Industry 5.0 and its applications in orthopaedics

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Dear Editor,

A revolution of IT-enabled smart manufacturing has evolved and is commonly known as Industry 4.0. This revolution is helping the manufacturing of customised medical implants/tools/devices with the use of smart machines, Internet of Things (IoT), cyber-physical system, cloud, artificial intelligence (AI) and cognitive computing and is to create a smart network through intelligent devices.¹

Nowadays we are looking beyond for Industry 5.0, which is the personalisation of products. The term Industry 5.0 was introduced in 2015 and is now being termed as "fifth industrial revolution" which is envisaged to have a significant impact also in different medical areas along with civil society, and manufacturing, especially for day to day life businesses.² It is an emergent artificial intelligence using components of Industry 4.0 along with Internet of Everything (IoE), emergent artificial intelligence, digital ecosystem, multi-agent systems etc., whereas different components of Industry 5.0 are shown through Fig. 1.

Industry 5.0 shows an increased collaboration between human and smart system through highly accurate industrial automation backed by critical thinking skills. It is to provide efficient tools that help to make organisation competitive and to works on Industrial upcycling which have the ability to immediate changes without any capital investment.³

Therefore, there is strengthening of contemporary manufacturing with advanced manufacturing technologies, and software's support including additive manufacturing, internet of everything, robotics and software with the use of the applications of technological advancements, Industry 5.0 to be introduced in manufacturing, medical and other associated fields. This revolution is to fulfil the highly personalised (customised) demand for products/services in medical and orthopaedics.

Personalisation is a higher level of customisation, here industry/producer or brand understands the specific customer needs and meets the same, without even customer asking for the change or liking. As customer personalisation is the "Aha" moment that a patient understands is just right from the start.

Personalisation is a crucial part of customer experience, with intelligent use of data allowing marketers to create relevant and unique experiences that hold attention for longer and generates loyalty in the long-run. With personalisation, it fulfils the significant requirement for the manufacturing of different human implants with improved efficiency. It is only possible with close cooperation between man & machine and recycling of resources. It creates a virtual environment by efficiently utilising of machines and technologies.

Industry 5.0 allows the manufacturing of a personalised smart implant accurately as per the changing customer requirements. However, this is conceptual. The medical profession is moving toward artificial intelligence that measures different issues such as glucose level in blood deliver insulin into the blood and tweak the control system. Industry 5.0 can change a life with different technologies. It tends to automate the manufacturing system in a better way by creating smart factories, and manufactured product communicates digitally. The industrial robot will automate the entire production process and act as the back seat of human intelligence in this revolution.⁴

Industry 5.0 is to help implement mass personalisation by creating implants as per patient match which is the primary requirements of orthopaedics. It will change the traditional manufacturing methods of patient's implants and is capable of upgrading different tools and devices. Technologies used in this revolution are also helpful to perform surgery in a more precise way. It is also helpful for a medical student to provide the best education, teaching, learning, treatment, research and development process.³

In orthopaedics, the industry needs high quality customised implants with extended life that can be personalised. Industry 5.0 is to solve different challenges such as overproduction, lack of transparency and wrong tool selection. This revolution is to impact product

Fig. 1. Different components of Industry 5.0.

reliability, product lifecycle, profit, efficiency, service and business model, IT security, environment, machine and human safety.⁵ It will reach world to global business by creating good interaction between human and machines.⁶ It connects smart manufacturing system through devices to create better automation with the power of human brains.⁴ Industry 4.0 creates digitisation, where different technologies and devices like smart machines, data analytics and artificial intelligence automate the manufacturing process. Whereas, the main application of Industry 5.0 is personalisation. It focuses on the co-operation between man and machine leading to the mass customisation and personalisation for the customer. Human intelligent worked with cognitive computing and upskilled to provide value-added task in production. It allows the customer as per personal needs.

Industry 5.0 is helpful to provide high-quality personalised implants, tools and devices with a required range of specification as per the patient's requirements. In future, this revolution will be helpful in orthopaedics by solving problems over a long-term gentle life cycle. It can take data of diseases from the different set of patients, analyses them and efficiently make changes in the detecting the personal level of diseases and assisting in treatments without even patient asking for the same. In upcoming years, it will enhance the role of machines and human resources that provide creative & innovative ideas in medical and orthopaedics fields. It provides high-quality personalised implants and gadgets.

Conflicts of interest

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jcot.2018.12.010>.

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