Painted in a Different Light: How Military Contractors Use Civilian Applications to Garner Support

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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STS Research Paper

Introduction

Many products designed originally for military use are now everyday items, such as duct tape, microwaves, and canned food (NATO, n.d.). Duct tape was invented during World War II as a replacement for wax-coated paper tape used to seal ammunition crates. Microwaves were invented as a result of a military experiment with radar shortly after World War II. Canned food dates much farther back to the early 19th century as the winning invention of a competition to provide the French army with an efficient means of preserving food (Ewbank, 2023). This history suggests that without well-funded military programs, innovations like these might not have materialized, and consequently, one could argue that sustaining military funding could lead to further useful inventions as a byproduct. A significant player in this dynamic is the U.S. military, which often champions this narrative. However, if the benefits of such military inventions to the general public begin to diminish, it raises the question: does the U.S. military still warrant funding at levels equal to or greater than in the past?

Like any large organization, the U.S. military relies heavily on public support to continue its operations. However, weapons systems' high costs (Beranek, Smullin, & Tsipis, 1990) and controversial uses (Misselhorn, 2022) can jeopardize this support. National defense spending has gone as high as hundreds of billions of dollars, such as with the Reagan Administration's five-year, $1.5 trillion plan (Adams, 1981) or the $820 billion spent in 2023 (Peter G. Peterson Foundation, 2024). This trend of escalating costs, first identified in 1981 by Adams, has persisted for 44 years. To garner further public approval, some military technologies are marketed as having humanitarian benefits. Nevertheless, research indicates that only a fraction of these taxpayer-funded technologies transition into useful civilian products (Arcella, 2005). In spite of this, to what extent has the U.S. promoted military R&D under claims of civilian development?

The sociotechnical systems framework will be employed to explore this question and examine the interplay between military innovation and civilian applications.

Methods

This paper primarily employs documentary research to address the research question regarding the extent to which the U.S. has promoted military R&D under claims of civilian development. The research consists of two main components: organization websites from key participants and articles from external sources assessing the current state of technologies. The websites include content from defense organizations, military contractors, companies pioneering technological developments, and groups opposing certain integrations of those developments. This information is a blend of factual data, interpretable text, and figures, which help illustrate claims made by these organizations. In contrast, articles from external sources provide analyses sourced from academic journals accessed through databases such as Web of Science and JSTOR, as well as non-journal publications.

The research is presented in a topic-based structure that facilitates a logical flow of information, utilizing subheaders to define areas of investigation. Findings will be interpreted through two distinct lenses based on the type of information gathered. Quantitative data will be integrated into the overall analysis to quantify trends and impacts, providing a statistical basis for evaluating claims. Additionally, qualitative data, including analyses of text and figures, will be contextualized to extract implied meanings and insights. By combining these methodologies, the research aims to provide a nuanced overview of the subject.

Background

Just as military R&D has contributed to civilian products, civilian R&D has contributed to military products. This reciprocal relationship is largely facilitated by the U.S. national

security “Iron Triangle,” a mutual exchange of products, funding, and legislation between the Pentagon, defense contractors, and congressional committees (Adams, 1981). Former President Eisenhower highlighted this in his farewell address, in which he warned that the U.S. “guard against the acquisition of unwarranted influence, whether sought or unsought, by the military-industrial complex” (Eisenhower, 1961). This caution was particularly relevant at the time since the military and defense industries had significantly expanded over the last decade from the Cold War (Figure 1).

