# Impact of Weight Reduction in Defence Packaging

## Why Weight Matters

### Cost Savings - Fuel Spend, Vehicle Maintenance, Healthcare costs.

- DoD's annual fuel expenditure tops $16B
- Musculoskeletal injuries (MSKI) account for $434 million in direct patient care costs
- Vehicle downtime can cost $500 - $800 in productivity per vehicle, per day.

### Soldier Health and Force Readiness

- MSKI's accounted for 65% of all medically non-deployable AC soldiers in 2019

### Environmental Impact of Carbon Emissions

- Carbon boot-print of the world's combined armed forces is approximately 6% of total global emissions.[15]

## Reducing Weight Saves Multiple Costs Throughout the Defence Budget

All over the world, nations' military budgets are under increasing strain. As available funding remains flat or even decreases, operating costs continue to rise, making it difficult to maintain mission readiness.

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Two main areas where militaries are seeing their costs continue to rise – fuel and soldier health and productivity. Fuel is one of the biggest line items in any military budget, as more specialized land and air vehicles are required to run military operations.

At the same time, injuries to soldiers are having a dramatic effect on military budgets. Injuries associated with repetitive motion and heavy lifting not only add to military medical costs, but also result in lost time and decrease mission readiness of soldiers

In both cases, part of the solution lies in reducing the weight carried by both vehicles and individual soldiers. Lighter vehicles and payloads help increase fuel efficiency, with the additional benefit of reducing carbon emissions. Lighter materials carried by soldiers results in fewer instances of injuries and lost time.

For those reasons, militaries around the world are investing in lighter materials, equipment and vehicles. A bulk of weight carried into the field is water and fuel. While the weight of fuel and water cannot change, the containers in which they're carried can.

Plastic fuel cans – commonly known as jerricans – offer several benefits over their steel counterparts. They are lighter than traditional steel cans, which helps to reduce the weight carried by military vehicles. This has the effect of increasing fuel efficiency and reducing the costs and carbon emissions associated with fossil fuel use.

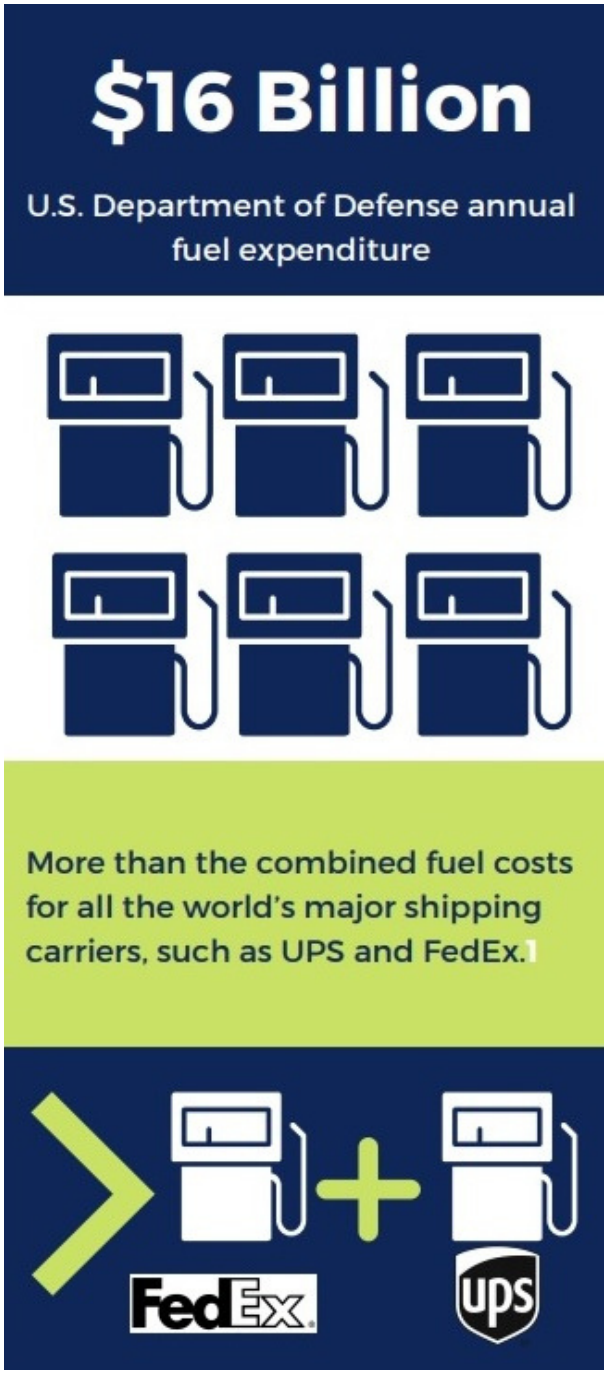
Lightweight cans also help protect the health and physical readiness of soldiers. By carrying less weight, soldiers are less susceptible to musculoskeletal injuries due to repetitive tasks and over-loading. This helps reduce medical costs, minimizes lost time, and helps maintain tactical readiness.

