain weak (Je H-J, 2023: 300).

This segmentation extended beyond industrial structure into governance. Civilian scientists and managers have been largely absent from the upper echelons of Korea's defense bureaucracy. Within ADD, nearly all directors between 1980 and 2005 were drawn from the Ministry of National Defense (MND) or the military services: from 2005 to 2024, most were internally promoted ADD scientists, with the few external appointees coming from other government-funded research institutes rather than civilian universities or private industry. A similar pattern holds for DAPA, whose leadership has overwhelmingly been composed of career defense officials or bureaucrats from other ministries. All Ministers of National Defense since 1962 have been former military officers. In contrast, the U.S. defense establishment has regularly incorporated civilians with scientific or industrial backgrounds into senior positions: a substantial share (23.8% since 1962) of Secretaries of Defense have come from private-sector or academic careers, and both the Under Secretary for Research and Engineering and DARPA directors have consistently possessed civilian scientific experience.

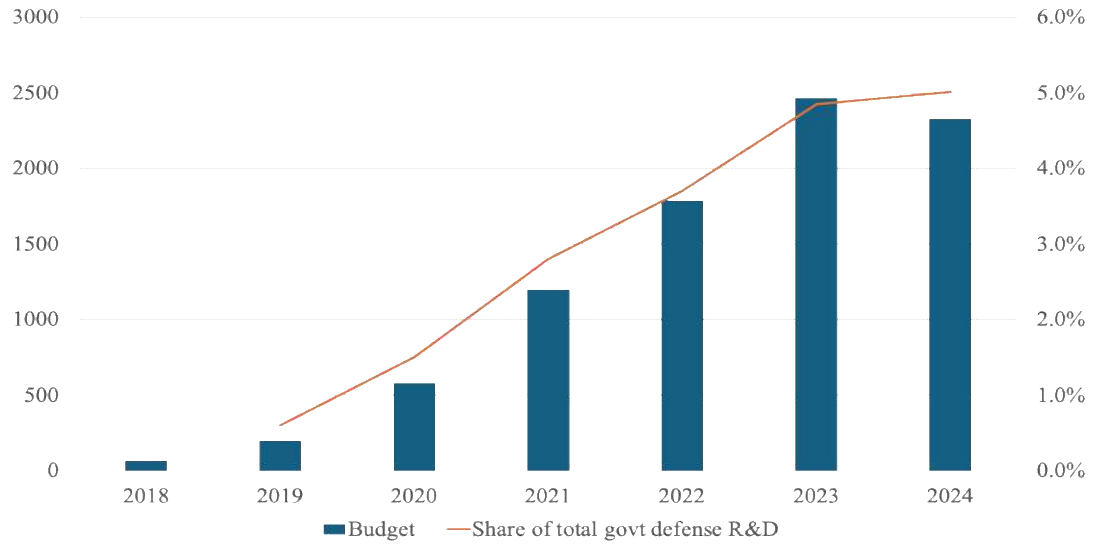
Taken together, these patterns indicate not merely low civilian participation but a structurally segmented defense innovation system. Organizational boundaries between the state and civilian science remained thick, leadership pathways remained internalized, and elite networks reproduced within defense institutions. In such a context, efforts to import an organizational model predicated on permeability to civilian expertise encountered not an open field but an entrenched governance structure resistant to lateral entry.

As the empirical findings below will show, these three legacies—organizational centralization, acquisition-centered evaluation, and segmented industrial boundaries—did not preclude reform. But they structured the conditions under which reform would occur. The attempt to introduce an exploratory, PM-driven, and civilian-permeable innovation model confronted a system historically optimized for hierarchical coordination, risk minimization, and deployment discipline.

5. The Founding of the Future Challenge Defense Technology R&D Programme (K-DARPA Programme)

Modeled after the DARPA model, the Future Challenge Defense Technology R&D Programme (henceforth, "K-DARPA programme" or "Future Challenge programme") entered Korea's defense policy agenda in 2018, first as a pilot initiative (KRW 6.4 billion). Following the pilot, it was formally formulated and initiated as a full programme in 2019 (KRW 20 billion), and its budget then expanded rapidly—reaching roughly KRW 240 billion (roughly 5 percent of defense RDT&E) by 2023.

Figure 4. Changes in K-DARPA programme budget by year



The programme emerged as a policy response to three widely diagnosed problems in Korea's defense sector: demand/requirement-driven acquisition, an overwhelming emphasis on weapons system development, and an organizationally closed innovation system. These concerns circulated among senior officials in the Defense Acquisition Program Administration (DAPA) and among external policy experts, even as the Ministry of National Defense (MND) and the Joint Chiefs of Staff (JCS) were comparatively inattentive (interview with AF, 2/13/2024). Institutional developments within DAPA provide indirect evidence of this problem recognition: between 2010 and 2022, successive DAPA administrators were increasingly recruited from outside the services—via other ministries (especially the Ministry of Economy and Finance), from ADD, or through internal promotion—rather than through service pipelines (interviews with AF, 2/13/2024; AM, 3/13/2024). The shift did not automatically produce a technology-push strategy, but it created a governance space in which dissatisfaction with requirement-centric R&D could be articulated at senior levels.

