

Virtual Human Digital Twins: A key tool for new patterns for prediction and prevention

This EHTEL **Imagining 2029** webinar, held in conjunction with the **COMFORTage project**, explored the current and potential uses of **virtual human digital twins**. It gathered together more than 150 attendees to learn more about the potential of this crucially **disruptive innovation**. Ultimately, much information was shared about how **an ecosystem** can collaborate on these twins. The webinar was introduced and facilitated by EHTEL General Secretary, **Marc LANGE**, and Digital Health Facilitator, **Luc NICOLAS**.

Among the afternoon's themes, the webinar:

- Indicated the key actions supported by the European Commission in the context of the **European Virtual Human Twins Initiative**.
- Explored the history of virtual digital twins and how they have developed thanks to **machine learning** and **big data** and are now evolving towards **personalised medicine**.
- Covered the use of this disruptive innovation in contexts such as **cardiovascular diseases, dementia, and frailty**.
- Commented on how a large-scale project, like COMFORTage, can work on being part of an **ecosystem**.
- Highlighted how a dynamic ecosystem is a pre-requisite to move forward **concrete European work on virtual human digital twins**.

WHAT ARE VIRTUAL DIGITAL TWINS?

Digital twins are precise **digital replicas of physical entities** such as patients, medical devices, or biological systems. These digital models are continuously updated with real-time data and can simulate various processes, predict outcomes, and support decision-making in healthcare. Digital twins hold significant promise for **transforming healthcare**, including management and delivery, disease prediction, prevention and treatment, and health well-being maintenance, ultimately improving human life. What is key? Continued **research, technological advancements, and collaborative efforts** – like ecosystems and data sharing platforms – are essential to achieve the potential of this technology.



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WHAT DID THE SPEAKERS SAY?

The webinar:

- Offered **five stakeholder viewpoints** on virtual human digital twins.
 - Presentations were made by a European **civil servant** (policy officer), a university hospital **clinician** and a university **researcher**, a **software developer**, and the **project coordinator** of an EU-financed coordination support action on digital twins.
- Responded to important **questions** about virtual human digital twins, including **patient** involvement in its further development, through a panel question-and-answer session.
- Conducted three short **polls** on attendees' experiences of and impressions about digital twins.

The five speakers were:

- **Margherita FANOS**, Policy Officer, European Commission: **The EU strategic viewpoint**
- **Frank RADEMAKERS**, former CMO & CMTO UZ KU Leuven, Belgium: **The clinician viewpoint**
- **Frank EMMERT-STREIB**, Professor at the Predictive Society and Data Analytics Lab, Tampere University, Finland: **The researcher viewpoint**
- **Stelios KOKKAS**, Artificial Intelligence Researcher, CERTH, Greece: **The developer viewpoint**
- **Enzo FABIANI**, Project manager of the Cooperation and Support Action EDITH on Digital Twins in Healthcare, Pi School, Italy: **Pathways for increased collaboration of the value chain.**

IN MORE DETAIL...

- **Margherita FANOS**, Policy Officer, European Commission: **The EU strategic viewpoint**

Ms FANOS described the [European Virtual Human Twins Initiative](#), which aims to advance the emergence and adoption of the **next generation** of virtual human twins solutions in health and care. She detailed **how virtual twins can be used**, in the health and care fields, to assist e.g., European leadership, the work of healthcare professionals, drug discovery, personalised medicine, medical education and training, and medical research. The European Union is working hard to strengthen these approaches, including through a **Manifesto**. In terms of what she called "*the last mile*", she emphasised the importance of **integrated technologies** working on clinical concerns like cancer, cardiology, mental health, and preventive medicine as well as the Commission's desire that, overall, current and future initiatives should **be inclusive** in their approach. She also referred to a strategic, ongoing, procurement action targeting the creation of an Advanced Platform for Virtual Health Twins (VHT) Models Integration & Validation. This platform holds the promise of becoming **the cornerstone** of the Virtual Health Digital Twins (VHDT) ecosystem.