The information that follows provides details on how the military can use plastic as part of a "light-weighting" strategy to reduce costs and maintain a fit, effective fighting force.

## Saving Fuel Costs

For any military or defense department regardless of the country, liquid fuel is often one of the largest line items in their operating budgets. The United States Department of Defense, for example, is the largest user of liquid fuels in the world. The US military's annual expenditure for fuel tops $16 billion, far exceeding the combined fuel costs for all the world's major shipping carriers, such as UPS and FedEx.[1]

The DOD's reliance on liquid fuel puts their budgets at risk in the face of rising fuel costs. While the department's overall budget has remained flat, the price of oil has fluctuated. A rise in the cost of oil of just $10 per barrel would cost the DOD an additional $1.3 billion.[1]




## Increased Interest in Light-Weighting for Fuel Efficiency

With the DOD's reliance on fossil fuels being so critical to military operations, and the threat of rising fuel costs placing pressure on their budgets, many see fuel costs as a critical problem. For the United States, as well as for other countries around the world, fuel costs are increasingly being seen as a matter of national security.[1]

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As a result, the DOD has become more interested in the fuel efficiency of their vehicles. In the early 2010s, the US military increased its focus on improving the fuel efficiency of its ground vehicles, looking at technologies like hybrid engines, low-resistance tires, computerized transmissions and aerodynamics.[2]

But those kinds of improvements have varying success, depending on the type of terrain in which the vehicle is used. In Iraq, for example, which is flat and has relatively good roads, braking is less frequent, so hybrid engines have less benefit, but aerodynamics are important. In Afghanistan, however, the benefits are inverted. The mountainous terrain minimizes speed—and therefore aerodynamic gains—yet maximizes the energy-capturing benefits of a hybrid engine. [2]

Another way to increase fuel efficiency no matter the location or vehicle type is to reduce weight.

The effect of less weight on fuel consumption is well-documented. The Environmental Protection Agency has estimated that every 100 pounds of excess weight reduces fuel efficiency by approximately one percent. [3]

Vehicle performance is also impacted. Every ounce or pound of weight removed from a vehicle, will result in a better horsepower/weight ratio, enabling the vehicle to accelerate faster, improve handling characteristics, and reduce braking time. As a general rule, every 10 percent reduction in weight has a comparable 10 percent reduction in the force required to accelerate or decelerate.

As a result, manufacturers of civilian vehicles have also been developing ways to take weight out of their fleets, offering greater efficiency to consumers.[4]

However, making military vehicles lighter in the name of fuel efficiency is not always practical. Much of the added weight lies in the armor, and removing it obviously compromises the safety of the soldiers inside.

In addition, newer, lighter materials come at a significant cost. That cost can far exceed any savings gained by increased fuel efficiency, creating a net loss. Still, the United States Department of Defense is interested in reducing weight wherever it can.[2]

### More Weight Increases Maintenance Costs

Aside from fuel, the largest cost to keep any vehicle running – civilian, commercial or military – is maintenance, especially repairs and replacement of wear parts like tires, brakes and shocks. In addition, any time a vehicle spends in a repair shop is time that could be spent performing its functions.