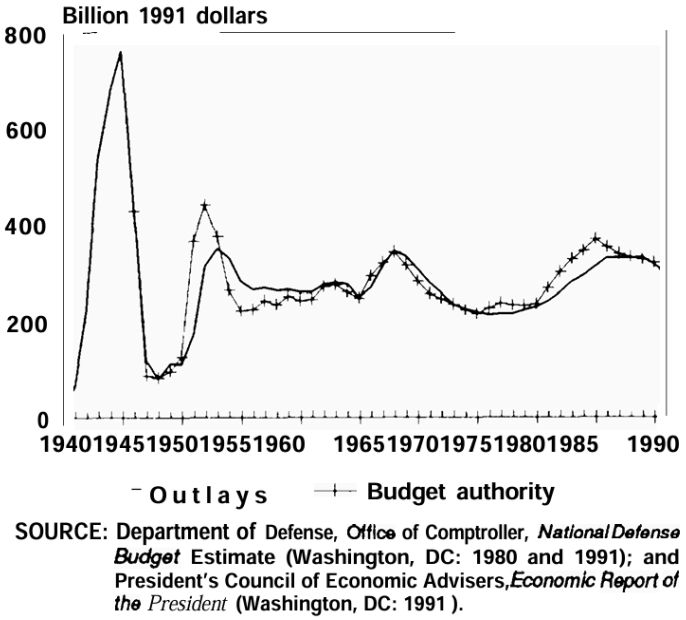

Figure 1. National defense spending from 1940 to 1991 (U.S. Congress Office of Technology Assessment, 1992).

As seen in Figure 1, national defense spending surged sharply after 1948, stabilizing at around $200-400 billion throughout the Cold War. A substantial portion of this funding was spent designing, testing, and stockpiling weapons. By the time of Eisenhower’s speech, the U.S., U.K., and Soviet Union had collectively developed and tested over 100 nuclear bombs (CFR, n.d.).

In addition to the Iron Triangle, organizations like the National Defense Industrial Association (NDIA), promote the defense industry through lobbying efforts that influence

legislative decisions (NDIA, n.d.). Other defense-related non-profits, such as the Air & Space Forces Association (AFA), share similar advocacy goals. However, some organizations focus on providing a voice for specific groups rather than promoting a strictly pro-defense agenda.

Framework

Key participants in this analysis include the Defense Advanced Research Projects Agency (DARPA), which asserts that technologies developed to improve military capabilities also enhance civilian society, such as with the Internet, compact GPS devices, and language translation tools (DARPA, n.d.). This study also considers companies that advertise products for military usage, such as Ghost Robotics (Figure 2), or for civilian usage, such as Boston Dynamics (Figure 3). These entities are interconnected within the Iron Triangle introduced by Adams (1981). Through this, defense contractors wield significant lobbying power and resilience against opposition, allowing them to exert considerable influence over legislation and funding for their products. Participants also include government agencies like the NDIA, which defines itself as an "educational nonprofit that engages thoughtful and innovative leaders to promote the best policies, practices, products, and technology for warfighters and others who ensure the safety and security of our nation" (NDIA, n.d.). Finally, participants include groups against certain forms of militaristic technology development, such as the Campaign to Stop Killer Robots and its opposition to Lethal Autonomous Weapon Systems (LAWS). This organization raises critical concerns on LAWS being unable to make complex ethical choices and the uncertainty about future proceedings over unjust actions, stating "It's unclear who, if anyone, could be held responsible for unlawful acts caused by an autonomous weapon – the programmer, manufacturer, commander, or machine itself – creating a dangerous accountability gap" (Stop Killer Robots, n.d.).

Figure 2. VISION 60 Q-UGV with military personnel (Ghost Robotics, n.d.-a).

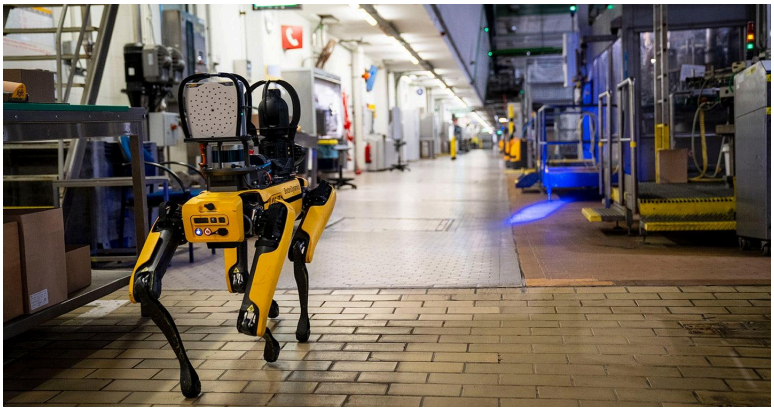
Figure 3. Spot in a food and beverage facility (Boston Dynamics, 2024).