- **Frank RADEMAKERS**, former CMO & CMTO UZ KU Leuven: **The clinician viewpoint**

As a **cardiologist**, Professor RADEMAKERS, offered his clinical viewpoint on **digital twins**. His talk covered plenty of areas of literature, history, and documentation. A number of problems can be alleviated by digital twins. A first example offered was that of the [DestineE](#) platform that mimics a **replica of planet earth**. Indeed, in 2023, the European Commission launched an initiative on [virtual worlds](#). In the **health field**, many **unsolved challenges** remain, however: unmet needs; rapidly increasing demand for care; scarcity of resources and health staff; a lack of diagnoses; under-use of preventive medicine; and data overload. Why not search therefore for “*achievable health*” based on/around “*re-usable data*”? Beyond data, information, and knowledge, the search is now on for “*real wisdom and impact*.”

Scientifically, Professor Rademakers showed a considerable interest in **deep digital phenotyping**.

Pragmatically, however, he pointed out that - far less than intellectual/conceptual understanding - what often “*nudges*” people to act positively behaviourally in terms of their health, are often **feelings** or **emotions**. In terms of supporting literature, he was keen to point out the most recent work of the late Nobel Prize winner, Daniel KAHNEMAN and colleagues on **challenges to decision-making** (not only in the health and care environments). Not only **behavioural**, but also **social and environmental characteristics**, are important when making decisions, however. Professor Rademakers sees virtual health digital twins as a “*coach*” for healthcare professionals and patients (which can then help to address some **critical gaps**). To fill in those gaps, one should start from the needs of patients and healthcare professionals, gather the relevant information, and interpret that information. Ultimately, digital twins, however, can only be “*as good as their data source*”.

- **Frank EMMERT-STEIB**, Professor at the Predictive Society and Data Analytics Lab, Tampere University, Finland: **The researcher viewpoint**

Professor EMMETT-STREIB started his talk by offering a **range of definitions** of mirrored spaces and mirrored worlds, from 2005 onwards. Today, these domains are known as digital twins. His own work on digital twins has been in the field of **data science**. The talk looked back, **historically**, at the way in which the focus on **virtual interventions**/digital twins has been built up through earlier work on statistics, big data, and deep neural networks. If, as an example, a digital twin is used in pharmaceutical research it can permit a **test drug to be tried out on a data model** (as opposed to a live patient). To summarise, researching digital twins is a little like working on a **Matryoshka (Russian) doll**: the efforts made are nested and consist of many layers. Digital twins can certainly help researchers with making virtual interventions and are likely to **become more useful over time**.

- **Stelios KOKKAS**, Artificial Intelligence Researcher, CERTH: **The developer viewpoint**

Stelios KOKKAS, an engineer, is a member of a **developer network** that works on health digital twins. Areas of work include **data** aggregation, data modelling or simulations, artificial intelligence/machine learning, real-time data processing, and visualisation tools. In the health field, digital twins may help different categories of people to understand the health implications of various activities like **breathing, diabetes, nutrition, and sleep**.

Internationally, not only is the European Union/European Commission working on digital twins but also e.g., global firms like [Siemens Healthineers](#) and smaller companies like California-based, [TwinHealth](#). Mr Kokkas examined briefly various aspects of **data** (such as sources, data integration, data privacy and security, data modelling and simulation, and useful simulation sites and programming languages), as well as **artificial**



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intelligence (AI). AI use will, in the [COMFORTage project](#), be tested in health fields like **dementia** and **frailty** in **13 pilots**.

- **Enzo FABIANI**, Project manager of the Cooperation and Support Action EDITH on Digital Twins in Healthcare: **Pathways for increased collaboration of the value chain**.

