



# The Shift in Technological Innovation from the Defense Sector to the Civilian Sector

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**EXECUTIVE SUMMARY:** During most of the 20<sup>th</sup> century, the defense sector was the undeniable leader of technological innovation, with technology developed in defense labs often trickling into the civilian world. In the 1990s, however, due to a dramatic decrease in defense budgets and the streaming of funds to commercial applications led by startup companies and internet giants, the flow of innovation reversed direction. The defense sector has accordingly adopted an “Open Innovation” approach to exploit new technologies developed by the civilian sector.

Throughout human history, technological innovation has been a critical factor on the battlefield. Ever since the Industrial Revolution and the scientific breakthroughs of the 19<sup>th</sup> and 20<sup>th</sup> centuries, such innovation has been a major factor in all great military conflicts. The wars between the Great Powers propelled innovation by states that invested in large research and development (R&D) teams and facilities to obtain technological superiority. As a result, state defense sectors became the leaders and main implementers of technological innovation around the world. Technology developed for defense applications subsequently transitioned into the civilian sector and completely changed the face of human society. Some of these applications include the jet engine, modern electronics, nuclear energy, antibiotics, insecticides, the internet, cellular communication, blood banks, and GPS.

In the 1990s, as a result of far-reaching geopolitical changes, economic processes, and socio-cultural changes, the defense sector gradually ceded its leadership in technological innovation to the civilian sector. Today, a major proportion of this innovation is produced by the private civilian sector, with the state defense sector increasingly relying upon it rather than the other way around. The migration of technological innovation's center of gravity from the state defense sector to the private civilian sector can be described as a shift of technological dominance. This shift has forced the defense sector to adapt and transform its main innovation strategy from *closed innovation* to *open innovation*.

### **Forms of innovation**

Innovation is a multi-stage process whereby organizations transform ideas into new and improved products, services, or processes in order to advance, compete, and differentiate themselves successfully in the marketplace. There are three levels of innovation:

1. *Incremental innovation* deals with improving and upgrading something that already exists;
2. *radical innovation* refers to the introduction of completely new products, services, processes, or business models; and
3. *disruptive innovation* changes existing market rules and offers a brand new value pattern to the market, with the potential to affect other markets as well.

There are two strategies for implementing innovation in organizations:

1. *Closed Innovation* - This model is based on ideas that stem mostly from internal sources, as well as on the internal organizational application of the innovator's development and realization processes.
2. *Open Innovation* - This model relies on sources both internal and external to the organization. The system generates new ideas by interacting and exchanging information with the wider environment in order to infuse new ideas and direct their implementation.

### **The past - The defense sector's technological hegemony**

World War I began with cavalry charges led by sword-wielding officers and ended with planes, tanks, machine guns, and toxic gas dominating the battlefield.

The war broke out at a time when manufacturing and industrial capabilities were becoming significant, and as a result, considerable technological advances became available for widespread use.

Although the importance of technology on the battlefield was made abundantly clear during the First World War, it was the Second World War that significantly enhanced the connection between scientific research, technological development, industrialized production capabilities, and government mechanisms. The military relied more and more on technology-oriented warfare to determine the outcome of battle, including radar, wireless radio, fighter jets, heavy bombers, and ultimately the atomic bomb.

During the Cold War, the hectic technological race between the powers yielded advancements in many fields, including agriculture, biomedicine, ecology, geology, meteorology, seismology, oceanography, space and satellite exploration, navigation systems, genetics (including a detailed program for mapping the human genome), electronics, computers, communications, and perhaps the most influential of all, the internet.

As early as 1970, government institutions such as NASA (National Space and Aeronautics Organization) and the NIH (The National Institutes of Health) consumed about half the US government's budget for R&D, with most of this sum meant to fund projects dealing with national security.

### **The present - The civilian sector's technological hegemony**

Over the past few decades, a much higher share of capital has flowed into the development of technologies whose primary purpose is to meet the needs of the civilian market. This change is evident when examining the total sums invested by the US in government R&D (a major part of which is defense R&D) in comparison to the investment in the civilian sector's R&D. Until the late 1980s, government investment in R&D funding was very similar to that of private civilian R&D. However, since the 1990s a significant gap has opened up between the sectors, with private sector R&D benefiting by up to four times.

Today, cutting-edge technology is in the hands of giant civilian technology companies or startups, with the defense sector feeding, to a large extent, on

innovations in the private sector in key areas. This shift in technological dominance was propelled by a combination of three main interrelated factors:

### **1. The decline of war between states and armed conflicts between Great Powers**

The end of the Cold War and Great Powers competition led to a gradual reduction in defense research and development funds. The decline in the volume and intensity of wars led to the respective decline in investment in the development of defense and military technologies.

### **2. The age of startups**

Startups can easily implement disruptive innovation due to their ability to adapt and change quickly, their relatively small size, and their high risk tolerance. The rapid growth of the startup community, based on open platforms and information sharing, provided a clear technological advantage to its members and offered unprecedented access to information in general and technology in particular.