To explain why military technologies often fail at "bridging the valley of death" (finding civilian markets), Arcella (2005) blames high costs, long schedules, and unsatisfactory performance. This study found that while military technologies can appear useful to industries, many industry managers who evaluate costs, schedules, and performances of products are opposed to the risk of expensive, new technologies. It can then be reasonably inferred that products like the VISION 60 Q-UGV would see more use than products like Spot. Many features advertised by Ghost Robotics are also not easily transitionable to commercial applications, such as how they "improve its ability to walk, run, crawl, climb and eventually swim in complex environments that our customers must operate in" (Ghost Robotics, n.d.-a). The ability to

navigate complex terrain does not serve a purpose in many industrial settings, such as the food and beverage facility that Spot is walking through in Figure 3, or in other locations that have been monitored by Spot, including substations and nuclear power plants (Petrova, 2021).

Employee values can shape organizational policies, which contribute to the acceptance of technologies in an industry (Misselhorn, 2022; Beranek, Smullin, & Tsipis, 1990). Misselhorn also states that with LAWS, the "responsibility gap" (equivalent to the aforementioned "accountability gap") is a deterrent (Misselhorn, 2022). It is difficult to attribute blame when failures arise since the actions of LAWS are the result of complex systems built by many people; examples include the autonomous systems programmers and the designers of the physical body. Since systems guided by artificial intelligence have little "epistemic opacity," their malfunctions resist diagnosis (Vallor & Vierkant, 2024). Additionally, laws that protect this opacity limit the accountability of companies involved in developing these technologies.

The STS framework of sociotechnical systems is an appropriate lens for analyzing these dynamics. The framework emphasizes the interdependencies of technology and social factors, illustrating how the development of technologies affects society and vice versa. As de Wolff (n.d.) notes, engineered systems are "technological in nature and inextricably tied to delivering value to society." This relationship is particularly relevant to military projects, as their societal applicability impacts funding for the projects, and in turn, the extent of technological development within these projects.

Results and Discussion

In examining the intricate relationship between military R&D and civilian applications, this study reveals a multifaceted narrative: while military contractors and other benefactors often claim that military expenditures ultimately benefit civilian life, the actual transition of military

technologies to civilian applications is influenced by various factors. In some cases, this transition may not occur at all, or if it does, the product still serves a greater military purpose than a civilian one. The findings suggest that while there have been significant investments in military R&D, there are no consistent societal benefits to civilian society, necessitating a critical analysis of these claims.

Military to Civilian Technologies – The Message

Organizations such as DARPA advocate that improved military capabilities eventually enhance civilian society. For instance, DARPA states, "Often, DARPA innovations also become fixtures of modern civilian life… Our innovations have also transformed civilian society, leading to the Internet as we know it today, automated voice recognition and language translation, GPS receivers small enough to fit in consumer devices, and early investments in mRNA vaccine technology" (DARPA, n.d.). Numerous other defense organizations make similar claims in a broader sense, such as the Aerospace Industries Association (AIA) stating that "for over 100 years, the American aerospace and defense industry has shaped the world around us" (AIA, n.d.). This assertion is relevant to the sociotechnical systems framework: by stating that the aerospace and defense industry has molded the world, it implies that contributing to this industry effectively contributes to global progress. Despite the impact this industry has on the world around it, its actions are also dependent on societal perceptions.

