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War is a creation of mankind that has evolved along with human civilization, leaving a bloody trail in its wake. As there are those in our world who strive to improve peacetime society, there are also those who push the limits of weaponry and revolutionize the way war is waged. In this day and age, opposing forces rarely meet on a traditional battlefield but instead inflict death and destruction from across the horizon with weapons of catastrophic capability. Consequently the costs of developing such advanced war machines are increasingly heavy. With this rapid evolution of combat and the weaponry used in it, my question is simple: Are all the advancements truly worth the cost?

Thanks to the advances in weaponry, modern combat is becoming a field with only marginal human involvement. Unmanned vehicles, on land, air, and sea, are rapidly replacing the human element of warfare. These mechanized units are manipulated by soldiers far removed from the battlefield—those who will never physically witness or set foot in the areas where they send their drones, yet still possess the ability to control the fate of everything in that region. This widespread removal of soldiers from the battlefield has certainly led to mistakes, as physical presence in a situation allows for a better understanding of one's surroundings. By sending a drone to accomplish an objective, however, the errors in judgment that a soldier under fire may make are ultimately mitigated, allowing for a greater chance of success during a critical moment. Not all situations in war require a machine to be sent in. When the need arises, however, having one is often of great benefit to the soldiers on the ground.

The financial burden of war has always been an issue for nations large and small. Fueling the flames of weapons development has always come with a price tag; in an age when computer-based "smart weapons" rule the battleground, that price tag has become enormous. The amount of money that countries pour into the development and deployment of these new innovations has seen a meteoric rise. In the 2012 fiscal year for example, the United States Department of Defense plans to allocate more than $75 billion for weapons Research and Development purposes (United States Department of Defense). These funds could be reallocated and channeled through much more beneficial sectors of the economy. The desire for nations to strive for the newest and most modern weaponry they can develop is

an understandable endeavor. There is a boundary, however, between modernization and overindulgence; the financial cost of today's ever evolving warfare becomes one of the biggest factors in determining whether that boundary was crossed. Such is the case with the B-2 Stealth Bomber.

The B-2 "Spirit" Stealth Bomber was first unveiled in 1988 and is still in service today. It is a marvel of weapons engineering; "The B-2 can fly more than 6,000 nautical miles before refueling, and more than 10,000 nautical miles with just one refueling, while carrying 40,000 pounds of weapons" ("B-2 Spirit"). The aircraft is also, as the name implies, designed for stealth operations:

> Organic in appearance, a simple flying wing, with absolutely no vertical control surfaces, it has very smooth contours and few features that could "catch" radar waves and reflect them. It has a sweepback of 55 degrees and a "W"-shaped trailing edge. The aircraft is aerodynamically unstable, kept in the air with a quadruple-redundant fly-by-wire (FBW) system, under the control of a General Electric Flight Control Computer (FCC). ("B-2 Spirit")

The cost for such an advanced war machine was steep: roughly $2.3 billion per aircraft. The B-2 design was originally approved in large numbers by the United States Air Force, with 132 operational units set for production in 1981. Project cost estimates kept exceeding funding, however, and consequently led to that number dropping rapidly over the years; it was reduced to 76 in 1990 and then to 20 in 1992. The final cost of the project was estimated at $45.3 billion ("B-2 Production").

Comparing this advanced bomber to another in use, the B-52 "StratoFortress," the differences are few. The B-52 made its first flight in 1961 and is in reality quite similar to the B-2. The only true difference between the aircraft is the fact that the StratoFortress lacks the stealth technology that is present in its counterpart. Both are capable of carrying similar payloads, approximately 40,000 pounds ("Boeing B-52"); can climb to an altitude of 50,000 feet; and have the ability to travel more than 6,000 nautical miles without refueling ("B-2 Spirit"). The B-52 was built in a variety of different models and finished production with a total of 744 aircraft. While the figures vary from source to source, the average estimate is approximately $53 million per unit, or just under $40 billion for the entire project ("B-2 Spirit"). This is a major price gap for aircraft that share many similar features, leading people to question whether or not the B-2 was a worthwhile expenditure of military funding.

The level to which weaponry has advanced, particularly in recent years, is something that can be viewed as a marvel of engineering. "Fire and Forget" weapons have become mainstays in powerful armies; a gun can now be fired around a corner without exposing the shooter, or it can take out a target barely visible on the horizon. Satellites now pinpoint a location anywhere on Earth in the blink of an eye. These innovations open a floodgate of possibilities in modern warfare that were unheard of fifty years ago. A perfect example of such evolution is the story of the self-propelled explosive weapon systems.

