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MAKE IT THE INDIAN WAY: WHY THE COUNTRY MUST ADAPT TO ADDITIVE TECHNOLOGIES

Relevant for: Science & Technology | Topic: Robotics & Artificial Intelligence

If ‘Make in India’ is to succeed, it needs to encompass ‘Make it the Indian Way’. It need not emulate mass production technologies, fuelled in Detroit by massive capital investment or in Beijing by cheap labour. We are fortunate to be in a historic moment when the manufacturing sector is about to go through a transformation wrought by disruptive technologies — we have to find a way of making it work in India’s favour rather than against it.

Industrial 3D printing has begun to transform manufacturing in Western countries. The 3D printing has not yet entered our everyday lexicon, and even people who have heard of it view it as a toy technology that geeks play with, creating prototypes of robots using small machines that create moulds using materials such as plastic and photosensitive resins. Part of it must be the name, whoever heard of serious manufacturing using a printer! Rename this to “additive technology” and think of Ford Motors cutting down its cost of creating a new car prototype from six months and several hundred thousand dollars to four days and $4,000, and you begin to see its power.

Traditional manufacturing of mechanical parts involves making a mould and then stamping out parts by thousands every day. The equipment to make these parts and moulds is expensive, thus the cost of the first hundred units is high. Per unit costs decline only when they are mass produced. Because of limitations of how this technology works, one typically builds many small parts, which are later on assembled on an assembly line using unskilled labour or robots to build an entire system. Traditional manufacturing leads to high inventory costs of multiple parts that need to be produced and stored before being assembled. This makes the design phase complex and costly, rendering it expensive to redesign to correct initial mistakes or innovate to meet changing consumer needs.

In additive manufacturing, the physical object to be built is first designed in software. This design is fed to computerised machines, which build that object layer by layer. The technology is suitable for building the entire system in one go, with hollow interiors without assembly or interlocked parts. Changing features or tweaking shapes is a simple software change effected in minutes. Retooling of machines is not required and each unit can be customised. By eliminating the need to hold a large inventory of parts, set up an assembly line and purchase costly machines, adaptive manufacturing reduces capital and space requirements as well as the carbon footprint.

Additive manufacturing started out as a technology for nerds and geeks trying to build an arm of a robot or a body of a drone in their garages. Rapid progress in technology over the last five years has taken this type of machines from using one nozzle and simple resin materials to multiple nozzles, diverse materials and materials with different hardness in the same system. Today it is possible to build an entire shoe, including shoelaces, in a university laboratory. Tomorrow, Adidas and Nike may well start manufacturing them en masse.

Although it began as a quick and cheap way of developing prototypes, additive manufacturing has now gone mainstream in developed countries and is beginning to replace traditional manufacturing for many different applications. One recent survey of U.S. manufacturers shows that about 12% have started using additive manufacturing for their products and expectations are that this will result in about 25% of products in the next three-five years. This technology is

used to build helmets, dental implants, medical equipment, parts of jet engines and even entire bodies of cars. In some industries, the progress is astonishing. Nearly all hearing aid manufacturers now use additive manufacturing.

This technological nirvana carries dangerous implications for developing nations. It decreases reliance on assembly workers and bypasses the global supply chain that has allowed countries like China to become prosperous through export of mass-produced items. This may well lead to the creation of software-based design platforms in the West that distribute work orders to small manufacturing facilities, whether located in developed or developing countries, but ultimately transfer value creation towards software and design and away from physical manufacturing. This would imply that labour intensive manufacturing exports may be less profitable.

Fortunately, this manufacturing paradigm has several features that play to the strengths of the Indian ecosystem. First, it eliminates large capital outlays. Machines are cheaper, inventories can be small and space requirements are not large. Thus, jump-starting manufacturing does not face the massive hurdle of large capital requirement and the traditional small and medium enterprises can easily be adapted and retooled towards high technology manufacturing. Second, the Indian software industry is well-established, and plans to increase connectivity are well under way as part of ‘Digital India’. This would allow for the creation of manufacturing facilities in small towns and foster industrial development outside of major cities. Third, it is possible to build products that are better suited for use in harsh environmental conditions. Products that required assembly of fewer parts also implies that they may be better able to withstand dust and moisture prevalent in our tropical environment and be more durable. Fourth, in a country where use-and-throw is an anathema, maintaining old products is far easier because parts can be manufactured as needed and product life-cycles can be expanded. Finally, maintaining uniform product quality is far easier because the entire system is built at the same time and assembly is not required.

For countries that have already invested in heavy manufacturing, this shift to adaptive manufacturing will be difficult and expensive. For new entrants, it is easier to leapfrog. The “Make it the Indian Way” approach we advocate will need public-private partnership and multi-pronged efforts. On the one hand, we need to accelerate research at our premier engineering schools on manufacturing machines and methods and encourage formation of product design centres so that the products built suit the Indian environment and consumers. We also would need government support to provide incentives for distributed manufacturing in smaller towns, and for the IT industry to work on creating platforms and marketplaces that connect consumer demands, product designers and manufacturers in a seamless way.

However, a combination of science and art, with a pinch of Indian entrepreneurship thrown in, will allow us to develop a manufacturing ecosystem that will not only allow India to compete with global manufacturing, it will also create products that are uniquely suited to Indian conditions. The Industrial revolution somehow bypassed India, but we have a unique opportunity to catch the wave of the manufacturing revolution if we can learn to surf.

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