The Moon Jae-in administration (2017-2022), in line with the political and policy momentum for incremental change, elevated defense innovation as one of the hundred presidential priorities. Multiple ministries issued reform proposals consistent with the "Fourth Industrial Revolution" framing. *Defense Reform 2.0* (2018), issued by the MND, emphasized

emerging technologies such as AI, AR/VR, UAVs, and drones; and the jointly issued Future Defense Development Strategy (2017) (MND-DAPA-and the Ministry of Science and Technology) explicitly called for technology-push defense R&D and open innovation mechanisms designed to encourage entry by civilian scientific actors. The Presidential Advisory Council on Science and Technology also endorsed the need for more challenge-oriented defense R&D programmes in 2018. In response, DAPA—after consultation with the Ministry of Economy and Finance regarding budgeting—launched the pilot in 2018 and secured a separate budget line beginning in 2019 (Jang and Ma, 2021).

A critical legal foundation for the K-DARPA programme was established with the enactment of the Defense Science and Technology Innovation Promotion Act in 2020 (hereafter, the Promotion Act). The legislation was designed to address limitations in the existing Defense Acquisition Program Act, which, although applicable to defense R&D, remained primarily oriented toward system development and weapons procurement rather than exploratory research. The Promotion Act introduced several provisions directly relevant to the Future Challenge program. First, it formally defined "future challenge defense technologies" as innovative and high-risk scientific and technological efforts intended for application to weapons systems whose operational requirements have not yet been determined. This definition provided a legal basis for conducting requirement-free R&D for the first time in Korean defense establishment. Second, the Act established the administrative category of "honorable failure" to encourage risk-taking in research. Under this provision, projects that fail to achieve their original objectives are exempt from administrative penalties if researchers can demonstrate that the work was conducted diligently—for example, through documentation such as research notebooks. The measure was explicitly intended to counteract the prevailing bias toward low-risk, low-impact projects. Third, the Act's enforcement decree authorized the delegation of program management responsibilities to the president of ADD, thereby

embedding the Future Challenge initiative within the existing organizational structure of Korea's defense R&D system (more explanation on this point will be provided in the next section).

The program's rapid budgetary expansion was driven largely by active policy entrepreneurship within DAPA, combined with relative neglect from the Ministry of National Defense and the Joint Chiefs of Staff, which retain ultimate authority over defense budgeting (interview with AF, 2/13/2024). According to one senior DAPA official, the Ministry of National Defense had historically adopted a cautious stance toward technology-push acquisition, favoring demand-driven approaches through the mid-2010s. By the time the Future Challenge initiative was proposed, however, the growing strategic salience of emerging technologies muted institutional resistance. Defense officials increasingly recognized the limits of relying exclusively on top-down planning by acquisition personnel to anticipate technological trajectories. Thus, the program's budgetary growth did not stem from proactive ministerial sponsorship. Rather, it expanded in a context of sustained bureaucratic inattention. As overall defense acquisition spending increased, DAPA officials leveraged the comparatively shorter lifecycle of Future Challenge projects—relative to requirement-based R&D—to insert additional funding into the broader budget structure (interview with AN, 3/21/2024). Budget expansion thus reflected opportunistic institutional maneuvering as much as deliberate strategic prioritization from the policy entrepreneurs in DAPA.

K-DARPA thus began as an explicit attempt to carve out an exploratory space within a requirement-driven acquisition system, but it did so through an institutional pathway that already foreshadowed later constraints: rather than creating a new organizational locus of authority, the programme was legally and administratively embedded inside incumbent governance structures.

5.1. Organizational embedding and "internalization" of the dedicated unit

The dedicated implementing unit for the Future Challenge National Defense Technology Development Program—the Defense Advanced Science and Technology Institute (DASTI)—is not an independent agency but one of six-line divisions inside the Agency for Defense Development (ADD). DASTI was newly created when the programme moved from a pilot to a fully budgeted initiative. Its organizational origins, however, are inseparable from ADD's longer-running internal reorganization around "open innovation" and high-technology frontier planning.

