Kakavas G, et al., J Phys Med Rehabil Disabil 2022, 8: 075
DOI: 10.24966/PMRD-8670/100075
HSOA Journal of
Physical Medicine, Rehabilitation and Disabilities

Editorial

Is Virtual Twins Technology the Future in Sports Medicine?

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Introduction

Digital twins' techs have come a long way. The term digital twin in the present context was originally used by John Vickers of NASA in 2002. But digging a bit deeper will show that the concept itself is much older [1]. It was first applied in the 1970s during the Apollo XIII space program and NASA scientists needed to work with devices in outer space where it's almost impossible to be physically present and these virtual outcomes were extremely helpful [2].

Digital twins sound like science fiction, but they are a real technology now. And they're making huge steps in the healthcare sector among others. In short, this technology allows us to create a virtual representation of a physical object, athlete or system [3]. The options have expanded during recent years to include huge items such as buildings, factories, cars, airplanes and even people. Tech companies evolve digital twins technology as the virtual representation of a physical object or system across its life cycle. It uses real-time data and other information from sensors or wearables in healthcare to enable learning, reasoning, and dynamically recalibrating for improved decision making for many health problems. In short, they are highly complex digital models that are the counterpart, or twin, of a physical thing [4]. These 'things' could be a car, a tunnel, a bridge, or an athlete. Connected sensors on the physical asset collect data that can be mapped onto the virtual model. Anyone looking at the digital twin can now see crucial information about how the physical thing is doing out there in the real world [5]. So the definition is that "A digital twin is a virtual representation of an object or system or a human body that spans its lifecycle is updated from real-time data and information and uses simulation, machine learning, neural networks and reasoning to help decision-making" [6].

New technology like digital twins which we define here as a living replica of a physical system (human or non-human). A digital twin combines various emerging technologies such as AI (Artificial Intelligence), the Internet of Things, Big data and machine learning, robotics, each component bringing its socio-ethical issues to the resulting artifacts. The question thus arises which of these socio-ethical themes surface in the process and how they are perceived by stakeholders in the field. A digital twin is a living model of the physical asset or system, which continually adapts to operational changes based on the collected online data and information, and can predict the future or test the limits of the corresponding physical counterpart [7].

With this information and tech, organizations can learn more, faster and make better decision making about treatments and performance tests. They can also break down old boundaries surrounding product innovation, complex life cycles, and value creation.
Digital twins help manufacturers and engineers accomplish a great deal, like:

- Visualizing products in use, by real users, in real-time
- Building a digital thread (injury?), connecting disparate systems, and promoting traceability
- Refining assumptions with predictive analytics
- Better decision making
- Managing complexities and linkage within systems-of-systems like human health.

How can we apply Digital Twin in Medicine?

How can we apply Digital Twin in medicine and more precisely in sports medicine decision-making for return to play or injury prevention programs??

The use of digital twins in the healthcare industry is revolutionizing clinical processes and hospital management by enhancing medical care with digital tracking and advancing modelling of the human body [8].

Creating real-world scenarios, virtually a doctor or a physio testing an athlete, for example, would run a software simulation to understand how the system would perform in various real-world scenarios. This method has the advantage of being a lot quicker and cheaper than avoiding a re-injury before testing in the pitch. But there are still some shortcomings. First, computer simulations like the one described above are limited to current real-world events and different scientific and other scenarios. They can't predict how the athlete will react

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Citation: Kakavas G, Malliaropoulo N, Mitrotasio M, Tsaklis P, Bikos G, et al. (2022) Is Virtual Twins Technology the Future in Sports Medicine?. J Phys Med Rehabil Disabil 8: 75.

Received: July 08, 2022; **Accepted:** July 25, 2022; **Published:** August 01, 2022

to future scenarios and changing circumstances. Second, humans are more than muscles and bones. They're also comprised of millions of lines of code because they are complex systems non-linear organisms [9].

The Digital Twin technology can also be used for modeling an individual's genetic makeup, physiological characteristics, and lifestyle to create personalized medicine. It has a more individualized focus than precision medicine which typically focuses on larger sample groups [10]. The goal of replicating the human body and creating fully functioning tech twins of its internal systems is to enhance medical care and rehab and athlete treatment. Ideally, data scientists and developers will be able to leverage the partnership to quickly and easily build, train, and deploy machine learning models, to develop capabilities that may ultimately help predict and prevent injury to athletes [11].

Sports trauma is a complex emergent phenomenon and needs to be seen through a "lens of complexity". In this case, we should seek to identify features that are present in complex systems:

1. The pattern of relationships (interactions) between units (determinants).
2. The regularities (profiles) that simultaneously characterize and constrain the phenomenon,
3. The pattern that arises from the complex web of determinants [12].

Since injury is a complex phenomenon characterized by uncertainties and inherent non-linearity, an ACL injury (one of the most devastating injuries an athlete can have) will emerge when a specific pattern of interaction happens in the presence of an inciting event of a given value. Thus, the best manner to predict or rehab an injury is by understanding the interactions among the web of determinants and not the determinants themselves [13].

NFL's has been collected data sets from numerous sources including historical and current video feed, player position, and play type, equipment choice, playing surface, environmental factors, and aggregated and anonymized player injury information will all be used to support the project of injury prevention cause they cost money and affect the sports performance of the organizations [14].