Military Expenses Over Time

To accurately assess increasing costs, inflation of U.S. currency is taken into account. The U.S. national defense spending increased sharply during World War II, peaking at nearly $800 billion in 1991 dollars ($1.9 trillion in 2025 dollars) in the war's final year. Afterward, spending dropped to what it previously was at around $100 billion in 1991 dollars ($230 billion

in 2025 dollars), but with the rise of the Cold War and the military-industrial complex, annual spending climbed to around $200 to $350 billion in 1991 dollars ($470 to $820 billion in 2025 dollars) by 1952, remaining at that level for at least four decades (Figure 1).

The gradual increase was also identified after the Reagan administration announced an ambitious five-year plan costing $1.5 trillion in 1981 dollars ($5.3 trillion in 2025 dollars) (Adams, 1981). From that point on, the national defense budget has continued to increase overall (as Adams predicted in 1981), as seen in Figure 4.

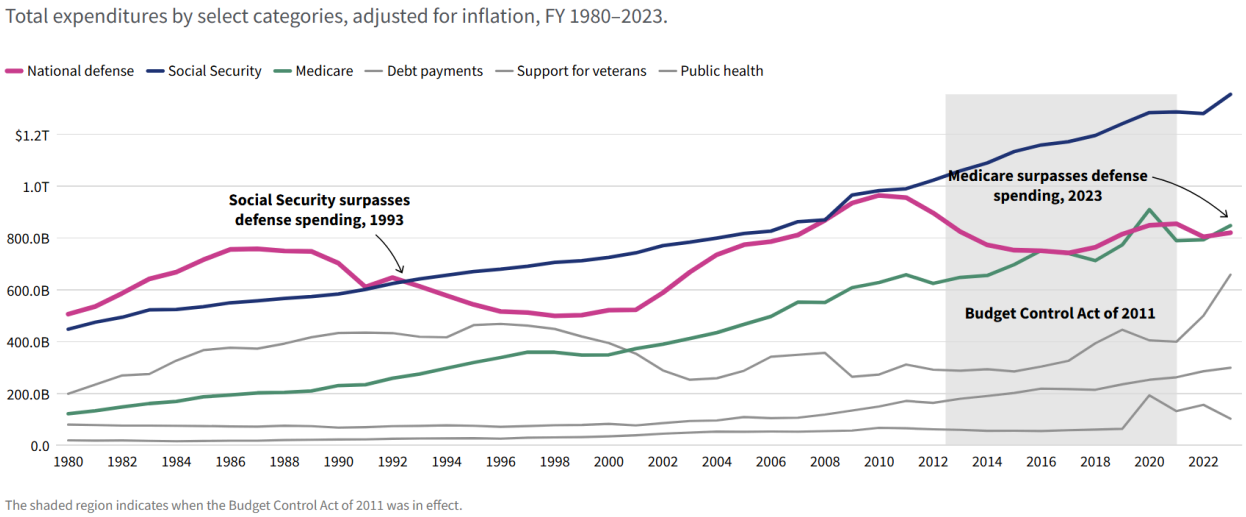

Figure 4. National defense spending and other U.S. expenditures from 1980 to 2023 (USAFacts, 2024).

Following the Cold War, while national defense spending decreased, it rose again from 2000 to 2010, reaching approximately $950 billion in 2023 dollars (about $1 trillion in 2025 dollars). Although that has been the maximum amount, for the past fifteen years, the annual defense spending has consistently exceeded $700 billion in 2023 dollars ($733 billion in 2025 dollars). Currently, the U.S. defense spending represents about 38% of its peak during 1945, when the first nuclear bombs were being developed and tested. Many increases in national defense spending are linked to ongoing conflicts and a heightened urgency to bolster national security. This trend reflects a societal fear of catastrophic events, which increases in severity as technologies of widespread destruction evolve.

This level of spending is unprecedented compared to other countries. USAFacts reports that "for 11 years, the US spent, on average, as much as the next 11-highest-paying states on national defense" (2024). Figure 5 illustrates this disparity, showing the U.S. in a much darker shade relative to other nations.