Vehicles that carry more weight than what they are rated for will often see an increased need for maintenance. The added weight causes strain on every operating system within the vehicle. The result is premature wear of replacement parts, as well as critical components like axles and drivetrain components. This can not only lead to more frequent replacement of parts, but also untimely failures and breakdowns.[5]

### Transporting Fuel Offers Weight-Reduction Opportunities

While incrementally reducing vehicle weight wherever possible remains an important strategy, an area where significant reductions can be made is in the cargo that vehicles carry. And one of the main types of cargo that needs to be transported to and around field military operation theaters is fuel, as well as water. Moving this bulk cargo comes at an extraordinarily high cost, which makes it an important target for weight reduction.[2]

**The Air Force, is the DOD's largest consumer of fuel. The branch uses approximately 2 billion gallons of aviation fuel per year.**

## Simply replacing steel cans with plastic ones would reduce the weight of the cargo by approximately 190 KG / 400 LBS in an airdrop of just 100 fuel cans.

The military branch primarily responsible for transporting bulk cargo, the Air Force, is the DOD's largest consumer of fuel. The branch uses approximately 2 billion gallons of aviation fuel per year. A significant portion of that is used by its C-17A transport aircraft, and in 2018 the Air Force implemented strategies to reduce weight carried by these workhorse planes, saving fuel and lowering fuel costs in the process. [6]

One of the strategies was to use lighter-weight equipment inside the aircraft. An example was replacing the heavy metal chains used to secure cargo with lightweight synthetic tiedown straps. This reduced the operating weight of an aircraft by approximately 1,000 pounds, with the added benefits of being safer and easier for airmen to handle.[6]

That practice demonstrates the benefit of making simple changes to the cargo to reduce weight, and thus fuel consumption, even if the weight reduction is in small increments. Further weight reductions will clearly result in further efficiency gains.

Ironically, where military organizations can reduce cargo weight is in the transport of fuel itself, as well as water. Fuel and water make up a significant portion of cargo that needs to be transported to and around military operation theaters, and it comes at an extraordinarily high cost.[2]

Of course, the weight of fuel and water itself cannot be changed, but the containers in which they are carried can be. For decades, the military has used five-liter (20 gallon) steel jerricans as the primary fuel and water containers for use in the field.

While versatile, these cans are heavy, weighing approximately 4.4 kilograms (9.7 pounds) empty. Lightweight cans made from High Density Polyethylene (HDPE), are more than 41% lighter, with each can weighing just 2.5 kilograms (5.7 pounds). So simply replacing steel cans with plastic ones would reduce the weight of the cargo by approximately 190 kilograms (400 pounds) in an airdrop of just 100 fuel cans.

A mission might have hundreds of cargo transports and air drops of fuel and water alone. Considering that fuel and water needs to be constantly transported into the theater—and empty jerricans transported out—the fuel savings just for the C-17A can add up quickly.

### Light-weighting Helps Reduce Carbon Emissions

Another important, but often overlooked, aspect of fuel consumption is carbon emissions and the resulting effect on climate change. And because military organizations use a great deal of fuel, they are significant contributors to this problem.

Because it's the largest military in the world, it's no surprise that the United States Department of Defense is one of the largest carbon emitting entities in the world. In 2017, the US Military poured almost 60 million metric tons of carbon dioxide into the earth's atmosphere, eclipsing the emissions of most countries. If it were a country, the Pentagon would have ranked 55 among all countries for carbon emissions.[7]

## In a 2015 report, the White House identified climate change and its effects as a major threat to national security.

By making this kind of contribution to climate change, militaries, around the world, may be making their jobs more difficult. In a 2015 report, the White House identified climate change and its effects as a major threat to national security. The report said that extreme weather events, rising sea levels, and other effects could exacerbate greater societal problems, which in turn could lead to increased terrorist activity and military conflict.[8]

