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IDSA COMMENT

3D Printing and Defence: A Silent Revolution

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Imagine a technician in a war zone sending an e-mail along with a digital scan of an unserviceable part of an armoured fighting vehicle which then gets printed at the nearest available 3D printer and delivered to him in no time. This can possibly minimize the need of carrying and maintaining large inventories in battle zone. This revolution is taking place in a very silent manner and is likely to have far reaching implications for supply chain and logistics management of the armed forces. In a 3D printing technology, an object is created layer by layer through a specially designed printer using plastic or other materials.

The history of 3D printing dates back to 1984 when commercial 3D printing was based on 'stereolithography' technique in which ultraviolet beams were used to trace a slice of an object on the surface of liquid 'photopolymer' resulting in the hardening of the 'photopolymer'. The process is repeated over several layers depending upon the shape and size of the object, till the complete object is printed.

As mentioned, 3D printing is likely to alter the ways in which supply chains and logistics are maintained in defence forces. For any supply chain the key elements are the manufacturer, goods/supply carrier and the end user. Considering the range and depth of the inventory maintained by defence forces, the supply chain and logistic lines of control stretches from one end of the country to remote border areas as also several hundred nautical miles into the sea carrying millions of tons of stores comprising of ammunition, spares and components, minor and major assemblies etc. Some of these stores are sensitive and a large number of them have limited shelf life.

Operational readiness of defence forces largely depend upon the serviceability state of equipment in the hands of the troops. Often, non-availability of critical spares and components leads to non-availability of equipments and weapons to the troops, seriously hampering their war-fighting capability and especially when it comes to vintage foreign origin equipments. Once the digital scan or drawing is made available, the component can

be straightway printed by a suitable 3D printer and raw material made available close to the site of breakdown in repair workshops. To start with, critical components of armoured fighting vehicles, small arms, field guns, UAVs, aircraft components etc. can be identified for printing onsite or close to the deployment of equipment which will drastically reduce the downtime of the equipment. Logistic tails thus will get reduced, reducing security risk with favorable economy of scales. The advantage of 3D printing also lies in its efficiency. The waste generated during traditional manufacturing is drastically reduced by 3D printing. The labour can also be reduced by 3D printing.

The most striking thing about 3D printing is the way it can convert the digital inventory into physical objects thereby reducing the requirement of critical storage space drastically. Navy is in an advantageous position since it allows digital inventory to be carried onboard ships and submarines.

Disaster relief is also one area where 3D printing can aid the relief operation. Shelters can be printed onsite as per the requirement. Walls of these shelters are printed using special blend of cement and there strength is found to much higher than traditional walls due to layer by layer printing. Another area where defence forces have its utility is healthcare. There is a possibility in the near future of bio-printing drugs and vaccines. Instead of keeping the sensitive drugs and vaccines close to battlefield, they can be simply printed through 3D printer to avert any pandemic or provide defence against a possible biological or chemical attack. Bio printing machines are able to recreate heart tissues, lungs, jaw bones and other prosthetics limbs which will prove to be very useful for military hospitals for onsite treatment when removal of patient is not possible.

The US Army has started experimenting with logistics based on 3D printing. Its Rapid Equipping Force (REF) has been assigned with 3D printers and have been deployed in war zones of West Asia. The US government has launched a 30 million dollar pilot programme for research on 3D printing and NASA is likely to launch its first 3D printer in space sometime in 2014. China is also not far behind and is likely to expand its 3D printing capabilities many folds in next 3 years. In May 2013, China showcased the world's largest titanium aircraft critical component produced using 3D Laser Direct Manufacturing technology.

This technology if adopted by Indian defence forces will have a broad effect on the long supply chains being maintained thus reducing the cost of its maintenance substantially. Components which are critical to functioning of any vehicle or combat equipment can be

identified by each of the three services and by placing the 3D printers along with raw material and digital designs at key locations these components can be churned out as and when needed. This will save the exchequer on maintaining the storage space, shelf life and manpower needed to maintain the long supply chains.

3D printing technology is going through a phase of evolution but at the same time there are certain flip sides which also need to be taken into consideration before its mass utilization by defence forces. First, replacement parts which in war fighting machines are very critical have to be ensured for their safety standards since quality of 3D printer, the material used and the environment in which they are created has serious bearing. Therefore, standards are needed which are virtually non-existent world over. Secondly, printing of parts also requires purchasing intellectual property rights from original equipment manufacturer (OEM) which may cost a substantial amount to exchequer. Thirdly, the ease with which parts can be printed does raise serious questions. Anyone holding digital designs with printing capability can churn out critical parts which have serious implications for national security. Digital designs of weapons falling into the hands terrorist organizations can result in disastrous situation. Further, if an adversary lays his hands on digital files of proprietary designs, there is a possibility of altering the designs by hacking into the digital repository. Therefore, cyber security will assume greater importance.

3D printing technology is still in nascent stage. However, it is not difficult to imagine as to how it will drastically enhance the capabilities of defence forces.