In 2014, ADD created a small-scale *affiliate*[9] institute, the Defense Advanced Technology Institute (2 centers, 1 office), partly as an organizational response to the Park Geun-hye (2013-2017) administration's broader "creative economy" policy agenda that promoted growth model based on high-tech startups and open innovation (Pacheco Pardo and Klingler-Vidra, 2019; 2020). Within this small research institute, the Convergence Research Center experimented—apparently for the first time in ADD's history—with recruiting civil program managers (PMs) on fixed-term appointments to source ideas from civilian R&D communities and connect them to defense problems. Yet the initiative lacked a dedicated

[9] In South Korea's government-funded research system, *buseol yeonguso* (*affiliate* research institutes or laboratories) are semi-autonomous research units established within a parent government-funded institute under its articles of incorporation rather than through a separate statutory act. Unlike fully independent government-funded research institutes, affiliate institutes do not possess a distinct legal foundation. Nevertheless, they are typically granted substantial managerial autonomy in practice. They often maintain separate budgeting and accounting procedures, prepare independent annual plans, exercise discretion over staffing and internal organization, and manage research projects with relative operational independence, even though ultimate oversight and auditing remain with the parent institute (Cho Y-R et al, 2018).
Affiliate institutes historically functioned as flexible organizational devices through which parent institutes and policy elites respond to emerging research domains and shifting policy priorities. They are frequently created to incubate new or strategically important fields that fall within the parent institute's broad mandate but are not yet institutionally consolidated. As these research areas mature and gain political salience, affiliate institutes may expand significantly—sometimes surpassing the parent institute in size or budget—and can serve as stepping stones toward eventual organizational upgrading or spin-off as independent government-funded research institutes. In this sense, the affiliate institute represents an intermediate institutional form that combines exploratory flexibility with administrative containment.

budget line and therefore operated by reallocating a small portion of ADD's existing budget ("core enabling technology" program), which constrained projects to relatively small grants (roughly KRW 200-300 million per projects) awarded to universities or defense firms (Park H-B, 2014; Song C-W et al, 2018: 51; interview w/ AD, 2/7/2024). Once the K-DARPA programme secured a stand-alone budget in 2019—and then expanded rapidly over a short period (from roughly KRW 20 billion in 2019 to KRW 246.5 billion by 2022)—this open-innovation unit was restructured.

In principle, the program's rapid growth was enabled by a small group of policy elites inside the Defense Acquisition Program Administration (DAPA), whose strong preferences for "DARPA-type" innovation model pushed institutional change. In practice, however, ADD leadership did not share this orientation. Many incumbent decision-makers inside ADD regarded the K-DARPA programme as incompatible with established organizational routines and were skeptical that it would last (interview with CA, 2/20/2025).

However, as the program's budget grew rapidly, this initial skepticism evolved into a process of organizational cooptation. In 2021, following the inauguration of a new ADD director, DASTI converted from an affiliated institute into a line organization (one of six internal line divisions) within ADD's core structure. An interview with the former director of DASTI (who also served as the head of ADD's policy planning during the time of this organizational absorption) captures both the initial resistance and the subsequent drift away from the programme's founding intent. In his account, the programme was initially treated inside ADD headquarters as imposed by DAPA and expected to be terminated soon; when the programme scaled, however, no stable consensus formed about how to operate the programme. It became increasingly shaped by the internal managerial preferences rather than by its initial reform rationale:

> At headquarters of the Agency for Defense Development (ADD), the Future Challenge program initially received little attention and was viewed quite negatively. It was seen as too different from existing systems—people simply did not want to change what had been done by convention. The program itself was regarded as something imposed by the Defense Acquisition Program Administration (DAPA), and there was a fixed belief that it would not succeed anyway—"they'll try it for a bit and then stop."
> At the time [when K-DARPA programme just initiated], DAPA had an intention to separate the DASTI from ADD, but headquarters did not view the issue in systemic terms…No shared consensus was formed. Even though the budget expanded rapidly, …the head of ADD did not share that long-term vision. The program came to be treated as discretionary funds—planned, managed, and executed according to the director's personal research interests. Looking back, I regret that we did not create an entirely new organization from the outset. What was needed were newly recruited people with a different vision and new capabilities. But because legal backing was required, there was strong internal resistance to establishing a new organization. Those who advocated for such changes were often isolated [socially within ADD].

