



PROJECT DELIVERABLE REPORT



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Advanced personalised, multi-scale computer models preventing osteoarthritis
SC1-PM-17-2017 - Personalised computer models and in-silico systems for well-being

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1.3	19/04/2021	Kyriacos Felekis (UNIC)	Review of the first draft - Minor changes

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1 Summary

This Deliverable is part of WP 10 and in particular Task 10.5: Organizing the OActive Workshop and training Sessions. This report describes the Workshop organized by AXIA Innovation in collaboration with CETRI, regarding the “Personalised predictive models”, focusing on 1) the scope of the workshop, 2) the agenda, 3) the target groups, 4) the workshop content (including presentation of the OActive concept and outcomes, as well as the presentation of the cluster projects advancements) and 5) feedback provided regarding the workshop, and the OActive concept and impact to society. The workshop was held online on the 26th of March 2021 and presenters from the consortium and some of our cluster projects (namely SILICOFCM, PRECISE4Q, BackUp, InSilc, CarBon, and EUSTANDS4PM) were invited to talk about their projects' outcomes. Invited projects were selected based on their focus in providing personalised solution in healthcare, with the aid of predictive modelling. The workshop allowed having an overview of all the medical fields where the predictive models can be applied, bringing together experts and the general public from all over Europe.

2 Introduction

The present Report on Deliverable 10.7 “OACTIVE dissemination workshop” summarises the activity developed during the workshop on “Personalized predicted models” organized under the OActive project. In order to ensure the wide-scale uptake of knowledge and technology generated within the sector of predictive models for medical application, AXIA Innovation has organized a workshop to present the main outcomes of the project, inviting also speakers from other projects working in related concepts.

The workshop was held online on the 26th of March and the aim was to involve and inform the general public including important key players in the medical sector. To set up the event, AXIA Innovation led the organization according to the following strategic steps: i) identification of the key speakers, ii) structure the agenda and dissemination material iii) dissemination of the event through social media, the project website as well as the company’s website.

The workshop included presentations of the main OActive technologies, including Biomechanical predictive models for Osteoarthritis management and Augmented reality (AR) interventions for Osteoarthritis, as well as a discussion on the exploitation strategy for OActive results. Additionally, similar EU-funded projects presented their work in the area of personalized or predictive medicine, concerning their respective projects.

2.1 Purpose and Scope

One of the main objectives of this workshop was to familiarise the audience with the predictive modelling opportunities offered in particular when addressing medical challenges in different fields, including, pain-related chronic diseases like osteoarthritis, neck and back pain, heart conditions, and strokes, among others. The workshop highlights the key technologies applied and tools used to improve the quality of life of the patients.

The main focus was to give some insights on the Biomechanical predictive models for Osteoarthritis management and Augmented reality (AR) interventions for Osteoarthritis, developed in the framework of the project. In addition to the specific OActive application, scientists working in similar EU project namely [SILICOFCM](#), [Precise4Q](#), [EU-STANDS4PM](#), [Back-UP](#), [Insilc](#), and [CarBon](#) had the chance to present their work in the field of personalised predictive medicine. CETRI has undertaken the identification and initial communication with the cluster projects as being the responsible of building the OActive community (see also Task 10.4: Clustering Activities). The projects focus on the development of predictive simulation computer models enabling personalised disease treatment. Through the projects the need to focus on prevention, early prognosis and rehabilitation was highlighted. The developed prognostic models are addressed to patients, clinicians, health care providers, occupational managers, etc. Moreover, light was shed to harmonised transnational standards, recommendations and guidelines that allow a broad application of predictive in silico methodologies in personalised medicine across Europe.

Therefore, this workshop has given a great opportunity to raise awareness about these new technologies which are under development. Thanks to the workshop a wider audience will be able to:

- understand the risk factors for the development and progression of OA, cardiomyopathies, stroke, Back and Neck pain etc.
- provide personalised interventions
- simulate and predict optimal treatments, better diagnostics, and improved patient outcomes
- promote patients’ improved quality of life
- inform health industry on alternative practices in several medical fields
- improve healthcare by transforming and accelerating diagnosis and prediction

- offer both clinical assessment and rehabilitation options, through Augmented reality (AR) practices
- expand & improve the currently limited opportunities for rehabilitation scenarios
- enhance primitive spatial and temporal training scenarios
- addresses staff and facility limitations as well as human factor

2.2 Preparation for the meeting

A consortium meeting was organized to decide the main topics of the workshop and to make a list of the possible invited speakers.

The final agenda was created by AXIA Innovation, and distributed among the participants (Figure 1).



Figure 1 Workshop's Agenda

Once the agenda was finalized, the event was advertised on social media platforms, the OActive website and AXIA's website.

Through the post it was possible to register for the workshop, providing general information such as email address, name, company and country (Figure 2). Soon after the registration, the participants have received the confirmation email and the day before the workshop a reminder with a link to connect to the meeting and the agenda have been automatically sent. The overall number of registrées was above 120.

Figure 2 Workshop registration

2.2.1 Social media campaigns

Organizing this workshop as an online event, due to the current COVID-19 pandemic situation, did not prohibit the project partners from promoting it. In the absence of printed materials (flyers, brochures etc.) the project's digital media were the main channel used to increase the workshop's outreach and attract interested participants. The promotion objective has been dual: to attract relevant stakeholders particularly interested in OActive's technologies as well as to widely communicate OActive's key messages to the general public and substantially increase public visibility of the project to non-expert audiences. Due to the strong technical nature of the chosen subject in this particular workshop, the latter objective has naturally been the secondary one.

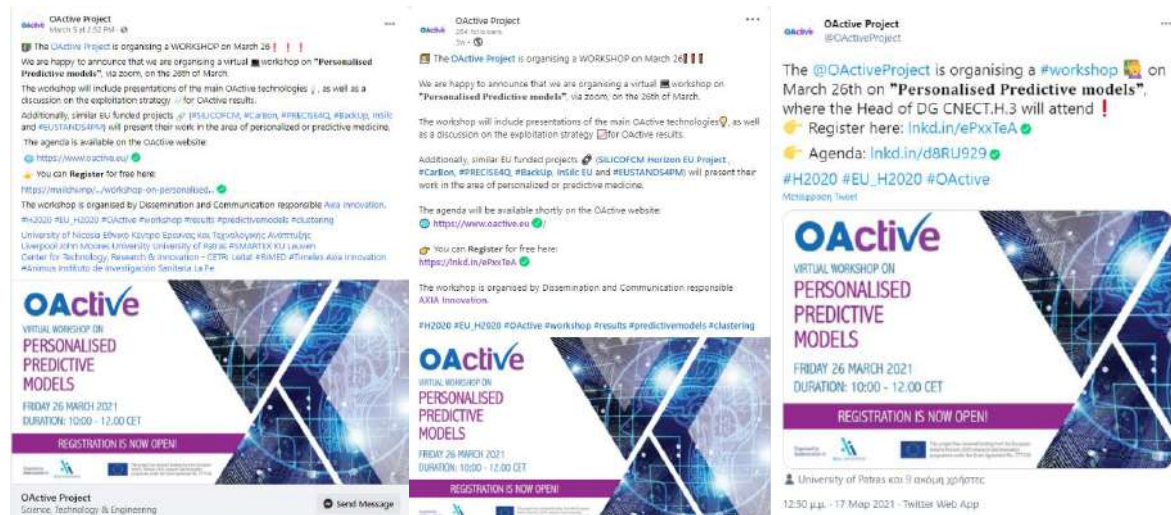


Figure 3. Social media campaign

A social media campaign (Figure 3) has been launched via all three social media platforms consisting the main digital communication channels of OActive. As a result, the outreach achieved summed up to almost 30K total impressions in all three social media platforms (Facebook 24903, LinkedIn 2434 and Twitter 2364).