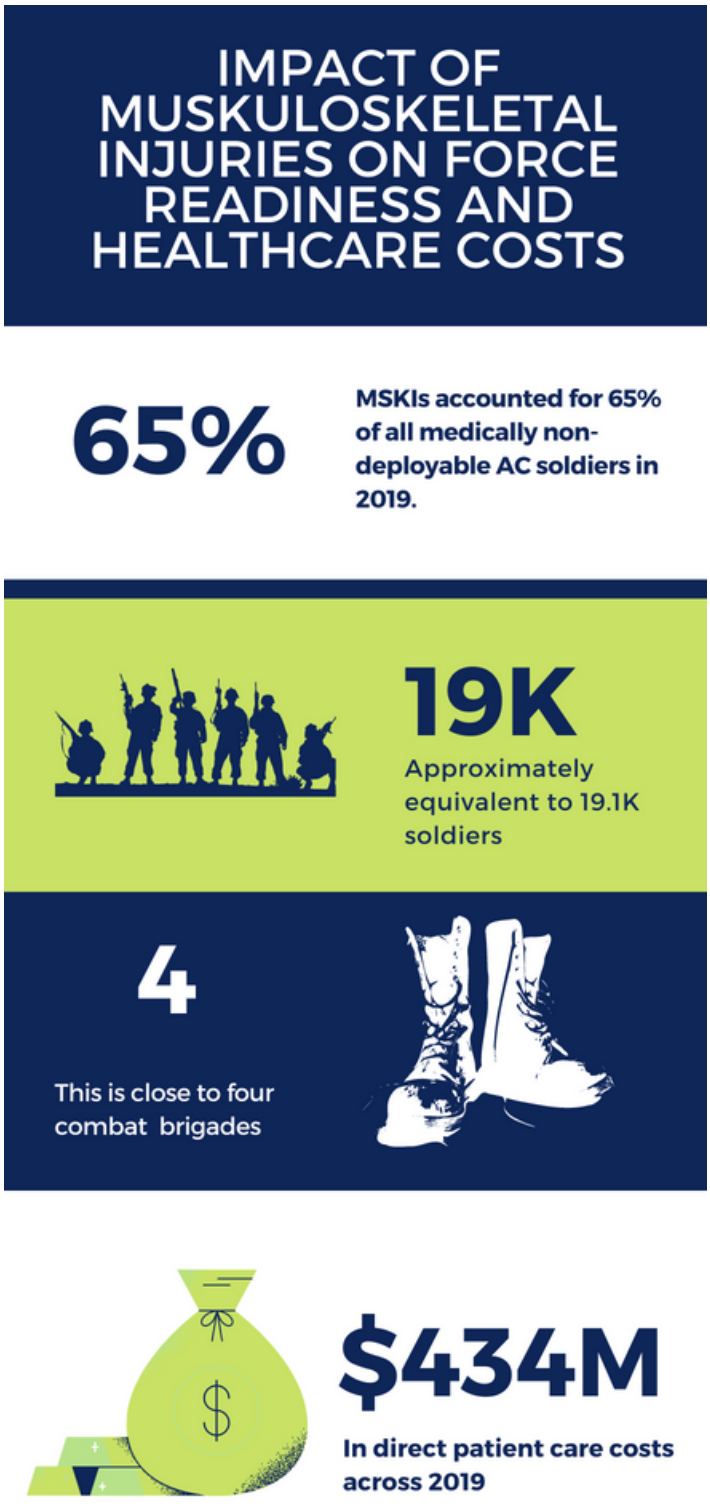
Through its ongoing efforts to reduce the weight carried by aircraft and land vehicles, the Department of Defense is not only reducing costs, but they are also helping to reduce their carbon footprint. And that could be making their mission easier.

## Musculoskeletal Injuries are Common in the Military

Aside from fuel, another major cost military organizations face is medical costs due to musculoskeletal injuries experienced by soldiers. Military work is inherently physical and is often dangerous, so it would be natural to assume that combat injuries are common and make up the majority of soldier hospitalizations, and therefore medical costs.

However, the majority of injuries experienced by soldiers in the United States military occur not during combat, but during the everyday activities. Combat injuries tend to be more severe, but non-combat musculoskeletal injuries are six times more likely to occur, resulting in more than 68,000 soldiers being nondeployable every year.[9]

Most of those injuries happen not as a result of sudden trauma, but instead during the course of regular, ongoing training and the day-to-day work of being a soldier. Such injuries, which are cumulative in nature, include stress fractures, shin splints, patellofemoral syndrome, tendinitis, bursitis, plantar fasciitis and back pain.[9]




**MSKIs among the entire Army AC accounted for $434 million in direct patient care costs across 2018**


The nature of these injuries, being relatively minor when considered individually, means that they often go un-reported. A study conducted by the United States Army found that 49% of injuries were not reported to medical during a 12-month period.[10]This makes it impossible for injuries to be treated and causes them to worsen over time.