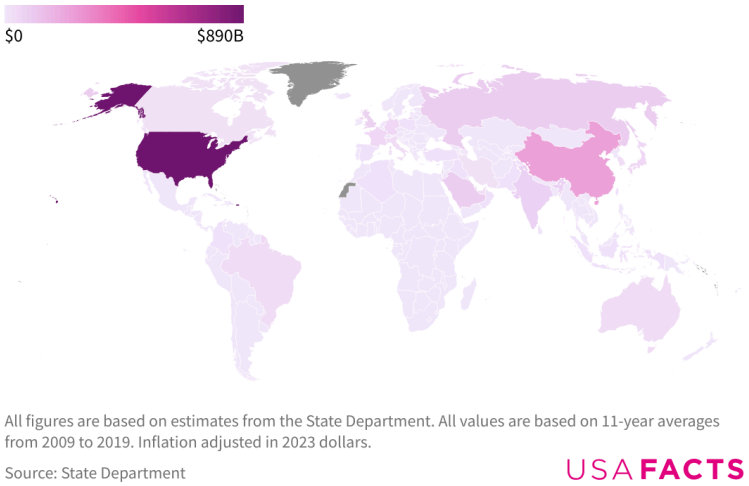

Figure 5. Average annual military spending from 2009 to 2019 for different countries (USAFacts, 2024).

This is not simply due to the U.S. spending more overall. The Peter G. Peterson Foundation reports that "the U.S. has historically devoted a larger share of its economy to defense than other G7 countries" (2024), as depicted in Figure 6.

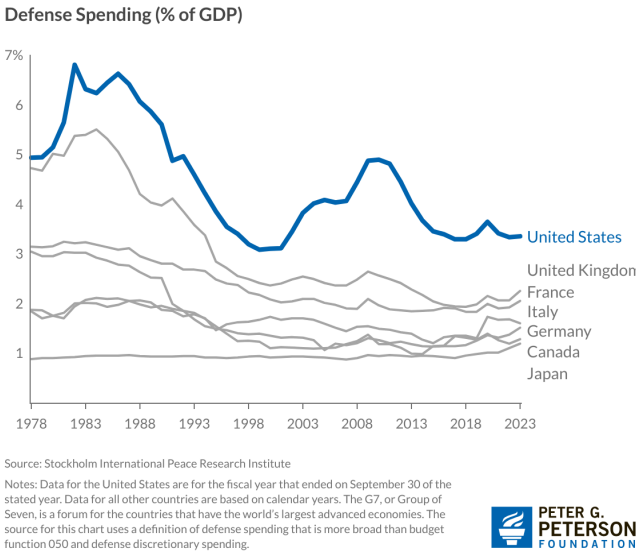

Figure 6. Annual defense spending of the U.S. and other G7 countries from 1978 to 2023 (Peter G. Peterson Foundation, 2024).

Military to Civilian Technologies – The Effectiveness

Given the steady increase in the national defense budget, a pertinent question arises: has this funding been directed toward enhancing military technologies or successfully transitioning them into civilian applications that benefit society? As not all military technologies can reasonably transition into civilian uses, this section will focus on a case study of a technology with both uses: autonomous robot dogs. The VISION 60 Q-UGV (Quadrupedal Unmanned Ground Vehicle) from Ghost Robotics is designed for military applications, while Spot from Boston Dynamics targets civilian uses. Figures 7 and 8 provide visual examples from each company's offerings.

Figure 7. VISION 60 Q-UGV performing various defense/homeland scouting tasks with different attachments on its back (7a Left, 7b Middle, and 7c Right) (Ghost Robotics, n.d.-a).

Figure 8. Spot in a hazardous mining site (8a Left) and performing various inspections (8b Middle and 8c Right) (Boston Dynamics, 2024).