The Facebook and LinkedIn campaigns, in particular, were also boosted via launching a low-budget sponsored promotional campaign (less than 40 euros in total) with specific audience targeting parameters. Facebook has been used mainly to achieve wide communication and outreach, while LinkedIn was mainly targeting relevant stakeholder by academic profile filtering. Twitter did not receive any kind of sponsoring as it is considered an all-around medium in terms of targeting.

Events were also created on LinkedIn and Facebook to engage even more participants, as presented below.

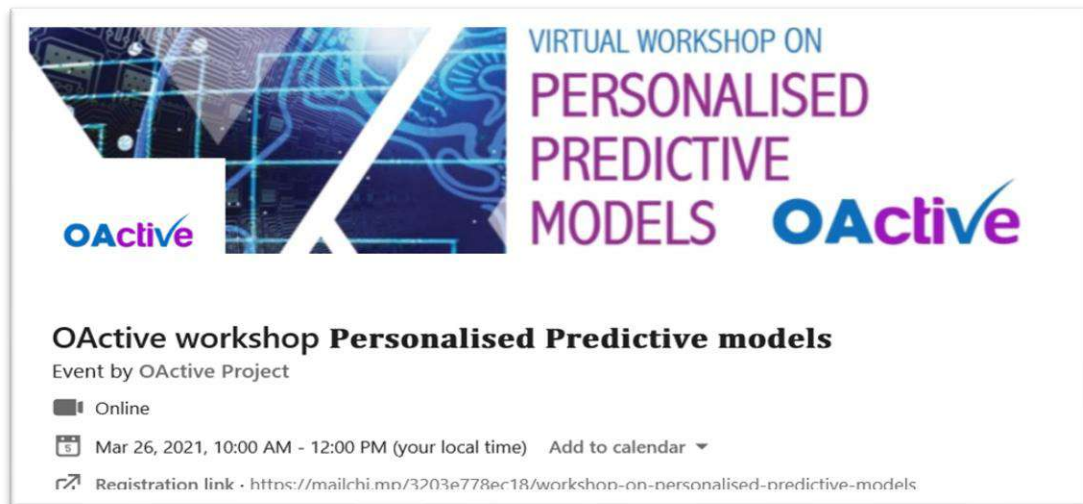


Figure 4. Social media post

The event has been also promoted in CORDIS in order to reach a wider audience.

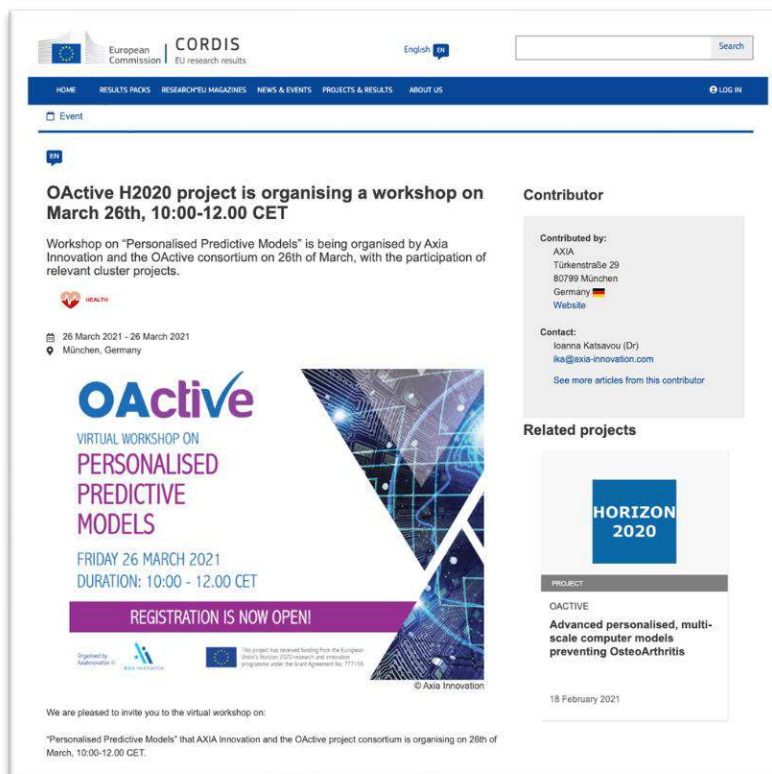


Figure 5. Cordis workshop advertisement

2.2.2 Workshop rehearsal

A rehearsal was organised on the 19th of March among all the speakers, to check the ZOOM platform and to solve any potential technical drawbacks. The event's scope was to go through the Agenda and inform them that the event will be recorded. The presenters were asked to provide their presentation in advance to AXIA Innovation. Moreover, technical information related to the platform (information on how to mute/unmute, share the screen) were provided. Other instructions provided:

- Connect in advance to the platform (at about 9.45 CET)
- All presenters should Login with the following code for presenters: Name- Company
- All participants should deactivate their microphones and cameras to achieve better quality in sound when not presenters
- Presenters will unmute themselves and start the presentation from the bottom right button.
- Presenters were encouraged to use their cameras when presenting.
- After the end of each presentation presenters should stop the presenting mode, so that the next presenter can take over.
- Questions will be asked through the chat and AXIA will collect them and presenters will be asked to reply at the end of the workshop

2.3 Number of participants and target groups

The number of participants that attended the workshop was 80. The main target groups, to whom the workshop was oriented, involved the representatives of :

- medical and ICT universities and research centers,
- hospitals,
- rehabilitation centers,
- medical care centers,
- medical institutes,
- health service providers,
- orthopaedic associations,
- medical organisations,
- regulatory authorities, NGOs, non-profit organizations, public initiatives, policy makers, standardization bodies
- physicians,
- caregivers,
- companies in the health field or/and in the ICT field,
- general public
- OA patients and their families,
- elderly,
- athletes,
- participants in related EU projects, research societies, interested in early diagnosis and prediction of diseases or interested in computer based modelling and simulation tools technologies, cognitive systems or human interfaces.

3 The workshop

3.1 Presentations

The overall coordination and introduction to the presentations of the event were made by AXIA Innovation. The workshop was attended by Mr Tobias Wiesenthal, Head Of eHealth, Well-Being and Ageing Sector, of the European Commission, who gave a short welcome to our workshop. Mr Tobias Wiesenthal, expressed his appreciation in seeing the workshop taking place with such an interesting group of projects. He was delight by the achievement of the OActive project and by the organization of the workshop since an event like this can bring together key stakeholders to enhance knowledge and exchange opinions.