Tanks, planes and bunkers have existed since the First World War; consequently there has always been a need to develop a weapon that could be used while on foot to eliminate such a threat. For the United States during World War II this weapon was known as the M1 Bazooka. It was an incredibly simple design, forged out of pure necessity; "The system consisted of a basic tube, wiring and a pistol grip, fore grip and shoulder rest (all three usually of wood) with the rocket loaded from the open rear" ("M1 Rocket Launcher"). Because it had such rudimentary features the weapon was conceived and deployed into combat within a thirty-day period. The original design was also very cheap to build, at only $19 per weapon ("Bazooka"). It became a wild success on the battlefield, with more than 475,000 fielded during the war ("M1 Rocket Launcher").

Yet that does not imply that it was without faults. In reality there were many deficiencies and drawbacks that hampered the weapon. Its main problem was the range at which it could be used; the user was restricted to a very short distance. "Though the effective range of the system was listed at about 300 yards, usage of the Bazooka was usually kept around or under 100 yards to increase accuracy" ("M1 Rocket Launcher"). This meant that the men using it had to get well within the range of enemy fire to guarantee a hit on their target. It was also incapable of hitting a flying target, as it did not possess any form of tracking equipment. The weapon also gave off a massive back-blast of smoke upon being fired, exposing the crew's position to opposing forces ("Bazooka"). Despite these drawbacks, though, it was a weapon that accomplished the job. This became evident when the German high command went so far as to imitate the weapon system for its own troops. "The lethality and effectiveness of such a cheap system to produce enlightened the Germans to use the M1 as the basis for their own Bazooka-type system, becoming the larger caliber Raketenpanzerbusche" ("M1 Rocket Launcher").

Fast forward forty years and the FGM-148 "Javelin" arrives on the battlefield. First born into the Army as the "Advanced Anti-Tank System – Medium" initiative in 1983, the weapon took ten years of development and testing before being approved for

production in 1993 ("Raytheon/Lockheed Martin")—a far cry from the thirty-day development of the Bazooka. Yet in those ten years a truly dominating weapon was born. The missiles fired from the Javelin launcher are built with a High Explosive Anti-Tank (HEAT) charge within them, comprised of two separate explosives, that is designed specifically to be able to punch right through a modern tank's armor ("Raytheon/ Lockheed Martin").

The Javelin's target acquisition has also seen a major advancement, in the form of Infrared Imaging. All an operator must do is locate the objective, lock onto it, and let the missile take over while they move to another position—a literal "fire-and-forget" weapons system. It is a very versatile platform as well, able to strike targets both in the air and on the ground. Once a target is acquired, the missile is propelled by a spring-loaded mechanism several feet in the air before igniting its rocket propulsion system ("Raytheon/Lockheed Martin"). The back-blast of such a powerful weapon, while still dangerous to anyone exposed to it, is greatly reduced and offers little opportunity for being spotted. One of the missile launcher's biggest assets, though, lies in its range capabilities; a target can be located and destroyed by the Javelin anywhere from 75 to over 2,700 yards away ("Raytheon/Lockheed Martin").

The only real flaw of the Javelin weapon is the expense associated with producing it: the weapon itself costs $165,000, and each missile costs between $40,000 and $80,000 ("Raytheon/Lockheed Martin"). Though this price tag is far in excess of its rudimentary ancestor's own $19 build, the results and benefits are clear to see. In the evolution from Bazooka to Javelin, soldiers are now able to strike more accurately on a wide variety of targets from much greater distances than ever before. Operators can now engage multiple targets without fear that they might miss, due entirely to the advancements made in guidance systems within the missiles themselves. While the cost for this new weapon of war may be large, having it on the battlefield is a major benefit to the soldiers who would otherwise be much more vulnerable.

Are all the advancements made in weapons technology really worth the cost, though? I believe that the answer is not as simple as yes or no. Weapons technology is a title that encompasses every innovation and advancement made to further the ways in which war is waged. There are many times, such as in the life of the B-2, when advancement shows negligible improvements over pre-existing weapons despite enormous financial investment. From this perspective I would be inclined to say that no, the cost of that weapon was far in excess of the benefits it presented. Yet history has shown us that weapons advancement can also be a major asset to soldiers on the frontline, as is the case with the Javelin missile system. Its predecessor was a weapon that, while simple and effective, possessed flaws in need of improvement. The advances in the Javelin have proved invaluable for the men who wield this modern weapon of war. Regardless of what the particular weapon may be, it is the delicate balance between benefits and costs that will ultimately determine whether or not the advancement is worth making.

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