An account from an external policy researcher from Science and Technology Policy Institute who has served multiple advisory roles for defense R&D similarly suggests that ADD leadership leveraged information asymmetries and the relative neglect of outside principals to legitimize internalizing DASTI, framing the move as a response to staff turnover even when the turnover rate resembled ordinary public-sector churn:

> There is an organization called the Defense Advanced Science and Technology Institute. It used to exist as an affiliated research institute [of ADD], but last year Director Park reorganized it into [its] line unit. In September, at a workshop held at…[redacted], I presented on defense R&D [to the senior defense officials] and asked [to the director] quite directly: 'What has actually changed [since the open-innovation model was first introduced into ADD]? Why had DASTI moved from an affiliated institute into a line organization?' They replied that it was due to staff attrition. But when I looked into other government-funded research institutes, the turnover appeared fairly typical.
> Even figure like the Minister of National Defense does not really understand this issue. What would they know? Many are not even familiar with acquisition, and their interests lie more in force operations—operations and strategy. If they do not even understand acquisition, how could they understand R&D? Every time they visit ADD and receive briefings, they simply respond, 'You are doing very important work—keep it up.' So when outsiders like us report that 'ADD needs organizational innovation,' the initial reaction is, 'Oh, is that an issue?' But once they go visit ADD, their attitudes reset. I have been observing this for years.

> Director [at the time - redacted] and the leadership at ADD are, to the core, ADD insiders. They sometimes boast about the organization—for example, saying that when they met the Saudi crown prince, he supposedly offered to pay any amount to acquire an organization like ADD. But that is only because he does not fully understand it. Under Korean conditions, this model can no longer work indefinitely. ADD should continue doing what it does well, but for functions it cannot perform effectively, new organizations are necessary." *(interview with AD/2/7/2024)*

While these accounts differ in emphasis, both point to a common mechanism: as K-DARPA's budget expanded, authority over the implementing unit shifted from reformist institutional entrepreneurship toward incumbent organizational control. Internalization did not merely locate the programme inside ADD; it reinserted the programme into ADD's personnel regime, managerial hierarchy, and administrative routines—the very channels through which later "DARPA-like" elements would be filtered.

5.2. From "ideal" to "degenerated" K-DARPA: the narrowing of PM autonomy and bottom-up programming

This organizational internalization mattered because it constrained the very administrative flexibilities that the DARPA model depends upon—especially exceptional personnel authority and PM-centered planning. As one senior DAPA official put it, the programme contained "an ideal version" designed in 2019 and a "degenerated version" after 2021 (AN, 3/21/2024). Early on, some reformers imagined recruiting highly qualified civilian PMs first and granting them autonomy over program conception, management, and evaluation—prioritizing individuals capable of system-level thinking and those without prior experience in defense R&D. Yet the program's operational reality moved in the opposite direction. The internalization of the DASTI within ADD structurally reduced flexibility in personnel arrangements and the scope of program manager authority. Existing organizational bylaws—anchored in statutory institutional rules—constrained the creation of exceptional employment conditions. Attempts by reform-oriented actors to introduce such provisions were

either blocked by internal and external opposition or preemptively abandoned by organizational designers who anticipated resistance.

The first core institutional bottleneck was the rigidity of the personnel regime, which significantly constrained the recruitment of external civilian program managers. Some reformists within ADD and DAPA understood that attracting top-tier talent would require exceptional compensation for short-term professional contracts, as such arrangements imposed substantial career risk in Korea's relatively inflexible labor market where re-entry into comparable position would be far from guaranteed (AP, 3/29/2024; AN, 3/21/2024). However, these proposals quickly encountered resistance from key stakeholders—both internal and external to ADD.

Internally, because DASTI was embedded within ADD's organizational structure, compensation practices were effectively bound to the existing seniority-based salary system unless formal regulatory changes were introduced. Under this system, offering truly exceptional pay would have required setting compensation at a level comparable to that of the ADD's director—an arrangement widely viewed as likely to undermine internal morale.

> At the time of recruiting for K-DARPA, the annual salary of the president of the Agency for Defense Development was a bit less than 200 million won. I thought that, to recruit top program managers, we would need to offer compensation at least at that level. But if a new PM were brought in at such an exceptional pay level, other members of the institute inevitably asks, "How extraordinary is this person, really?" and morale would suffer. This reaction is especially strong when the PM is hired as an internal employee. Moreover, once someone is hired as a staff member, they become bound by the existing seniority-based pay system, which makes it very difficult to offer unusually high compensation. As a result, PM pay deteriorated. Taken together, problems arose around contract duration, compensation, and organizational affiliation (interview with AD, 2/7/2024)

These negative reactions were not merely an internal organizational issue. Compensation for PMs at the DASTI—an internal unit within ADD—also risked being viewed unfavorably by the Ministry of Economy and Finance, the external fiscal planning and

oversight body responsible for evaluating equity through institutional status equivalence. According to a civil servant at the Defense Acquisition Program Administration who provides administrative support for the Future Challenge program:

> Program managers holding concurrent appointments at the Agency for Defense Development receive no official salary—only small incentives. External concurrent PMs receive about 1.9 million won per month. Why was personnel compensation set this way? The Ministry of Economy and Finance only considers how much researchers at comparable government-funded research institutes are paid—issues of 'equity,' nothing more… (interview with AN, 3/21/2024)

The rigidity of the personnel regime ultimately constrained the recruitment of civilian program managers (PMs), thereby undermining the program's original objective of actively incorporating civilian ideas into defense R&Ds. When the envisioned professional contract system failed to offer sufficiently exceptional compensation and employment conditions, the pool of qualified civilian applicants remained limited. Given this shortage alongside the rapid expansion of programme budget, allocating funds primarily to civilian PM-led programs—planned and managed by these actors—became increasingly difficult.