The workshop was constituted by two parts. In the first part, the OActive coordinator and other WPs leaders presented the main outcomes of the OActive project, the exploitation strategy and the main OActive outcomes. In the second part, representatives from other projects involved in the same scientific fields, provided information about the ongoing activities. The presentations are listed below along with the presenters.

Introduction and Exploitation strategy of the OActive project: *Prof. Felekis, OActive Project coordinator, UNIC, Cyprus; Ioanna Barouni, Innovation Manager, CETRI, Cyprus*

Prof. Felekis gave a short overview of the OActive project starting from explaining what is osteoarthritis (OA), the risk factors and the difficulty in defining, predicting and treating of this disease. The main goal of OActive is to perform a holistic multiscale analysis by using a combination of mechanistic computational models, simulation and machine learning in Osteoarthritis (OA). To achieve this, a large database was created including biomarkers, environmental factors, behaviour and social risks factors, with the final aim of generating robust prediction tools for new personalised interventions for better diagnosis. The above aspects are supported by augmented reality (AR). The technology will be validated by in vitro systems, human population and large data registries (Figure 6)

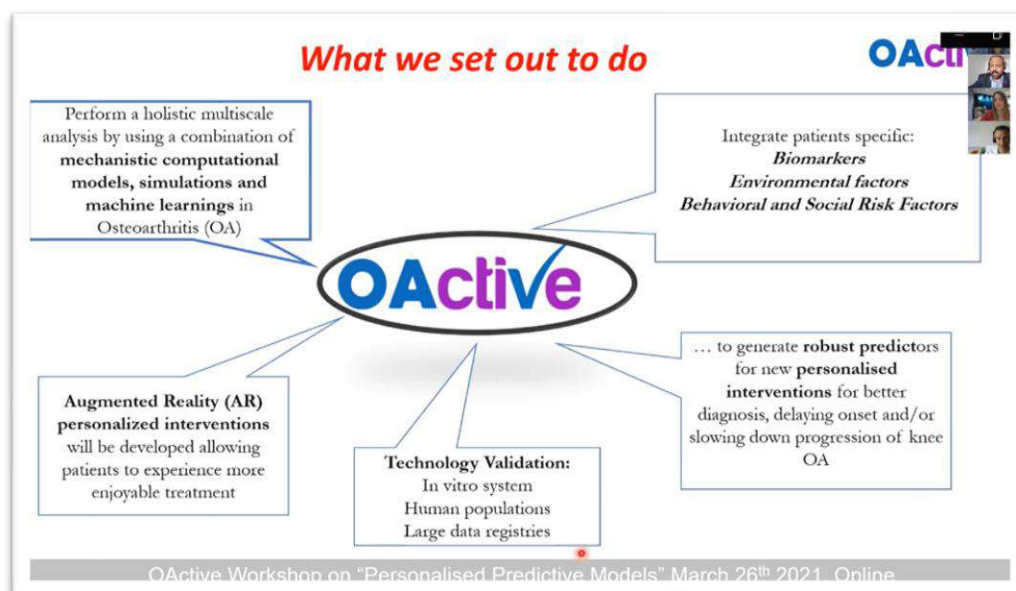


Figure 6. OActive objectives

Followingly, Ms Barouni gave an overview of the exploitation strategy in Horizon 2020 and explained how the OActive exploitation strategy was built. She subsequently briefly presented certain Exploitation aspects,

such as OActive's market positioning analysis, OActive's PESTEL analysis and a list of OActive products, services & non-commercially exploitable results. One of the main outputs of the market analysis is that OActive has been placed in the Personalized Medicine Market which is of course expected to grow significantly in the upcoming years. Also, another significant aspect presented, is the fact that OActive's position and opportunity lies at the intersection of the Competition's Weaknesses, the Customer Needs and OActive's key strengths, as depicted in Figure 7: OActive's market positioning Figure 7.

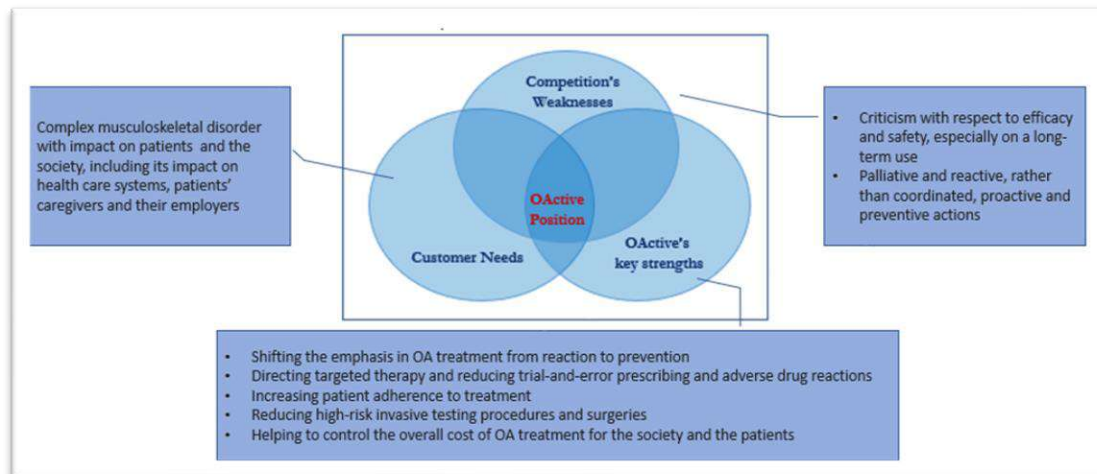


Figure 7: OActive's market positioning

Main outcomes of the OActive project: Prof. Bill Baltzopoulos, Professor of Biomechanics, LJMU, United Kingdom, Dr. Giorgos Giarmatzis, Sports scientist / Biomechanist, University of Patras, Prof Paulo Lisboa, Professor in applied mathematics, LJMU, United Kingdom

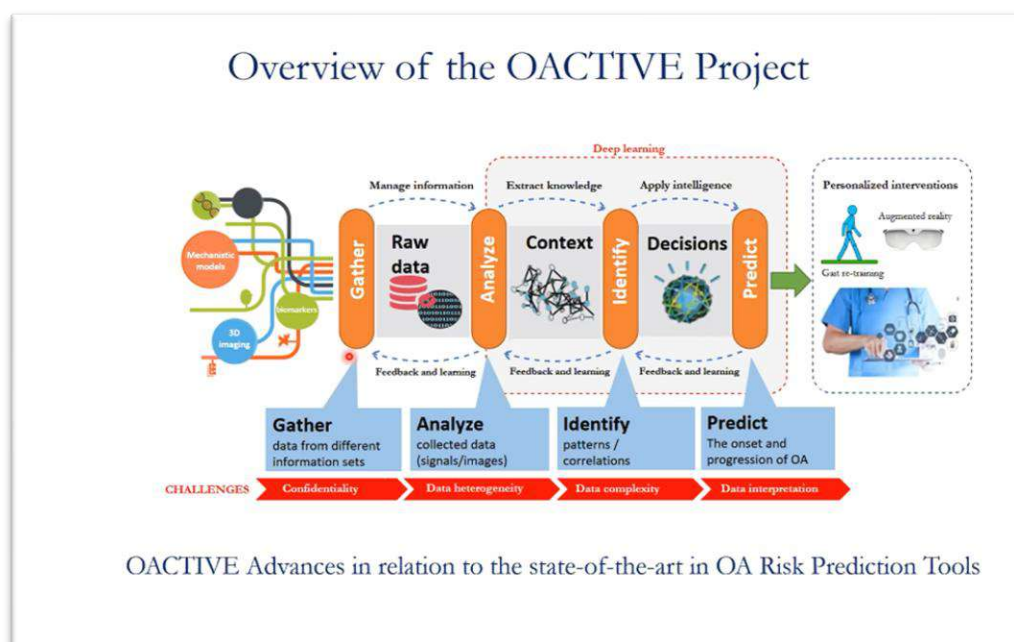


Figure 8. Overview of the OActive project

The main outputs of the project's presentations can be summarized as follow:

- Knee osteoarthritis (KOA) is difficult to predict and therefore is difficult to develop tools to understand how the disease will progress.