Ghost Robotics has been refining its product since 2015 (Ghost Robotics, n.d.-b), while Boston Dynamics, founded earlier, released its product in 2020 (Boston Dynamics, 2020). This parallel development of autonomous robot dog technologies along military and civilian paths better allows for comparative evaluation of the products and the companies.

However, a limitation exists in fully comparing the technologies and companies, as comprehensive details about the technologies (such as schematics, programming, and product applications) and the companies (including financial information, accurate company size, and employee distribution) are not publicly available. Therefore, known details were used to apply a scaling factor, allowing for an assessment of the companies' impacts relative to their size rather than evaluating their total impacts directly.

According to LinkedIn data, Boston Dynamics has 1,157 associated members (Boston Dynamics, n.d.) and Ghost Robotics has 92 (Ghost Robotics, n.d.-c). Spot from Boston Dynamics is priced at $75,000 (Standard Bots, 2025), whereas the VISION 60 Q-UGV from Ghost Robotics is priced at $150,000 (Feldman, 2022). From acquisitions, a company's approximate financial valuation can also be derived. In 2021, Hyundai Motor Group acquired a controlling interest in Boston Dynamics from SoftBank for $1.1 billion (Boston Dynamics, 2021). In 2024, the South Korean defense technology company LIG Nex1 acquired a 60% controlling stake in Ghost Robotics for $400 million (PR Newswire, 2024).

These findings reveal that despite being 12.5 times smaller in size, Ghost Robotics can sell similar products as Boston Dynamics at double the price, possibly due in part to Spot's $75,000 price being its base price before including additional features such as payloads, sensors, software packages, or an extra arm (Standard Bots, 2025). The valuation of Ghost Robotics at roughly one-third of Boston Dynamics indicates a complex market dynamic in which military-focused products are often perceived as more valuable than their civilian counterparts.

Considering these insights, there are numerous opportunities for future research focused on evaluating the effectiveness of military innovations and their integration into civilian society. Conducting additional case studies to the comparison between Spot and the VISION 60 Q-UGV

can provide valuable insights into this dynamic. By systematically analyzing a range of technologies that succeeded or failed to transition from military to civilian applications, researchers can better assess the overall impact of military funding on civilian advancements. As many case studies are completed, patterns may emerge that highlight key factors influencing successful transitions. These may involve the adaptability of military innovations to civilian needs, technological readiness of the technology, and market demand for it. Identifying such trends would enable researchers to better assess whether currently developing military technologies are likely to benefit civilian society and, if so, when these benefits might materialize.

Investigating technologies across other sectors, such as healthcare and transportation, can further deepen our understanding of how military innovations can be tailored for civilian use. This exploration would help determine the potential utility of future military innovations in civilian society. Ultimately, these insights could provide policymakers, voters, and stakeholders with a clearer picture of the effectiveness of investments in specific military R&D projects, highlighting those that yield meaningful benefits for civilian life.

Conclusion

This study underscores the complexity of military innovation and its often intertwined existence with civilian technologies and society, revealing that while significant technological advancements have arisen from military R&D, the direct benefits are often overstated. The case study analysis on Spot from Boston Dynamics and the VISION 60 Q-UGV from Ghost Robotics shows that even though Ghost Robotics operates on a smaller scale, it can command higher prices for its military-focused technologies and is overall worth nearly as much as Boston Dynamics, which reflects prioritization in defense spending.

As U.S. military technologies continue to evolve and permeate civilian markets, it is imperative for civilians and policymakers to be aware of the origins of these technologies and assess the narratives surrounding them accordingly. This awareness can bring about more informed public discourse and policy decisions regarding U.S. defense spending, technological oversight, and improved tracking of governmental decisions as a whole. In a similar manner, as civilian technologies are conceptualized and developed, it is important to be aware of how these technologies could be used for other means. Ultimately, ensuring that military-funded technologies improve societal welfare requires transparency and accountability at various levels during their development and deployment.

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