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TECHNOLOGY FOR FUTURE WARFARE: MECHANICAL ENHANCEMENT

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A "light and nimble" yet "heavily armed" combat soldier has been the holy grail of surface combat enthusiasts and practitioners. This contradictory requirement appeared to be just that, a dream that was unlikely to be fulfilled due to the obvious dichotomy between heavily armed and light and nimble. However, it appears that modern technology is on the verge of providing a feasible solution to achieve this dream of enabling fielding of the best surface combatant.

BACKGROUND

Warfare by humans has always required the combatants to use weapons. Such weapons typically require to be carried along by the warriors. Human beings initially commenced warfare on land where individual fighters met individually or in opposing groups to fight. Initially hand held weapons in the form of heavy rocks and sticks were used. In time sharp edged weapons such as swords, spears, pikes etc came into widespread use. The increasing lethality of the weapons forces combatants to also field defences against their opponents' weapons. The most common such defence was the shield usually made of heavy weathered hardwoods, and / or multiple layers of tanned leather reinforced with metal. Heavier sharp edged weapons were more easily able to cut through enemy combatants and their defensive equipment.

INCREASINGLY WEIGHED DOWN WAR FIGHTERS

This led to sharp edged weapons also being made heavy in addition to having a fine sharp edge. Defensive equipment such as shields and personal armour usually in the form of body plates made of metal and over garments of chain mail had to be correspondingly dense and heavy as well to be able to resist penetration by the sharp edged weapons. Thus over time the equipment used in land combat became so heavy that only the very strong could effectively use it. The advent of the war horse did little to stem this increase in the combat ready weight of warriors. Later technology in the form of firearms seemed to offer an end to this gradual but steady escalation in combatant weight. Projectiles fired by firearms were able to penetrate most defensive armour of the time and so it was thought that the need to carry heavy equipment would soon cease as a relatively light firearm could achieve what the earlier weapons could not. However, the firearm came with its own problems. Combatants now were required to carry their own firearms which weighed a few kilograms. Combatants also required to carry ammunition for their firearms intended for immediate use on their person. In addition soldiers also had to carry their own minimum reserve of food and other equipment that was designed to ensure their survival as well as combat efficiency as individual fighting elements. This equipment included communication equipment such as small radio sets, water, shelter making essentials etc. Over time the more modern firearms equipped soldier also ended up having to carry several tens of kilograms of equipment on his person. In addition the heavier firearms with greater penetration power and combat utility came with a greater weight as well. In order to reduce per person combat load these were often broken down into their

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component parts and the separate parts carried by different members of a cohesive fighting group. Despite this a few kilograms of weight more were added to each soldier's responsibility. In order to make carriage of all this equipment possible without the soldier getting too tired to be effective in combat efforts were made to design harnesses able to distribute the load optimally over the soldier's body. While fairly effective these harness systems along with their backpacks were soon outstripped by more "nice to have in a fight" equipment and their added weight in the soldier's combat kit. Modern high rate of fire weapons while very good to have in a fight require correspondingly more ammunition to be carried by each soldier as he expends his ammunition faster at high rates of fire. Efforts to design even better harness systems resulted ion a few effective bits of combat clothing being designed but a better solution continued to be sought.

WEIGHTY SOLUTIONS

One section of designers continued to attempt to improve upon the best equipment carriage harnesses through leveraging modern science to locate optical load distributions and load carriage parts of the human anatomy. Another section of, apparently a more mechanical bent of mind sought to delve into the realms of what had a little earlier been firmly science fiction to attempt mechanical augmentation of the human musculature. "if combat loads cannot be reduced why not make the combatant stronger" appeared to be their though process. The field of robotics was one discipline that combined with bio-mechanical systems being developed in medical research and development for bringing mobility to grievously injured people.

It is reported that the latter systems are nearing proof of concept phase. Researchers claim to have developed exo-skeletons that utilise hydraulic motors to power metal limbs that are worn like a suit of armour. One such exo-skeleton built by a research team at the Perceptual Robotics Laboratory (Percro) at Pisa, Italy can magnify pure human muscle power to an extent that can enable lifting of 50 kg in each extended hand[i].another such exo-skeleton called Human Universal Load Carrier (HULC) can enable effortless carriage of 91 kg[ii].