The [EDITH coordination support action](#) has spent two years working on digital twins. As the support action's formal title suggests, the focus has been on fostering **an inclusive ecosystem** for digital twins in healthcare in Europe. This talk ranged over the **barriers** facing the use of digital twins in healthcare and what policymakers can do to tackle them. EDITH's work has had many aspects: undertaking **hackathons** ('modellathons'), designing a future **roadmap**, gathering **use cases**, strengthening **crowdsourcing** of data, and exploring **value creation** (and improved management of costs). It has also used **a tool** like Alex Osterwalder/**Strategyzer's [business model canvas](#)**. EDITH's priority has been on bringing added value from digital twins in the health field to the many **stakeholders** involved: European policymakers, hospitals and information technology departments, research laboratories and innovators, and regulatory and legal staff. Clearly, the ever-present **hurdles need to be transformed into opportunities**. This impetus is "*more than about isolated digital twins*". Actual virtual twin use cases are the **seeds for scalable business models**: examples include clinical decision support systems; personalised medical products; and real time data acquisition for intensive care management. Various key **partnerships** are crucial (including **public-private partnerships**). In Mr Fabiani's own words, "*We must do our work [in this field] if we want to be competitive, [creating] new markets and new partnerships.*"

WHAT DID THE PANEL OFFER?

Animated by **Luc NICOLAS**, EHTEL digital health facilitator, before the panel was started, some rapid feedback was offered on the **polls** undertaken during the course of the webinar.

Three polls had been organised. In terms of the **length of time** digital twins have been around, some attendees had first heard of digital twins several years ago; others only during the last 2-3 years. The **definition** of digital twins most often used by attendees was one developed by the American [National Space and Aeronautics Agency](#) (NASA). In terms of **who will benefit most (quickly) from digital health twins**, pharmaceutical companies featured conspicuously among the responses indicated; the personnel involved in the prevention of diseases less so.

During the panel, various **questions** were posed to the speakers/panellists. They partly focused on the potential of **a future European platform/ecosystem** on digital health twins. They explored the relationship between digital twins and **medical devices**. They looked into predictions of future time horizons for the **actual practical implementation** of digital health twins, and their use in e.g., **hospitals**. How can **citizens/patients and their data** become more involved? More specifically, the panellists reflected on:

- Will future European Union funding for [a platform for digital twins](#) be used by all types of innovation projects? And by all clinical organisations?
- Would the existence of such a platform change the **work of COMFORTage**?



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- What types of **ecosystems** ('**data lakes**') can be joined together?
- Are virtual human digital twins included under the umbrella of '**medical devices**'?
- When – in the future – can the use of digital health twins be **expected to materialise practically**?
- Which kinds of organisations (especially **hospitals**) will make use of digital twins in their **daily practice**?
- At **what stage** of any digital twin initiative should **citizens** be involved?
- What opinions do panellists have on including **patients' own data reporting** in any data set?

WHAT'S NEXT?

The **video recording and presentations** from this session were made public on the [EHTEL website](#).

The work of COMFORTage will be explored further in-depth in EHTEL's [4 December 2024 25th Anniversary Symposium](#).

The **notion of 'twins'** has featured often in recent European Union-related work: first, in the '**twin transition**' of digital and of green activities; second, in **twinning** between different locations, sites, and personnel. More dedicated towards health, at least two 2023-2024 health-related European Commission calls for project proposals have mentioned **digital twins** in their content. One call, already closed, was on personalised prevention for non-communicable diseases: successful project proposals are currently being negotiated. Another call, closing on **26 November 2024 17 00 CET**, is about creating [a partnership for pandemic preparedness](#).

WHAT IS THE COMFORTAGE PROJECT?

The [COMFORTage project](#) is a **large-scale project** that is focused on 13 pilots related to the prevention, monitoring, and offering of personalised recommendations on the prevention and relief of **dementia** and **frailty**. Key to its work is the use of AI.

WHAT DOES EHTEL DO IN COMFORTAGE?

EHTEL is **supporting** COMFORTage, all its pilot sites, and innovators/tech companies in:

- Reaching quality.
- Developing **innovative solutions** and deploying innovative services.
- Preparing **exploitation** that results from these innovations.



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- Developing **synergies** with other large-scale pilots and initiatives (thereby enabling a second generation of the [European Health & Care Cluster for Large-Scale Pilots.](#)).
- Creating **policy messages** related to Active and Health Living in a Digital World.

This webinar was organised by EHTEL in collaboration with [COMFORTage](#).