- OActive aims to identify people at risk and come up with effective tools to reduce loading in the joints.
- Development of risk prediction tools.
- Analyse the movement of individuals to calculate individually the loading in the joint thanks to a finite element model development.
- Knee Osteoarthritis Diagnosis at First Presentation: selecting age, BMI, age, gender, baseline symptoms, pain (difficulty of getting upstairs) it is possible to predict the probability of having KOA. For each individual, it will be possible to understand which factors affect the disease (BMI is one of them).
- Finite element analysis
- Musculoskeletal performance analysis and augmented reality interventions
- Personalised individual knee loading data used
- Knee joint model and motion analysis data used to predict the loading in the joint

SILICOFCM: Computational platform for In Silico clinical trials of familial cardiomyopathies: *Prof. Nenad Filipovic, Head of Center for Bioengineering, BioIRC, Serbia*

Cardiomyopathies are defined as structural and functional abnormalities of the ventricular myocardium that are unexplained by flow-limiting coronary artery disease or abnormal loading conditions.

The SILICOFCM project aims to develop in silico computational cloud platform which will integrate from stopped-flow molecular kinetic assays to magnetic resonance imaging of the whole heart, bioinformatics and image processing tools with state of the art computer models to reduce animal and clinical studies for new drug development and optimized clinical therapy of FCM.

The developed system will be distributed on the cloud platforms in order to achieve efficient data storage and high-performance computing, that can offer end users results in reasonably short time.

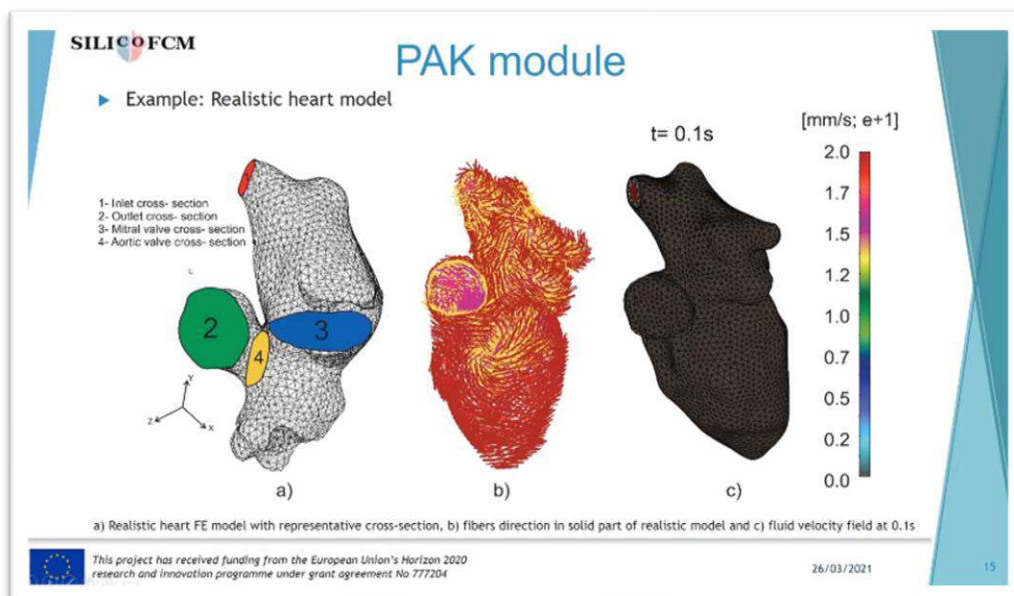


Figure 9. SILICOFCM's PAK module

The main outcomes of the SILICOFCM project's presentation can be summarized as follows:

- Development of a model to understand Cardiomyopathies as a disease.
- Realistic 3d simulation of the heart
- Model to understand where the ischemia is and to simulate the tissues.
- PAK module: body surface potential map
- O' Hara-Rudy model: simulation of the electric field in the heart
- Fluid simulation of the heart to understand how the disease progress.
- How to exploit the results with a pharmaceutical company? Virtual drug testing: the user can select the drug combination, feed in the SILICOFM musico model and thought the finite element model have a clinical decision.
- Specific tools are under investigation.

PRECISE4Q: Precision-medicine for stroke using hybrid, multi-level, and multi-timescale modelling *Prof. Gunnar Cedersund, Senior Lecturer, Linköping University, Sweden*

Stroke is one of the most severe medical problems reaching public health and having socio-economic impact, gathering momentum in an ageing society. PRECISE4Q sets out to minimise the burden of stroke for the individual and society. It will create multi-dimensional data-driven predictive simulation computer models enabling – for the first time – personalised stroke treatment, addressing patient's needs in four stages: prevention, acute treatment, rehabilitation and reintegration.

PRECISE4Q will have a clinically measurable and sustainable impact leading to a better understanding of risk, health and resilience factors. In contrast to current schematic therapy guidelines, it will support patients throughout their life-long journey by personalised strategies for their specific needs.

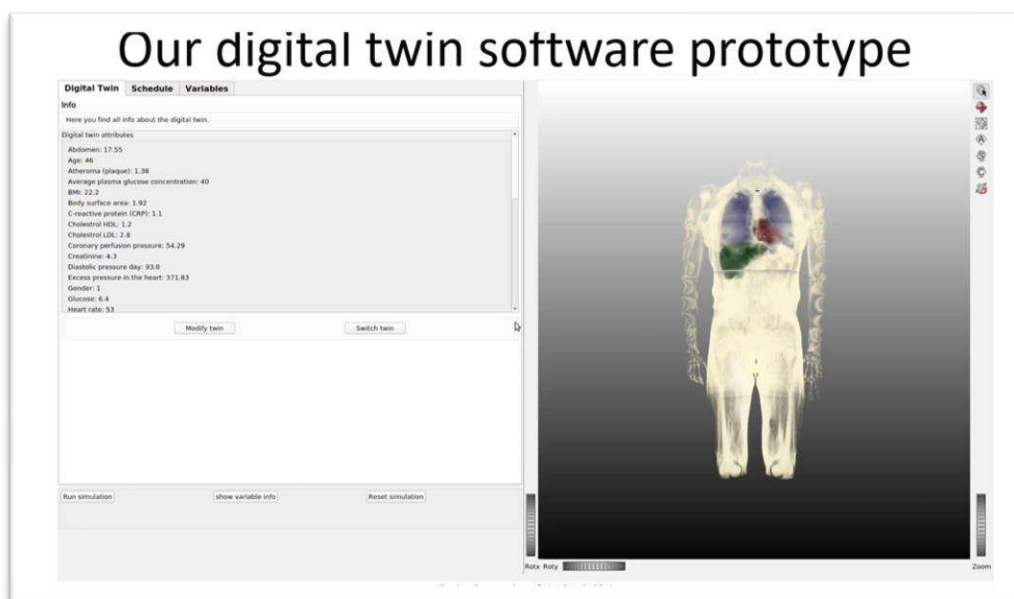


Figure 10. Digital Twin software prototype developed by PRECISE4Q

The main outcomes of the PRECISE4Q project can be summarized as follows:

- Predictive model for stroke
- Digital twins solution
- 10 larges clinical studies

- Stroke prevention, monitor e post-treatment.
- Different risk factors: liver fat is one of these. Conversation with patients reduce stroke by 30% thanks to changes in diet.
- By simulating different scenarios, it is possible to show how the liver fat is getting worse or better depending on the person's diet, exercise etc..
- Twin software allows seeing the organ behaviour by changing the diet or doing exercise. There will be an answer to liver fat.
- Using the developed tools it is possible to estimate the probability to have a stroke

EU-STANDS4PM: A European standardization framework for data integration and data-driven in silico models for personalised medicine, *Dr. Marc Kirschner, Scientific Officer, Forschungszentrum Jülich GmbH, Germany*

The capacity to generate data in Life Sciences and health research with modern omics and imaging technologies has increased many orders of magnitude in the last decade. In combination with patient/personal derived data such as electronic health records, patient registries and -databases, as well as life style information this Big Data holds immense potential for clinical applications, especially for in silico personalized medicine approaches. Expert forum has two main objectives: (i) to assess and evaluate national standardization strategies for interoperable health data integration as well as data-driven in silico modelling approaches and (ii) to harmonize and develop universal (cross-border) standards as well as recommendations for in silico methodologies applied in personalized medicine approaches. This pan-European Expert Forum —the EU-STANDS4PM consortium— has the overarching aim to bundle transnational standardization guidelines for in silico methodologies in translational and clinical research to unfold the potential of personalized medicine.

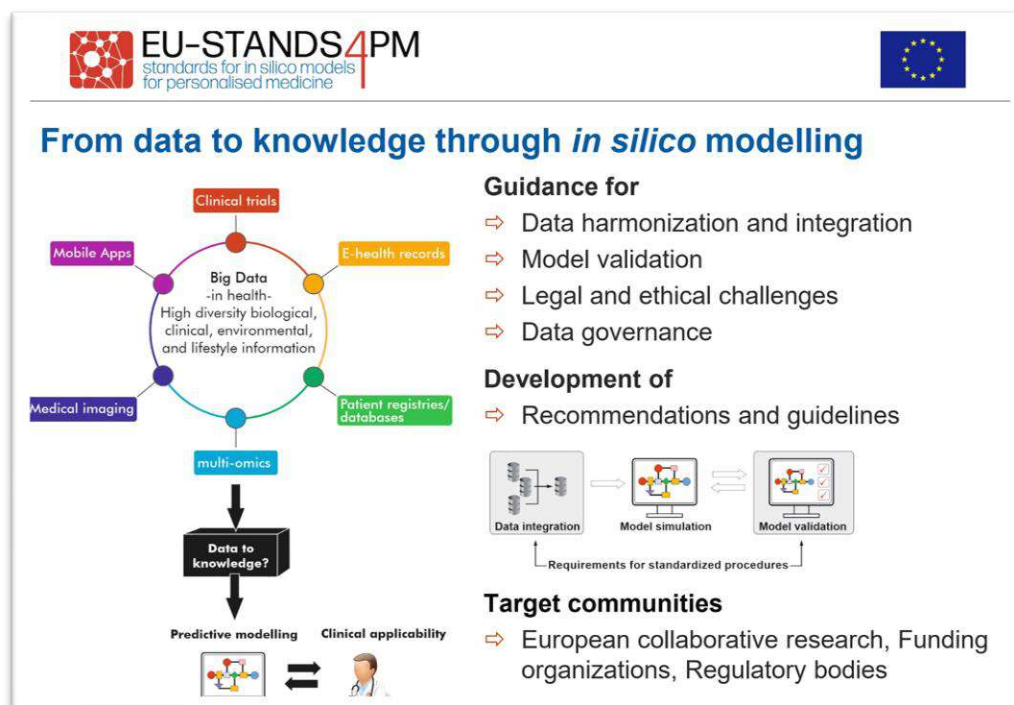


Figure 11. In silicomodeling in EU-STANDS4PM

The main outcomes of the EU-STANDS4PM project can be summarized as follows:

- State of the art modelling approaches for personalised medicine
- Recommendations for data integration and model validation
- Different use cases
- In silico modelling approach
- EU-wide mapping of data sources relevant for personalized medicine
- Legal and ethical review of in silico modelling

Back-UP: Risk stratification and personalised prediction models for Back and Neck Pain, *Prof. Jonathan Hill, Senior Lecturer in Physiotherapy, Keele University, United Kingdom*

Neck and low back pain (NLBP) are leading causes for years lived with disability in Europe and worldwide. About 70% of all adults experience NLBP at some point in their lives, and both conditions are among the top ten in terms of overall disease burden. Back-UP project provides a wider vision of NLBP, bringing together the research groups that are leading these and other innovative approaches to create a prognostic model to underpin more effective and efficient management of NLBP based on the digital representation of multidimensional clinical information and on simulations of the outcomes of possible interventions. Patient-specific models will provide a personalised evaluation of the patient case, using multidimensional health data from the following sources: personal, health, psychological, behavioural, and socioeconomic factors related to NLBP; biological patient characteristics, including musculoskeletal structures and function, and molecular data; and workplace and lifestyle risk factors. Back-UP will provide health, well-being and economic benefits to different user profiles (clinicians, employers / insurance companies and patients) and will create a channel for sharing information during the rehabilitation and return to work process.