In response, administrators adopted three compensatory measures: i) permitting concurrent (part-time) appointments for civilian PMs, ii) appointing PMs from within ADD, and iii) establishing a parallel top-down program planning track led by ADD and alongside the PM-driven programs. Each measure solved a short-term administrative problem but cumulatively narrowed the institutional space for bottom-up programming and increased opportunity hoarding by incumbents.

Table 4. Structural Differences between DARPA and the K-DARPA 1

	U.S. DARPA	**Future Challenge National Defense Technology Development Programme (K-DARPA)**
Dedicated organization	Independent agency under DoD	Co-governed by internal division within ADD (one of six) and a

		IPT team within DAPA
Independence from services	Decoupled from the services' required operational capability in deciding plans for R&D funding	Decoupled from the services' required operational capability in deciding plans for R&D funding
Founding leadership	Civilian scientist-administrators	Senior administrators in DAPA and ADD
Program-level planning, development, and management	Discretion of individual program managers (approved by director)	Three tracks: 1. PM-initiated (bottom-up) 2. ADD-initiated (top-down) 3. DAPA-initiated (top-down)

First, recruitment channels were diversified to allow civilian scientists to retain their home institutional affiliations while serving part time as a PM for K-DARPA[10]. Although this arrangement reduced career risks for civilian applicants, it blurred role boundaries by requiring PMs to plan and manage programs while simultaneously maintaining their existing research portfolios. Compensation further reinforced this constraint: because pay was calculated according to project-level personnel cost regulations, deviations from standard salary rule were difficult.

Second, researchers in ADD were appointed to fill vacant PM positions. However, reliance on internal personnel effectively narrowed the candidate pool due to entrenched internal rank hierarchies. Given the program's scale—which required PMs to coordinate multi-organizational consortia, often including ADD teams—senior researchers with at least 10-15 years of tenure became the primary applicants (interview with AO, 3/25/2024). Yet even among this group, participation remained limited. Many were reluctant to assume responsibility for outcomes partly dependent on external consortium partners, reflecting a broader sensitivity to research failure (more about this below). Internal compensation rules compounded the problem: ADD PMs typically received incentives of only 10-20 percent, offering little motivation to undertake the additional risks associated with program leadership

[10] According to the rule, part-time PMs from the private sector must dedicated at least 20 percent of their total working hours and effort to the planning and management of programs under the K-DARPA programme.

(interview with AD, 2/7/2024; CA, 2/20/2025). Under these conditions, internal PMs were more likely to leverage the K-DARPA programme as a vehicle for sustaining or expanding their existing laboratory agendas rather than pursuing genuinely novel technological trajectories

Third, because these measures provided insufficient to absorb the growing budget, administrators introduced a top-down planning track led by ADD and DAPA. Whereas PM-led programs rely on PMs to formulate research goals and assemble their own consortia to pursue them, top-down programs begin with predefined technical objectives developed in consultation with the Ministry of Defense, military services, DAPA, and ADD, after which a single performer organization is selected. In institutional terms, this structure closely resembles conventional state-led R&D programming rather than a DARPA-style model of exploratory, PM-driven innovation.

The budgetary patterns underscore the cumulative effect of these adjustments. PM-led programs ended up accounting for only 38.0% of total budget, compared to 60.9% for top-down initiatives (see the table below). Moreover, only about half of the appointed PMs were drawn from civilian sectors such as universities and firms, with the remainder recruited internally from ADD. Because nearly all PMs—both civilian and internal—served on a part-time basis, program leadership became layered onto existing research commitments rather than constituting a dedicated entrepreneurial role focused on agenda-setting and portfolio construction.