## Carrying and Lifting Excessive Weight Causes Musculoskeletal Injuries

One of the key causes of non-combat musculoskeletal injuries is repetitive motions during training and work. Activities like running and marching while carrying heavy loads, or lifting heavy objects, causes small tears in tissue that, if not given time to heal, can lead to overuse injuries.[9]

Today's soldiers carry a great deal of weight into combat, with the average infantry soldier being weighed down with between 90 and 140 pounds (40-64 kilograms) of armor and gear. The United States Military is investing in lighter gear to help prevent these injuries.[11]

However, in addition to carrying combat gear into battle, occasional lifting tasks also can be a significant cause of injury. Moving materials, loading and unloading transport vehicles, and carrying fuel and water tanks, and other heavy equipment cause additional wear on tissue, resulting in injury, despite being intermittent and not applying a constant load. One study found that lifting was one of the most commonly reported causes of injury among deployed soldiers.[12]

**In the United States Military, non-combat musculoskeletal injuries cause more than two million medical clinic visits per year**

## Musculoskeletal Injuries Are a Major Cost to the Military

With musculoskeletal injuries—particularly those caused by overuse and repeated carrying or lifting heavy weights—being so common, it's also resulting in significant cost to the military.

Among the many costs that result from these injuries, medical costs are the first and most immediate. In the United States Military, non-combat musculoskeletal injuries cause more than two million medical clinic visits per year, resulting in an annual cost of more than $3.7 billion.[9]

But the costs of these injuries extend beyond medical treatment. They also result in lost time and productivity. In 2019, soldier injuries cost the United States Army more than 4.1 million days of productivity, with more than 70% of those being musculoskeletal injuries.[13]

Finally, because musculoskeletal injuries have a cumulative effect when left unreported and untreated, they can also have long-term implications for soldiers. Servicemen and women often experience debilitating and lingering injuries long after they leave the military. One of the most common long-term conditions is osteoarthritis.[9]

While osteoarthritis is seen throughout the population, it is more common among military veterans, affecting more than one-third of servicemen and women, compared to just 20% of the overall population. In addition, 43% of veterans experience chronic joint pain, 33% have back pain, and 16% live with neck pain. These and other injuries degrade the sufferer's physical and mental health over time, leading to a reduced quality of life. In addition, these chronic conditions contribute some of the highest medical costs in the military.[9]

**In 2020, approximately 60% of United States soldiers' limited duty days were attributed to non-combat musculoskeletal injuries.**

This means that soldiers are very often unable to be deployed or actively perform the duties for which they are being paid. U.S. Army researchers found in 2020 that approximately 60% of United States soldiers' limited duty days were attributed to non-combat musculoskeletal injuries. The same study also found that those injuries also accounted for 65% of soldiers who were unable to deploy due to medical reasons.[14]

Musculoskeletal injuries can also have a permanent impact on soldiers' abilities to serve. The Army study found that a significant majority (85%) of soldiers who were medically evacuated for musculoskeletal injuries did not return to active duty.[14]

## Lightening Soldier Load

A key strategy of the United States Military, as well as in other countries, is "light-weighting," looking for every opportunity to reduce the collective weight carried by military vehicles and personnel. One of the easiest ways to help accomplish this goal is to replace traditional steel cans used to transport fuel, water and ammunition, with lighter weight plastic containers.

Fuel and water containers from Scepter are designed to help militaries decrease the weight carried by vehicles and soldiers, while also providing safety and performance features far superior to steel containers. Made from High Density Polyethylene (HDPE), the fuel cans are lightweight, rugged, and virtually indestructible, making them ideal for use in military operations.