Sports organizations are partnering to develop a "digital athlete" platform, which creates a computer simulation of NFL players to model "infinite" scenarios. NFL will feed historical and current data into the platform, including video feeds, player position, plays, equipment, environmental information, and injury reports, according to the announcement. The NFL will use its digital athletes to model scenarios, but it could use derived insights to inform player performance and augment their capabilities [15]. It's important to be neither too simplistic nor too broad when creating a model for a digital twin and to be selective i4.n choosing where to begin and choose the right steps to make the better decision making and what outcomes we need to interpret [16]. Digital Twins tech can be described and take the next steps of evolution.

Imagine

To begin, think about which products or systems could benefit most from having a digital twin. Good candidates normally have two characteristics. First, they are valuable enough to justify the investment. And second, there are unexplained process- or product-related problems that could potentially unlock value for the organization or sports team.

Identify

After creating a shortlist of potential scenarios, assess them for suitability for a pilot testing, taking operational, business, and organizational factors into account. Good examples include systems or components that have high variability in the manufacturing process-made-to-order or advanced configurations, for instance-and those that drive quality for a better product or service (treatment). It can be a good idea to focus on areas with the potential to scale across equipment, treatments or rehab strategies, or technologies.

Pilot

Consider moving quickly into a pilot program using different cycles to accelerate learning, manage risk proactively, and maximize return on initial investments. As soon as that initial value has been delivered, it's crucial to communicate it to the stakeholders.

Industrialize

Once success is shown in the field, companies can industrialize the digital twin development and deployment process by compiling insights and publishing them broadly. This step may include moving from a siloed implementation to integration into the enterprise, implementing a data lake, improving governance and data standards, and making crucial changes to support the digital twin.

Scale

Once successful, identify opportunities to scale the digital twin technology in real practice. Target adjacent or interconnected processes. Use lessons learned and tools, techniques, and playbooks developed during the pilot to scale expeditiously. Along the way, continue to communicate the value realized to the organization.

Measure

Identify the tangible benefits in cycle time, yield throughput, quality, utilization, incidents, and cost per item or system, for example. Make changes to digital twin processes iteratively and optimize the configuration.

Our paper has shown that the digital twin is still, at the current technology level, almost indistinguishable from already-existing efforts to digitalize and evolve the healthcare process and sports medicine [17]. The digital twin might of course in theory different from the (less emerging, more established) digital model or digital shadow. But until the connection between the athlete and the model is brought to life, the two worlds will share socio-ethical benefits and socio-ethical risks. Content, quality, and ownership of data are central to these efforts and given the importance, stakeholders attach to these issues, it might not be farfetched to say that if these issues are solved, the digital twin will penetrate the socio-ethical system fast and with the support of all helixes [18].

References

1. Grieves M (2015) Digital Twin: Manufacturing Excellence through Virtual Factory Replication. LLC, USA.
2. Qi Q, Tao F (2018) Digital twin and big data towards smart manufacturing and industry 4.0: 360 degree. comparison. IEEE Access 6: 3585-3593.
3. Tao F, Zhang M (2017) Digital twin shop-floor: A new shop-floor paradigm towards smart manufacturing, IEEE Access 5: 20418-20427.

4. Barricelli BR, Casiraghi E, Fogli D (2019) A survey on digital twin: Definitions, characteristics, applications, and design implications. IEEE Access 7: 167653-167671.

5. Vachalek J, Bartalsky L, Rovny O, Sìsmìsovà D, Morhac M, et al. (2017) The digital twin of an industrial production line within the industry 4.0 concept. in Proc. 21st Int. Conf. Process Control (PC), Bratislava, Slovakia 258-262.

6. Barricelli BR, Valtolina S (2017) A visual language and interactive system for end-user development of internet of things ecosystems. J. Vis. Lang. Comput 40: 1-19.

7. Zhu L, Mussio P, Barricelli BR, Iacob C (2010) A habitable space for supporting creative collaboration. in Proc. Int. Symp. Collabo- rative Technol. Syst. (CTS) 617-622.

8. Zhu L, Barricelli BR, Iacob C (2011) A meta-design model for creative distributed collaborative design. Int. J. Distrib. Syst. Technol 2: 1-16.

9. Björnsson B, Borrebaeck C, Elander N, Gasslander T Gawel DR, et al. (2019) Digital twins to personalize medicine. Genome Medicine 12: 1-4.

10. Brey P (2012) Anticipatory ethics for emerging technologies. Nano Ethics 6: 1-13.

11. Bruynseels K (2020) When nature goes digital: Routes for responsible innovation. Journal of Responsible Innovation 7: 342-360.

12. Bruynseels K, Santoni F, Sio D, Hoven JVD (2018) Digital twins in health care: Ethical implications of an emerging engineering paradigm. Frontiers in Genetics 9.

13. Bittencourt NFN, Meeuwisse WH, Mendonça LD, Aguirre AN, Ocarino JM, et al. (2016) Complex systems approach for sports injuries: Moving from risk factor identification to injury pattern recognition-narrative review and new concept British Journal of Sports Medicine 50: 1309-1314.

14. Coffey DS (1998) Self-organization, complexity and chaos: The new biology for medicine. Nat Med 4: 882-885.

15. Rickles D, Hawe P, Shiell A (2007) A simple guide to chaos and complexity. J Epidemiol Community Health 61: 933-937.

16. Philippe P, Mansi O (1998) Nonlinearity in the epidemiology of complex health and disease processes. The or Med Bioeth 19: 591-607.

17. Meeuwisse WH, Tyreman H, Hagel B, Emery C (2007) A dynamic model of etiology in sport injury: The recursive nature of risk and causation. Clin J Sport Med 17: 215-219.

18. Kakavas G, Malliaropoulos N, Pruna R, Maffulli N (2020) Artificial intelligence: A tool for sports trauma prediction. Injury 51: 63-65.

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