Table 5. Structural Differences between DARPA and the K-DARPA 2

	U.S. DARPA	**Future Challenge National Defense Technology Development Programme (K-DARPA)**
Budget share of PM-initiated programs	100%	38.0% (Top-down programs: 60.9%; Challenge/Prize: 1.1%)

PM's prior institutional affiliations[11]	Private firm	40.6%	ADD (internal)	50%
	University	15.6%	University/private sector	50%
	FFRDCs	18.7%		
	Service	10.4%		
	Others	14.7%		
PM's term	2-5 years		5 years	
PM's salary	Top executive level cap		Full time: pay scale at ADD apply Part time: project-based labor cost	
Recruitment process	-Mostly referral- and/or network-based -Streamlined and flexible procedures		-Standardized/formal procedure	
Employment status	Full-time (supported by contractual, technical, and administrative staffs)		Part-time (PMs from ADD cannot get administrative supports)	

As discussed above, DARPA's flexible organizational structure and processes—together with its commitment to open innovation—enables the exploration into technological opportunity spaces under deep uncertainty, even at the risk of failure. The K-DARPA programme likewise represented the first institutional attempt within Korea's defense acquisition system to plan and manage R&D "from below," including technologies not grounded in predefined military requirements. The program was designed to explore latent technological possibilities embedded in basic research—even when such possibilities fell outside existing weapons classifications—or to develop emerging technologies that had yet to be fully systematized.

However, organizational inertia rooted in preexisting structures and procedures—both formal and informal—obstructed the conditions necessary for such proactive exploration.

[11] Percentage for K-DARPA is based not on the official documents due to confidentiality; it is based on the estimates of interview with AN(3/21/2024).

These impediments can be grouped into three categories: 1) the employment of part-time program managers (PMs), 2) organizational pressure to prioritize performance targets oriented toward operational deployment, and 3) the absence of institutional supports capable of facilitating PM-led planning.

First, part-time (concurrently appointed) PMs were structurally inclined to exploit knowledge closely related to their own existing research agendas rather than to pursue genuinely novel technological trajectories. Because the DASTI recognized the difficulty of recruiting full-time PMs (as discussed earlier), it neither prohibited nor discouraged PMs from serving simultaneously as principal investigators (PIs) on the projects they designed; in some cases, this arrangement was actively encouraged. As a result, program planning and management overlapped with project performance, leaving PMs with little discretionary capacity to engage in exploratory search for program planning (interview with AP, 3/29/2024).

Second, exploratory search was constrained by organizational pressure from both the Agency for Defense Development (ADD) and the Defense Acquisition Program Administration (DAPA) to meet performance targets tied to operational deployment. In the case of DARPA, technical objectives are typically defined in terms of building prototypes to verify novel concepts rather than producing technologies ready for immediate deployment. Because short-term goal attainment is not the central evaluative criterion, DARPA institutionalizes exploratory planning as a legitimate activity. By contrast, even though the K-DARPA programme formally targeted non-requirement technologies, entrenched organizational practices within ADD and DAPA—long accustomed to early operationalization—began to permeate the program, narrowing the scope for exploration under uncertainty.

This process of institutional infiltration was facilitated by the continuity of existing evaluation frameworks, both internal and external. Selection committees for PM recruitment,

end-of-program evaluations, and sensitivity to informal assessments from external stakeholders collectively reinforced short-term orientations.

Because the programme was neither run by independent civilian-led agency nor permitted to deviate substantially from conventional recruitment procedures, selection and evaluation committees were largely staffed by personnel drawn from the traditional defense acquisition domain. Consequently, evaluative attention gravitated toward near-term considerations such as performance targets, immediate usability, and program duration (interview with AP, 3/29/2024). This short-termism reflected the core mission of the organizations (ADD and DAPA) involved, whose key performance indicators (KPI) emphasized accelerating operational deployment. Even within the K-DARPA programme, the single largest component of the final evaluation score (with failure assigned below 80 points) of each program concerned whether the prototype satisfied predefined requirements.

Informal accountability pressures intensified this tendency. Mid-level administrators responsible for providing administrative support within ADD and DAPA observed:

> You have asked what kind of program outcome is considered most important. I will tell you cases where new military requirements get generated seem to carry particular weight—for example, the emergence of micro-satellite systems, manned-unmanned teaming architectures, or quantum radar. Quantum radar, in particular, received extensive media coverage in Korea as a cutting-edge technology, and we even conducted what was described as the world's first outdoor demonstration. Why are such cases important? Because the K-DARPA programme is ultimately defined in its operating guidelines as *aimed* at "enabling applications to weapons systems prior to formal requirement generation." (interview with AO, 3/25/2024)

Another mid-level administrator similarly noted:

> Most programs appear concentrated around technology readiness levels (TRL) 5-6[12]. When deciding whether to allocate additional funding to

[12] Technology Readiness Levels (TRLs) are a commonly used metric across U.S. federal R&D agencies to assess the maturity—and thus the relative readiness for operational deployment or commercialization—of a given technology. Although DARPA does not formally assign TRL levels to its internal programs, program managers occasionally use the framework when communicating with external federal actors (National Research Council, 2005: 16–19). Prior research suggests that DARPA-

