CEC Case Study

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The following four (4) questions are addressed based on the readings assigned in this Lesson.

Q: Does technology or requirement drive transformation?

In this case, it was primarily the requirement for advanced fleet air defense that drove the transformation. Of course, the work by APL could not have been carried out in absence of the basic technological building blocks (e.g., timing capability provided by cesium clocks), but the real transformation was motivated by need.

“The CEC was developed in response to the need to maintain and extend Fleet air defense against advanced, next-generation threats as well as to complement advances in sensor and weapon systems.”[[1]](#footnote-1)

“These needs were understood, at least dimly, from the very beginning…”[[2]](#footnote-2)

Q: To what extent can defense requirements drive technology in the 21st century? Do military needs drive technology development?

In contrast with the relatively large consumer impact to technological innovation, the total defense budget is fairly small and has a correspondingly marginal impact with some notable exceptions. Those include the large technological contributions of the paramilitary organizations of NASA and DARPA (which includes the original implementation of what we now call the Internet) and government funded extra-military science spending on projects such as the Superconducting Super Collider (SSC).

The contributions of FFRDCs (e.g., MITRE) and DoD agencies (e.g., Army Research Labs) notwithstanding, the total research and development budget combined with the DoD procurement budget can’t come close to the collective influence of consumers (corporate, industrial, and individual) on the direction and application of technological innovation. Consequently, it is becoming more common for the military to adapt commercial technology both in the development of new solutions and integration into existing systems.

Q: What does technology truly transform?

Technology transforms the way we look at addressing the problems and opportunities around us.

Technology presents itself in two basic forms, Sustaining and Disruptive.[[3]](#footnote-3) Sustaining technologies include those innovations that improve our experiences, interactions, use of time, and use of energy (mental and physical) but that do not fundamentally change the way we approach a problem space. They may make a product lighter, more durable, or able to consume less energy. Disruptive technologies have the potential to more greatly impact our lives and the way we see the problems and opportunities around us. The Wright brothers’ development of human flight is an example of a disruptive technology. But while it did not change our need to travel and transport goods it certainly did transform the ways and circumstances under which we could do so.

Q: How much quantitative change amounts to a qualitative change?

There is no specific quantity of change that will result in qualitative change. Various technologies have different tipping points which when reached produce greater rewards. Smart phone adoption, for example, required a critical mass in order to fuel commercial spending on infrastructure, application development, and accelerated hardware innovation. When smart phones were first introduced they didn’t appear nearly as “smart” as they do today. Importantly, the subsequent qualitative change in the end user’s experience exceeds the linear prediction based on the summation of the technological improvements. This “whole is greater than the sum of its parts” effect is typical of substantial technological change.

Some technological change has a more immediate qualitative impact. This is often due to the inherent or imposed barriers to adoption. The invention of gunpowder in China during the second half of the 19th century resulted in almost immediate qualitative changes in the military, certain industries (e.g., mining), and in civil engineering (e.g., construction of tunnels and canals). In contrast, Thomas Edison filed a patent for a system for the distribution of electricity in 1880 but it took more than 50 years to see even the most fundamental benefits due to the time and cost associated with building out regional power generation stations and erecting transmission lines.

1. “The Cooperative Engagement Capability,” Johns Hopkins APL Technical Digest, Volume 16, Number 4 (1995). [↑](#footnote-ref-1)
2. O’Neil, William D., “The Cooperative Engagement Capability (CEC),” National Defense University (2007). [↑](#footnote-ref-2)
3. Christensen, Clayton M., “The Innovator’s Dilemma,” Harvard Press (1997). [↑](#footnote-ref-3)