These exo-skeletons have been developed primarily with an infantry soldier in mind and are intended to enable the soldier to be able to carry large loads into combat without degrading his fighting potential and mobility. However, like any technology these are adaptable to other uses. For instance first and even second responder teams rushing to rescue trapped people after natural disasters could utlisise such exo-skeletons to shift heavy debris, free trapped people, and move them to safety. This is especially applicable to situations of earthquakes and landslides. This is not to say that these exo-skeletons could not find use in other rescue operations. The loading and offloading of rescue stores from large cargo carriage vessels could also be expedited.

MILITARY AVIATION AND METAL MUSCLE

In a military aviation setting outside the army also such exo-skeletons offer great utility. Today arming of fighter and bomber aircraft requires large numbers of technicians along with specialised winches and hydraulic lifting trolleys to lift heavy ordnance from the ground into weapons bays and onto weapons carriage external pylons on aircraft. Due to the complex nature of the lifting equipment arming of modern combat aircraft takes considerable time. Availability of exo-skeletons could reduce this time appreciably by permitting a fewer number of personnel attired in the exo-skeletons to lift the ordnance into place more efficiently. Such a time saving can translate into a major force multiplier effect through allowing more combat missions to be flown by a given number of aircraft. Similarly the loading and offloading times of large heavy cargo carriers such as C-17 and Il-76 aircraft could be reduced appreciably thus again giving a force multiplier effect. The gains from induction of exo-skeletons could be much more in use in such aviation settings given the very high cost of modern aircraft and their equipment. Underutilisation of such expensive equipment would reduce the cost efficiency of the investments made. Thus it is possible that exo-skeletons developed initially to make the foot soldier's life more comfortable could give greater returns in the aircraft arming and loading / offloading arena of use. It would be prudent for air forces aspiring towards effective modern capabilities to devote attention towards examining possible applications of such modern technologies.

As a force aspiring towards effective application of air power the IAF would be well served by an examination of possible utilisation of such exo-skeleton technology. If found feasible then the IAF could launch an exo-skeleton development program in co-ordination with Indian Institutes of Technology and Indian Industry. As per available writings about developments of such exo-skeletons in the US and Europe the technology required involves basically hydraulic systems and high strength metal structures coupled with required software and biometric sensors. All these technologies are either readily available with private as well as public sector industries in India or available as commercial off the shelf (COTS) equipment. The spin offs of utilisation of the technology, once it is developed, by other agencies such as the National Disaster Management Authority (NDMA) etc. Would provide good returns on the investment as well as economies of scale.

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CONCLUSION

The ever increasing weight required to be carried by the modern infantry soldier led to two parallel lines of effort to find a solution. The first focussed upon developing better harness systems to distribute the weight across the human body more efficiently so as to reduce fatigue. The other line of research looked at means to augment human body power. While the former appeared to be reaching a practical limit the latter managed to develop exo-skeletons that utilise basic bio sensors to sense and thereafter augment human movement through use of strong metal support limbs powered by hydraulic systems. Exo-skeletons mimic human movement and through exercise of their hydraulics provide greater lifting power. Apart from their obvious use by modern foot soldiers these systems have great utility in other fields also. Arming modern combat aircraft could be done more efficiently by crew equipped with such exo-skeletons while loading and offloading times for large transport aircraft could be reduced appreciably. These applications are especially important given the high cost of modern aircraft. Force multiplication could then be achieved through use of exo-skeletons in the military aviation field. Myriad civil applications also exist for these exo-skeletons. These should enable economies of scale to bring down unit cost. It behoves any air force aspiring for cutting edge capabilities to examine development and fielding of such new "out of the box" technologies.

(Disclaimer: The views and opinions expressed in this article are those of the author and do not necessarily reflect the position of the Centre for Air Power Studies CAPS)

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[i] "Body suit 'can lift 50kg in each hand'", http://www.bbc.com/newsbeat/10703219, accessed on 10 Mar 2014.

[ii] "HULC", http://www.lockheedmartin.com/us/products/hulc.html, accessed on 10 Mar 2014.