> something like quantum computing or instead follow more immediate military (latent) demand—such as unmanned combat aircraft—the latter tends to prevail. Why? Because journalists and members of the National Assembly pay close attention. Quantum computing takes longer to explain conceptually and produces fewer visible outputs, whereas demonstration effects make the program appear more successful (interview with AN, 3/21/2024)

An interview with a former director of the DASTI further suggested the presence of external pressure:

> The TRL level was raised by previous leadership. Originally, the programme was designed around TRL 2-5. But the problem in Korea is that once a programme is created, no one is willing to wait five or ten years. If there are no visible results, the programme tends to get eliminated. Around, 2022, [3 years] after the K-DARPA programme began, demands emerged to 'show results.' There was a fear that pursuing programs with overly far-reaching goals could trigger audits or even sanctions. So the portfolio shifted toward projects capable of producing short-term outcomes (interview with CA, 2/20/2025)

As greater emphasis was placed on requirement generation and higher TRL levels, selection processes increasingly demanded detailed technical specifications at the earliest stages of program design. Researchers from government-funded institutes and basic science communities—often less accustomed to articulating complex performance specifications—were therefore more likely to be screened out or to struggle during the planning process (interview with AO, 3/25/2024) [13]. The current director of the DASTI recalled presenting the K-DARPA programme at the Emerging Technologies for Defense Conference (ETI) before senior U.S. defense R&D officials, including the USD R&E, who commented that the Korean

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funded projects typically span the early to mid stages of the RDT&E pipeline—roughly corresponding to TRL 2–6—focusing on concept validation and prototype demonstration rather than deployment-ready systems.

[13] Most members of the PM selection committee were drawn from ADD and DAPA's existing personnel, and consequently relied on established evaluative practices. No new criteria were developed for assessing program managers. According to the interviewee, among the selection committee members was a mid-level administrator from DAPA, whose line of questioning reflected conventional technology planning standards rather than an exploratory orientation. Questions focused narrowly on immediate application ("Where will this be deployed and used right away?"), clearly specified performance targets ("What exactly is the performance specifications?"), and compressed timelines ("Within how many years can this be achieved?"), indicating a tight evaluative frame rooted in traditional acquisition logic

programme appeared “remarkably condensed and optimized” relative to its American counterpart (interview with AR, 4/5/2024).

An additional unintended consequence emerged: in some instances, because evaluation focused on whether overall system specifications were met, research teams often had to prioritize meeting all the peripheral components rather than the most technically challenging bottlenecks. Paradoxically, predefining performance targets sometimes diverted effort away from the core technological challenge:

> The U.S. is developing unmanned underwater vehicles that can be launched from a torpedo tube, conduct surveillance, and return to the submarine [and we have similar program under K-DARPA]. Launching is relatively easy—but recovery, docking, charging, and reuse are extremely difficult, especially for smaller platforms. The key bottleneck is recovery technology. My concern is this: what if the project is judged successful because it meets the other specifications, even though the recovery function—the most critical element—fails? (Interview with AP, 3/29/2024)

Third, PMs made limited use of networking during program planning. Although part-time appointments and utilization pressures contributed to this pattern, additional constraints were evident. There was no dedicated support for planning-stage activities—such as travel funding, workshops, conference organization, or schedule coordination—nor seed funding for simulations or sub-prototype testing that could help explore relevant technological parameters and their complex relationships. Moreover, internal norms within ADD treated networking with universities and firms during the planning phases as a potential form of preferential treatment, further discouraging such efforts.

> Networking among PMs is almost nonexistent. Why? Because there is a perception that networking constitutes favoritism. In my view, networking during the planning phase should be distinguished from networking during project selection. But within ADD, even organizing conferences or workshops during planning is seen as granting someone an ‘advantage.’ It is not entirely wrong—but it is excessive (interview with AP, 3/29/2024).

Finally, although K-DARPA formally sought to institutionalize tolerance for high-risk research—implicitly accepting high rates of failure—through the introduction of the "honorable failure" clause, its implementation diverged markedly from this intent. R&D in Korea has historically been characterized by pronounced risk aversion; in the defense sector, formal instances of project failure have been extremely rare, reportedly fewer than ten cases. Interviewees recalled earlier episodes in which researchers were required to reimburse project costs from their own salaries following test failures, such as UAV crashes or missile malfunctions (interview with AF, 2/13/2024). Such precedents have contributed to a deeply entrenched culture of failure avoidance.

Even reform-oriented policymakers recognized these constraints. A former senior DAPA administrator involved in designing K-DARPA noted that, while DARPA might tolerate failure rates of 80–90 percent, achieving even a 50 percent failure rate would be ambitious in the Korean context (interview with AF, 2/13/2024). In practice, however, neither program managers nor mid-level administrators were willing to invoke the "honorable failure" provision to pursue genuinely high-risk projects. Respondents consistently emphasized that external oversight actors would not tolerate visible failure. Notably, even after seven years of implementation, no K-DARPA project has formally invoked the clause.