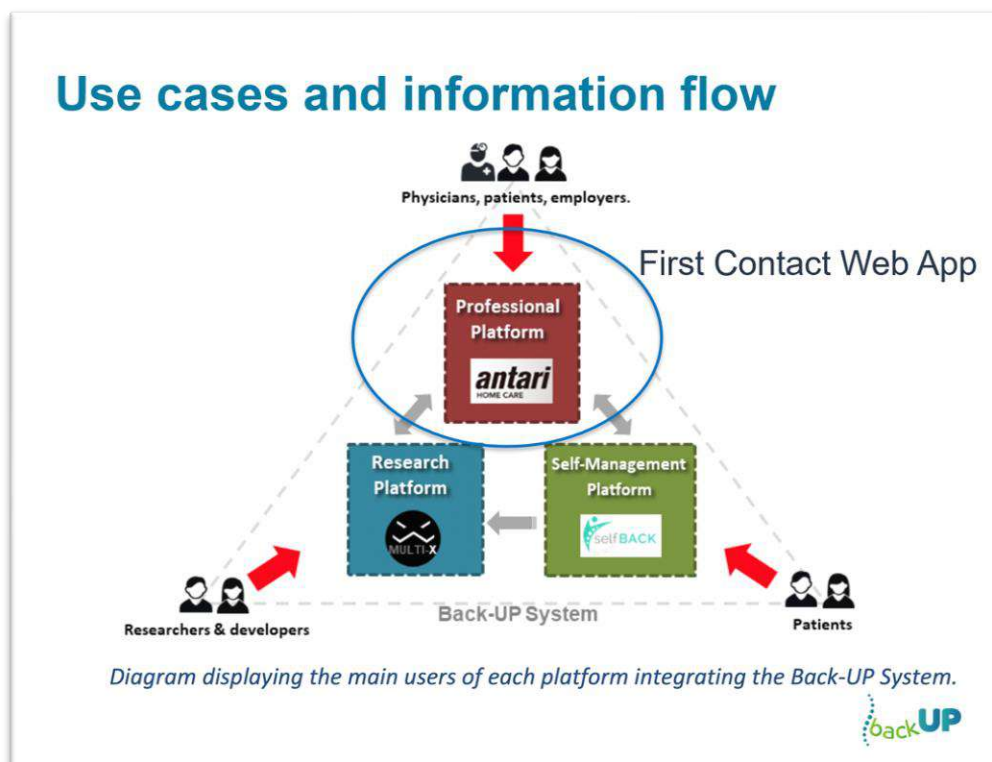


Figure 12. The Back-UP platforms

The main outcomes of the Back-UP project's presentation can be summarized as follows:

- Neck and low Back pain prediction tools
- Predict the problem, collect data for a predictive model.
- Platform demonstrator: age, economic model, an app for patient, physical activity
- First contact web app: stratify patients that present all the same pain and in low, medium and high risks.
- Individual risk prediction: 12 questions easily to be answered. Based on the risk level patients are offered treatment options

InSilc: In silico trials for advancing the design and development of stents; Where we stand, Challenges and Opportunities, *Georgia Karanasion, Technical Manager, FORTH, Greece*

The aim of InSilc is to develop an in-silico clinical trial (ISCT) platform for designing, developing and assessing drug-eluting bioresorbable vascular scaffolds (BVS), by building on the comprehensive biological and biomedical knowledge and advanced modelling approaches to simulate their implantation performance in the individual cardiovascular physiology. By integrating the information obtained from different in-silico predictive models, InSilc will: (i) assist in the development, assessment and optimization of the drug-eluting BVS and deliver accurate and reliable information to the Stent Biomedical Industry, (ii) assist the interventional Cardiologists in improving the surgical process of drug-eluting BVS implantation, support them in the clinical assessment and reduce the complications of suboptimal scaffold performance. By introducing computer simulations for establishing the safety and efficacy of drug-eluting BVS, InSilc aims to lower development costs and shorten time-to-market, reduce, refine, and partially replace human clinical trials through a more effective human clinical trials design, reduce the need for animal testing and result in a significant reduction of the associated direct and indirect costs.

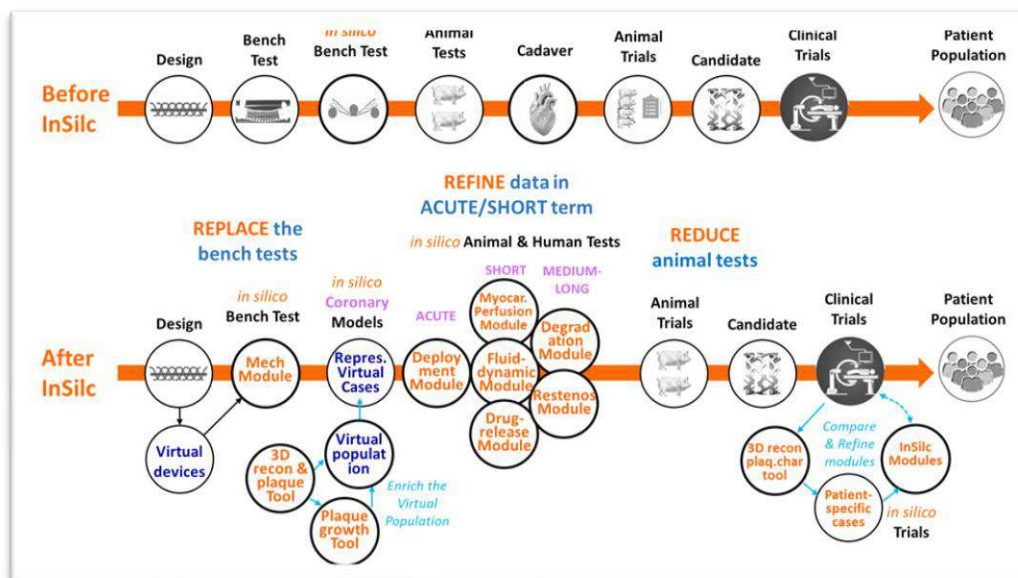


Figure 13. The InSilc approach

The main outcomes of the InSilc project's presentation can be summarized as follows:

- Coronary artery disease (CAD) investigation
- Percutaneous coronary intervention (PCI) with stent

- Create an in-silico trial platform for designing, developing BVS, based on comprehensive biological and biomedical knowledge.
- The stent expands in the artery, the last generation one is completely degradable.
- The predict module can predict how the stents behave and also how/when it will be dissolved.

CarBon: A Marie-Sklodowska Curie training network combining in silico, in vitro and in vivo approaches to study Cartilage and Bone biology and engineering, *Prof. Liesbet Geris, Professor in Biomechanics and Computational Tissue Engineering, University of Liège & KU Leuven-Belgium*

CarBon is training 14 high potential scientists to combine knowledge of cartilage & bone developmental biology, pathobiology and tissue engineering with skills in cell culture, animal models, proteomics, biomaterial development, bioreactors and computational modelling.

Identification of cell secreted factors that stimulate or inhibit endochondral ossification. The extracellular matrix and development of novel biomaterial scaffolds. The mechanical environment and use of bioreactors. Towards application and development of new treatments for bone defects and osteoarthritis.

The main outcomes of the CarBon research project's presentation can be summarized as follows:

- Understand the role and interplay of cell-secreted factors, extracellular matrix components and mechanical loading in cartilage and bone formation and repair.
- Use the combined knowledge and skills of matrix biology and tissue engineering to develop novel, biologically inspired biomaterials for the formation of stable cartilage and vascularized bone.