### **3. The internet giants**

The few startups that transformed into today's technological giants dominate key areas of technology by investing great sums in R&D, which until several decades ago could only be invested by states. The R&D investment of each of the five leading technology companies is more than triple that of the biggest R&D-intensive defense companies, such as Boeing and Lockheed Martin.

### **The transition from Closed to Open Innovation**

During most of the 20th century, the defense sector, which enjoyed strong funding and resources and the best minds in R&D, used the *closed innovation* model in its R&D activity. However, it suffered from a number of built-in barriers. One was binding conditions that are often cumbersome and onerous. Market opportunities are limited, and in most cases, the state demands full ownership of any resulting intellectual property. The second barrier is related to confidentiality and information security. Cooperation with commercial civil companies and the use of civil technology exposes a state defense sector to a significant threat: the availability of the very same technology to potential adversaries and the exposure of its limitations. The third barrier is bureaucratic. The defense sector is fundamentally different from dynamic and agile technology companies, which

must fight for their survival in a competitive market. The defense sector has rigid and cumbersome engagement and procurement processes that lack the flexibility to partner with small companies, so it has tended toward long-term relationships with large, stable companies.

Given these factors, the model of *closed innovation* brought about the desired results, as long as the technological advantage was in the hands of the defense sector. Under these conditions, there was no incentive for the defense sector to overcome the built-in barriers.

With the end of the Cold War, however, and the subsequent loss of technological dominance in favor of the civilian sector, the defense sectors in many states began to reexamine their innovation models, and the *open innovation* model came to be seen as more appropriate to carry the defense sector into the 21st century.

In 2015, the US DoD announced the launch of the Third Offset Strategy – the creation of a significant technological lead over the US’s main rivals. As part of the program, the DoD seeks to achieve dominance in technological fields including robotics, artificial intelligence, autonomous systems, and advanced manufacturing technologies. According to the Third Offset strategy, the US DoD and the entire defense establishment must open communication channels with civilian companies and use their products, services, knowledge, and capabilities to develop the next generation of weapons systems.

Under President Trump’s administration, the term “Third Offset Strategy” fell out of favor, with Trump having made an electoral pledge to spend more on reinforcing current military forces. But the 2018 National Defense Strategy (which did not use the Third Offset Strategy label) and new operational concepts such as Multi-Domain Operations indicate that the relevance of military-technological overmatch is very much intact.

The program includes an impressive number of diverse ventures, among them a Defense Innovation Board, a National Security Innovation Network, and a Defense Innovation Unit. The role of these initiatives is to bridge the gap between the defense sector’s cumbersome processes and civilian hi-tech and startup companies’ business models. This entails openly publishing challenges and expediting the engagement process with companies that present feasible solutions,

running innovation competitions and hackathons, engaging with researchers in academia, and much more.

At the beginning of the 21st century, the defense sector in Israel successfully identified this shift in technological dominance. This was followed by a change in the perception of defense innovation and an embrace of *open innovation* as a sustainable model. Like the US, Israel has invested a considerable effort in utilizing civilian technology for defense applications.

Several channels have been established for this purpose. DDR&D (Directorate of Defense Research & Development), the unit in charge of maintaining Israel's technological advantage, is actively engaged in mobilizing civilian technology by publishing challenges, funding selected technologies via incubation/acceleration programs, and conducting research with partners from Israeli academia. Another way to tap into civilian technology is through third-party innovation agents, commercial companies that link the defense sector with the private civil technological ecosystem. They seek startups with innovative technologies that could potentially provide solutions to the emerging needs of the defense entities it represents, manage the process of engagement, and see the solutions through the proof-of-concept phase.

## **Conclusion**

Throughout most of the 20th century until the end of the Cold War, the defense sector dominated the development of innovative technology, with the civilian world benefiting from the fruits of that innovation. Many technologies developed under the auspices of the defense system were adapted for civilian use and have become an integral part of the daily lives of billions of people. During the 1990s, technological innovation increasingly migrated from the defense sector to the civilian sector. Paradoxically, the defense sector's development of new systems like the internet enabled the civilian sector to take the lead in those fields. This shift means the defense sector is now forced to rely on technology that streams not from itself but from the civilian world.

As a result of this shift in technological dominance, the defense sector has moved from a *closed innovation* model to an *open innovation* model in order to ensure access to innovative technology emanating from the civilian world in key strategic areas such as artificial intelligence, machine learning, cyber, and more. As part of the

*open innovation* model, collaboration with civilian companies is expressed in various ways, such as publishing calls for proposals, establishing technology incubators and accelerators for civilian startups, holding joint forums and events, and so on.

We are currently witnessing the return of global power competition between the US, China, and Russia. Russia's recent invasion of the Ukraine could indicate the return of the use of military means as part of this competition. However, the trend towards open innovation will likely continue. The superiority of the civilian sector in many technological fields that are crucial for modern weapons and defense systems makes it highly unlikely that any country will deliberately reverse the process and risk losing its ability to further develop its defense capabilities.

In the world we live in, information is king. As long as the civilian sector's technological innovation process enjoys the overwhelming advantage of open-source platforms and a culture of sharing information, it will likely retain the upper hand.

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