The standard five-gallon/20-liter container weighs just 5.7 pounds, or 2.5 kilograms, versus the 9.7 pounds/4.4 kilograms steel cans weigh, which is 41% lighter. The cumulative effect of that reduced weight can have a noticeable effect on fuel consumption and the health and readiness of soldiers.

Plastic fuel cans can help protect solider health and fitness, while reducing the costs associated with increased medical attention and decreased productivity and lost time. Even reducing the weight of a full fuel can by just a few pounds makes a difference, as it reduces the cumulative effect of repeated lifting of heavier weights.

When soldiers are less fatigued and spend less time on medical leave, the overall tactical readiness of the fighting force is improved.

But their advantages don't end there, as they are well-suited to use in military operations and are superior to steel cans in a variety of ways.

**Rugged construction.** Plastic fuel cans can stand up to the punishment of use in difficult environments. They won't dent or puncture when dropped like steel cans will, always maintaining their shape and strength. Because of this, plastic cans don't require cushioning (which adds otherwise-unnecessary material) during air drops.

**Long-lasting.** Steel cans are vulnerable to the elements, and will eventually rust and corrode – inside and out – risking contamination of the fuel or water they contain.

**UL 94 flame rating.** When a metal can containing gasoline with pressure build-up is hit by a bullet, the container could explode, effectively turning the can into a bomb. Shards of steel become shrapnel, deadly to nearby troops. HDPE, however, carries a UL 94 flame rating, meaning plastic cans self-extinguish.

**Ease of use.** Plastic cans' light weight makes them easier to carry and pour. In addition, Scepter plastic cans pour faster, emptying their five-gallon/20-liter contents in under 40 seconds (steel cans can take almost three minutes) providing an advantage in time-sensitive, tactical situations. Finally, plastic cans with screw tops gradually release pressure build-up from fumes, rather than the sudden burst common with steel cans, protecting the user.

# Lighter. Better. Safer.



In addition to fuel and water containers, plastic ammunition packaging also offers significant weight savings.

Made from a proprietary material blend, Scepter ammunition containers offer excellent mechanical strength and superior impact resistance while providing a weight-savings of 14% - 41% over their steel and wood counterparts.

As an example, the 81 mm mortar containers represent a weight savings of 408 lbs. per pallet and 6,477 lbs. per 1000 rounds, and the 120 mm mortar container represents a weight savings of 412 lbs. per pallet and 8,578 lbs. per 1000 rounds (based on US configured pallet).

Modernization is a key focus within the Defence industry, yet ammunition packaging is often overlooked. Wood and steel are heavy, cumbersome, and an antiquated packaging solution. Wooden crates have been used since WWI, and metal cans since the second world war. Though there and have been various iterations over the years, both wood and steel boxes have changed very little and are still most commonplace today. These are often accompanied by cardboard tubes which serve as interior dunnage.

Plastic ammunition packaging offers benefits beyond weight savings.  Screw cap closures on Scepter's containers offer faster and easier access to ammunition when every second counts. Access to ammunition directly from the skid face also provides ease and efficiency in ammunition inspection activities. With minimal dunnage components, there is less ammunition handling required at ammunition plants and LAP facilities.

Plastic offers additional safety benefits as it creates less noise when handled in a tactical environment and with a custom fit interior, Scepter containers have fewer dunnage components to get left behind potentially alerting adversaries to position.

**Cost Effective:**

•Recoverable and reusable
•Excellent long term storage – reduced inspection and maintenance
•Strength and durability results in reduced loss associated with rough handling
•Reduced labor costs for OEMs vs. traditional packaging

**Lighter Weight:**

•Move more for less
•14% - 41% lighter per round. This means less fuel used and therefore less carbon emissions.

•Waterproof
•Corrosion and Fungus Resistant
•Withstands extreme weather conditions, i.e. heat, cold, humidity

•Hermetically Sealed
•Chemical Resistant
•Easily decontaminated

•Superior Impact Resistance
•UN / NATO qualified

•Easy to open screw cap
•Custom fit shock-absorbing protective interior

## For More Information

To learn more about Scepter fuel, water and ammunition containers, contact Military Sales at Scepter 1-800-387-6018, email: MilitaryCA@scepter.com or visit scepter.com.

## Footnotes

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