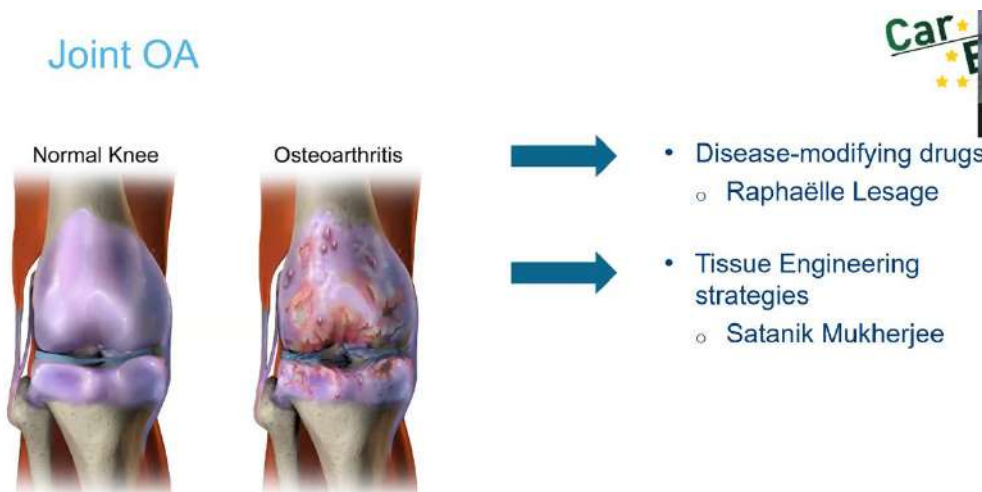


Figure 14. CarBon activities

- Use knowledge of cell biology, proteomics, mechano- and pathobiology integrated by computational modelling to identify and pursue drug targetable components for bone healing an osteoarthritis
- Disease modifying drugs
- Tissue engineering strategies

Closing discussions Prof. Felekis, *OActive Project coordinator, UNIC, Cyprus*, Dr. Ioanna Katsavou, *Project Manager, Axia Innovation, Germany*

The closing section was held by Dr. Katsavou and Prof. Felekis who have thanked the audience and all the cluster projects for the participation.

4 After the workshop

4.1 Social media post

During the workshop, a picture with all the attendees was taken and used for dissemination purposes.

A post related to the organisation of the workshop was posted on the OActive website and social media platforms mentioning that the recording and training material will be shortly available on the website.

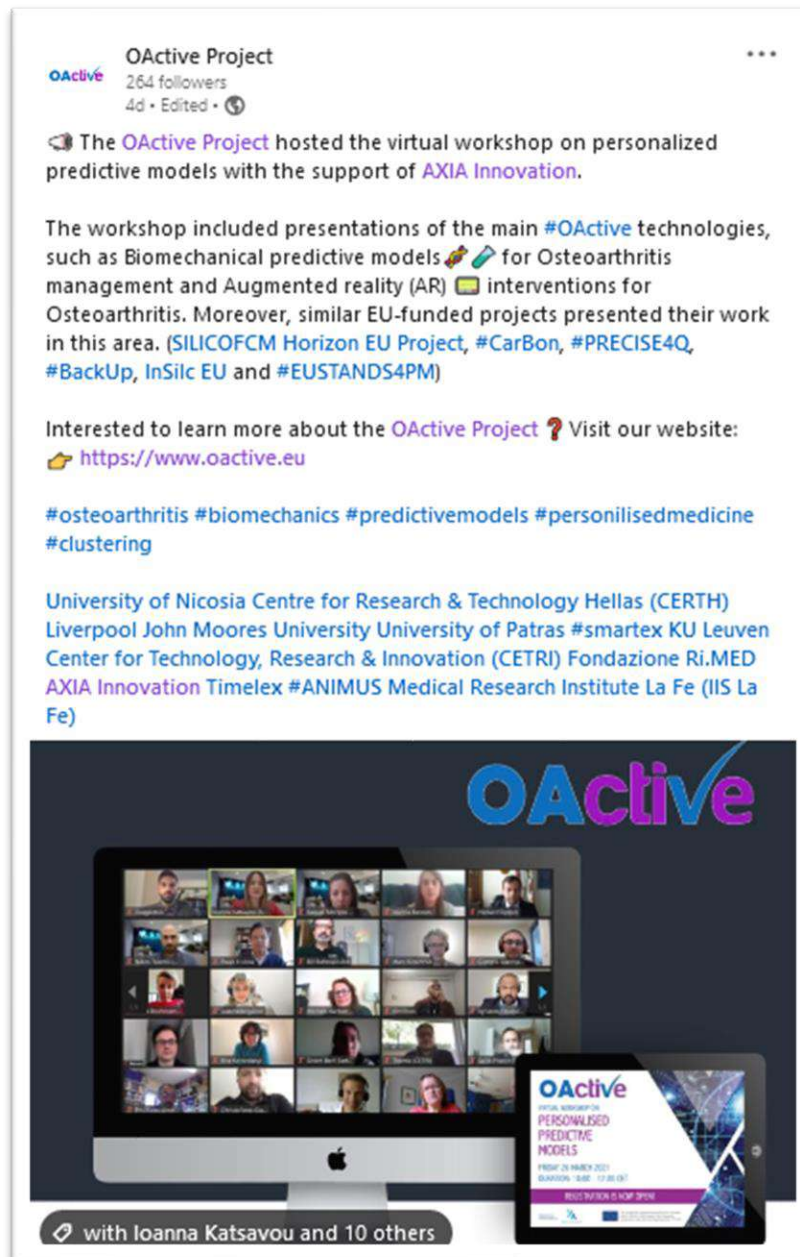


Figure 15. Social media post

4.2 Video recording

The OActive workshop was recorded and the video is kept for future use as educational/ training material. For reasons of GDPR compliance, participants were informed during the registration, as well as orally at the beginning of the session that the Workshop will be recorded, to achieve a wider audience reach for those that didn't have the opportunity to attend. The video can be found on YouTube: <https://www.youtube.com/watch?v=aGl8tF4Ifwk&t=971s>

