

Digital Twins–Part 2

Roberto Saracco , University of Trento, 38122, Trento, Italy

Patrick Henz , Risk & Compliance at a Metals Industry Company, Alpharetta, GA, USA

The Special Issue on Digital Twins received so many valuable contributions that we have split the selected articles into two issues, with this being the second one. For those who haven't had the chance to look at the first issue, which was published in May/June 2022, we encourage you to do so and to read the Guest Editor's Introduction that provides a general overview of the topic.¹

In the first special issue, we clustered the articles presenting the applications of digital twins in industrial frameworks, while in the second issue, we have clustered those focusing on digital twins mirroring humans or having strong interaction with humans, plus a closing article that shows how to develop digital twins, as we felt this is of general interest and an appropriate way to close this topic. Figure 1 shows that the digital twin topic picked up steam in 2016 (13 points in the Google Index), jumped to 60 in June 2019, and reached 93 in March 2021.

This second special issue opens with the article "Empowering Citizens With Digital Twins: A Blueprint." This is a topic of growing interest, as we have seen through the pandemic. Digital twins operate in cyberspace, but they are also a gateway to cyberspace, bridging the physical with the digital world. When connecting citizens, they can provide awareness by making the meaning of cyberspace available to citizens. We can expect this digital twin role to increase in the coming years as more and more intelligence can be extracted from cyberspace.

The second article, "A Vision for Leveraging the Concept of Digital Twins to Support the Provision of Personalized Cancer Care," is connected to the previous one in the awareness space, although this awareness plays both ways: making the healthcare establishment aware of the effect of the cure (and even predicting its effect) and making the patient aware of what is going on. We expect that there will be a significant evolution in this area as the whole healthcare sector is shifting

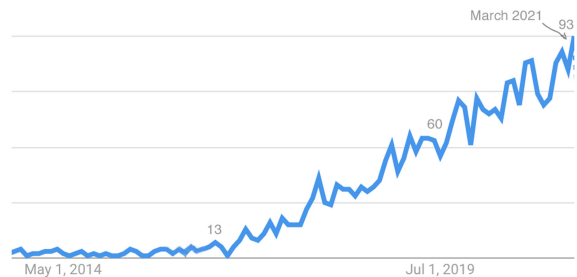


FIGURE 1. Growing number of searches for Digital Twins. Source Google Trends (accessed on March 2021).

towards personalized and proactive cures. This expected evolution and the role of digital twins in this shift is nicely presented in the third article, "Pervasive and Connected Digital Twins – A Vision for Digital Health."

The fourth article, "Digital Twin in the Military Field," touches on an area that we expect will make a massive use of the digital twin concept, but about which not much information is available. It has been predicted that future wars will be played more in cyberspace than in the physical space, and bridging the two will be a key aspect. Shared intelligence in the battlefield which leverages data processed in cyberspace will likely become a crucial factor.

The fifth article, "The Forging of Autonomic and Cooperating Digital Twins," is particularly interesting since it opens the door to the expected evolution of digital twins as autonomous entities, which is usually seen as digital twins at stage V. At that point, digital twins will become much more than a digital mirror of a physical entity, they will have an autonomous life that will remain coupled to their respective physical twin but, at the same time, will enable them to provide enhanced functionality to their physical twin by exploiting cyberspace. This will require a shift from a paradigm based on syntactic standards for cooperation to semantic ways of sharing context.

The closing article, "Construction of a Digital Twin Framework Using Free and Open-Source Software Programs," is interesting because it provides a guide to developing digital twins. It is in line with the trend of "low code – no code," aimed at expanding the capability

of industry (and researchers in general) by making it possible to create functions in cyberspace using an approach similar to Lego bricks. Users can focus on the goal without having to learn the tools that need to be used to reach that goal.

We hope you will enjoy this second issue, and if you missed the first one, we encourage you to read it.

We would like to close this introduction by thanking the publisher for their support and, of course, the authors who submitted their contributions. We equally thank those whose work we were able to include, as well as those we were not able to include due to space constraints.

REFERENCES

1. R. Saracco and P. Henz, "Guest Editor's Introduction: Digital Twins—Part 1," *IEEE Internet Comput.*, vol. 26, no. 3, pp. 5–6, May/June 2022, doi: [10.1109/MIC.2021.3088318](https://doi.org/10.1109/MIC.2021.3088318).

ROBERTO SARACCO is a lecturer with the University of Trento, 38122, Trento, Italy, and is a senior advisor of the Reply Group. Contact him at roberto.saracco@gmail.com.

PATRICK HENZ is head of Governance, Risk & Compliance at a Metals Industry Company, Alpharetta, GA, USA. Contact him at cerpheus27@gmail.com.



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