Administrative and political accountability pressures further reinforced this dynamic. Both DAPA officials and program managers identified the Board of Audit and Inspection as a powerful constraint: because project failure remains rare, failed cases are highly salient and therefore more likely to trigger investigation (interview with AO, 3/25/2024). In addition, media exposure and scrutiny from the National Assembly were perceived as significant sources of risk. Under these conditions, K-DARPA could not credibly operate as an exceptional institutional enclave insulated from conventional governance standards. Even

where failure was formally permitted, it remained administratively and politically dangerous, rendering risk avoidance the rational organizational response.

6. Conclusion

This study began with a puzzle: why did a reform initiative explicitly modeled on DARPA diverge sharply from its prototype in the very sector—defense—where the original model was widely believed to function best? South Korea's K-DARPA was introduced to overcome requirement-driven acquisition, hierarchical control, and closed innovation practices. It promised program-manager-led planning, tolerance for failure, and permeability to civilian scientific expertise. Yet, as the empirical analysis has shown, these elements were progressively narrowed once the programme was embedded within Korea's incumbent defense institutions.

Three mechanisms, drawn directly from the empirical findings, explain this divergence.

First, organizational internalization reasserted incumbent control over personnel and planning authority. Because DASTI, a dedicated organization to implementing K-DARPA programme, embedded within ADD rather than constituted as an independent agency, exceptional recruitment and compensation practices could not be sustained. Civilian PMs were recruited under conventional pay scales, frequently retained part-time status, and in many cases overlapped with principal investigator roles. As a result, program managers did not function as autonomous portfolio architects, but as administrators operating within existing research hierarchies. The expansion of top-down planning tracks further diluted bottom-up programing.

Second, conventional evaluation rules and practices reintroduced deployment-oriented performance logics into a programme nominally designed for exploratory search. Selection

committees, recruitment processes, and end-of-program reviews remained staffed by actors socialized within traditional acquisition frameworks. Evaluative attention gravitated toward predefined performance specifications, mid-level TRL milestones, and near-term usability. Even the largest component of programme scoring centered on whether prototypes satisfied predefined requirements. Under these conditions, risk-taking became structurally misaligned with evaluative incentives. Projects were increasingly selected and managed in ways that privileged demonstrability over conceptual ambition.

Third, administrative and political accountability pressures suppressed tolerance for failure in practice. Although the Promotion Act introduced the principle of "honorable failure," interview evidence indicates that visible failure could trigger audits, reputational scrutiny, and legislative attention. Program leaders therefore faced asymmetric downside risk. The rational response was to lower performance uncertainty, shift portfolios toward shorter time horizons, and prioritize projects capable of producing politically legible outcomes. The result was not overt prohibition of exploration, but a governance environment in which risk avoidance became administratively rational.

The Korean case is analytically significant because it represents a favorable setting for successful emulation. Defense R&D investment in Korea is high, stable, and politically insulated from partisan change. Alliance-based learning networks have long exposed Korean officials to U.S. acquisition and R&D governance practices, including interaction with DARPA personnel. If fiscal commitment and informational access were sufficient conditions for successful transplantation, the Korean defense sector should have approximated the DARPA model closely. Its divergence therefore points to deeper structural constraints.

Returning to the U.S. case clarifies those constraints. DARPA did not emerge as an isolated organizational innovation. It consolidated historically accumulated capacities forged during World War II and the early Cold War: flexible hiring authorities that enabled lateral

entry of elite civilian scientists; extramural contracting norms that institutionalized openness; insulation from service-specific procurement pressures; and political backing from scientist-administrators who legitimized risk-taking under prolonged strategic rivalry. Crucially, DARPA's authority to pursue exploratory research rested on legal and administrative protections that separated exploration from acquisition discipline and evaluated success at the portfolio rather than project level.

Those protections were not reproduced in Korea. While K-DARPA adopted the language of challenge-driven, bottom-up innovation, it remained embedded in a system in which authority over budgets, personnel, and evaluation criteria was concentrated within incumbent agencies socialized in requirement-based planning. Under these conditions, discretionary authority could not be fully institutionalized, and tolerance for failure remained politically fragile. The model's formal elements traveled; the institutional safeguards that sustained them did not.

The broader implication is that emulating frontier-oriented innovation governance requires more than copying organizational blueprints. It requires altering who controls discretion, how performance is judged, and how risk is politically absorbed. Where these foundations remain intact, reform initiatives are likely to be filtered through existing authority structures rather than transform them. The Korea's defense experience thus suggests that DARPA's success was not simply a function of design, but of the historically specific administrative and political conditions that made exploration governable in the United States.

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