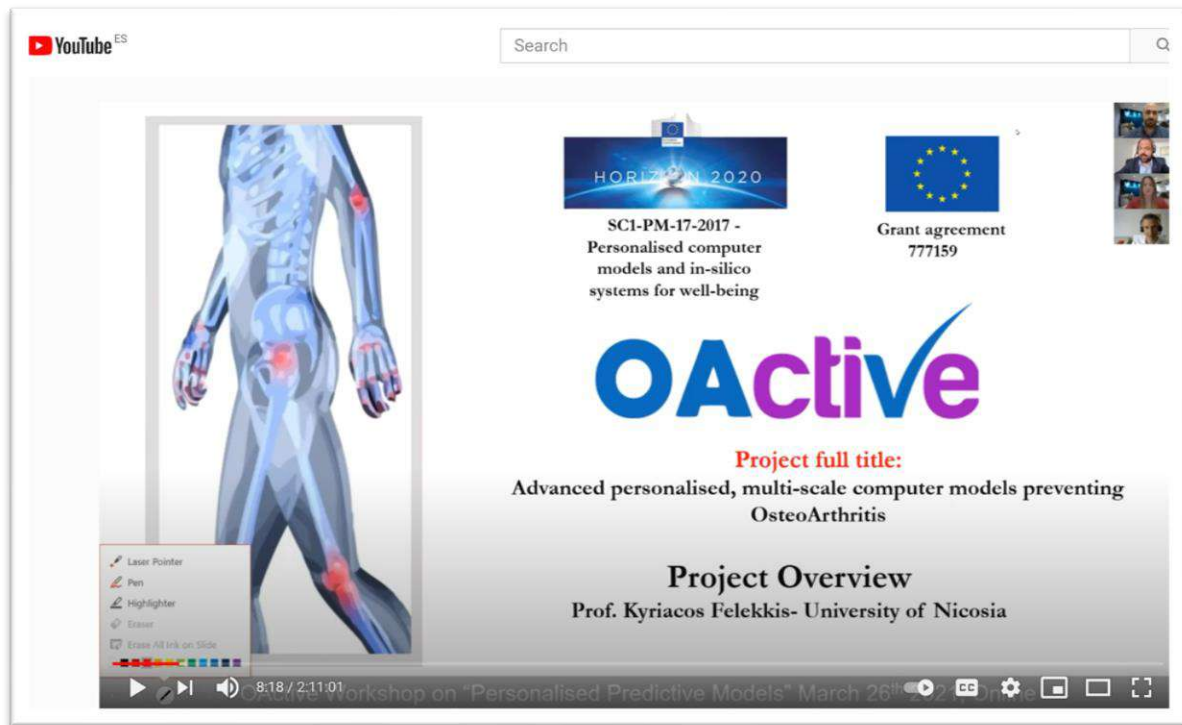


Figure 16. YouTube video for the OActive workshop

4.3 Training material

The presentations were compiled into a booklet, that can be found under the “[Dissemination material tab](#)” of the OActive website, for future use.

4.4 Comments and feedback

To collect feedback from the workshop attendees AXIA sent out after the workshop a survey created in Google forms to all the attendees to acquire the general thoughts and the impact of the event.

Figure 17. OActive workshop survey

Based on the replies collected 52.4 % were female and 47.6 male, while 42.9% were in an age range between 30 and 39 y.o. followed by 23.8% being between 40-49.

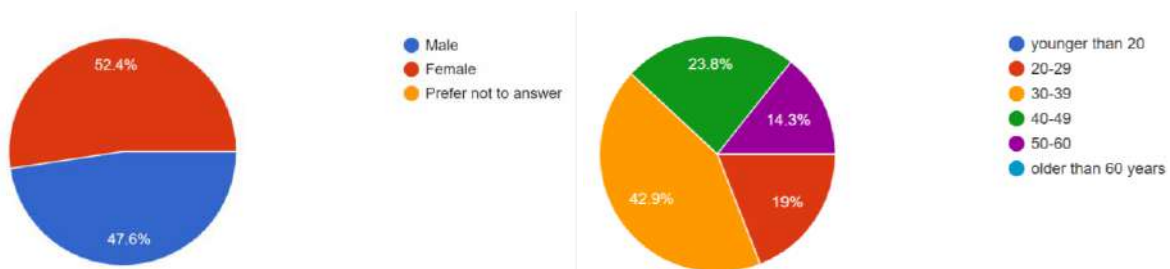


Figure 18. Workshop participants a. gender and b. age

The attendees that filled in the questionnaire come from around the globe; mainly from Greece, Cyprus, Germany, Serbia, UK and United States. Most attendees are scientists with expertise/interest related to the technologies discussed during the workshop.

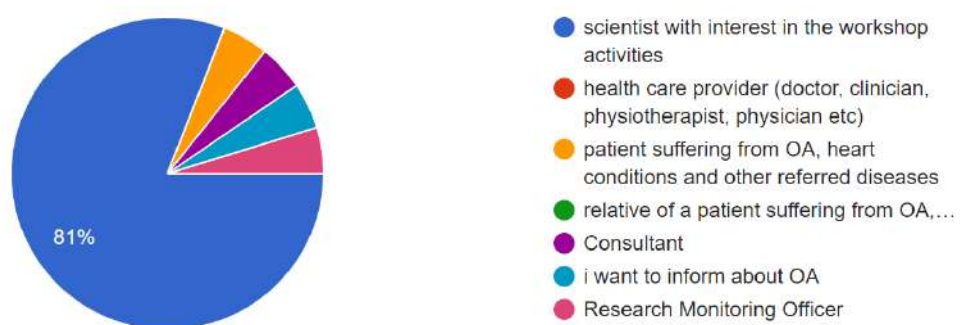


Figure 19. Which of the following categories fit better to your profile?

Most people seemed to be very much satisfied on the workshop content, type, duration and time for questions.

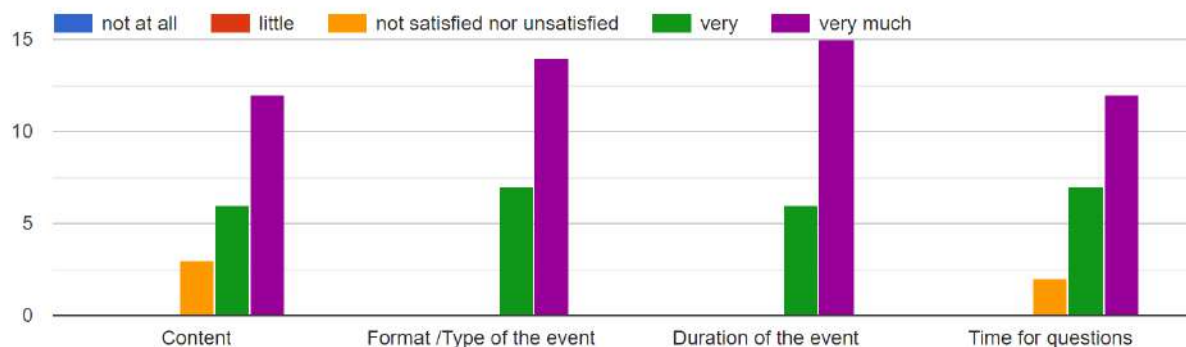


Figure 20. How satisfied were you with the following aspects of the event?

47.6% replied that they benefit a lot (5 in a scale of 1 to 5) from the event followed by 28.6% that ranked their benefiting through the event with 3.

Based on the content OActive concept most attendees found interesting the Musculoskeletal Biomechanics modelling and Personalised interventions using Augmented Reality (AR). This outcome was expected taking into consideration the focused audience of this event with interest in those fields. Other topics following in the opinion of participants were Tissue engineering and osteoarthritis models and then OA-related imaging biomarkers.

Most of the participants found that the OActive Integrated System will be of aid in real-world clinical scenarios and also it has the potential to enhance the innovation capacity and contribute to the growth of European companies active in the field of digital healthcare in the area of OA and beyond.

According to the participants personal view, the main BENEFIT towards the global transition from evidence-based medicine to personalised medicine is the generation of novel effective therapies and the reduction of high-risk invasive testing procedures and surgeries.

Main CHALLENGES include Experimental challenges, such as sample preparation and handling, study design, and reproducibility while PREREQUISITES are linked with the development of standards for big data in health to enhance and simplify its application and improve interoperability.

5 Conclusions

The reported Workshop is part of the training activities organized in the framework of the OActive project. This workshop related to the personalised predictive models was an external workshop where not only OActive partners presented the main project advancements of work, but also other cluster-projects have been invited to present their outcomes. The workshop was mainly addressed to scientific/technical audiences, not excluding also the general public, helping to disseminate the content of those innovative projects in several fields.

In the common opinion of participants, the training was evaluated as an interesting event, being the most recent source of information on the possibilities, technologies, purposefulness, and the need to raise awareness on advanced personalized interventions for combating pain related/chronic diseases. The attendees indicated a substantially high level of organization for the workshop.