

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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Project coordinator	University of Nicosia (UNIC)
Tel:	+357 22 841 528
Fax:	+357 22 357481
Email:	felekkis.k@unic.ac.cy &
	giannaki.c@unic.ac.cy
Project web site address	www.oactive.eu

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Abbreviations

BMI	Body mass index
CSI	Central Sensitization Inventory
DCP	Data collection protocol
FACHS	Functional Ambulation Classification of the Hospital at Sagunto
GADS	Goldberg Anxiety and Depression Inventory
HAD	Hospital Anxiety and Depression Scale
KL	Kellgren and Lawrence
KOOS	Knee Injury and Osteoarthritis Outcome Score
OA	Osteoarthritis
WOMAC	Western Ontario and McMaster Universities Osteoarthritis Index

1. Summary

This report refers to the Deliverable 6.1 which is related to the OActive's WP.6 "Hyper-modelling framework empowered by big data and deep learning", led by CERTH.

The report describes the cloud-based data management infrastructure i.e., the tools and the services that have been developed to realize a high-level data quality and accessibility for the data analytics applications.

2. Introduction

Data management infrastructure is the set of tools and services that are used to provide data management and enforce data management policies. A data management infrastructure would include resources such as a data repository and an information catalogue. The design and implementation of the data management infrastructure includes all the steps for collecting, storing and utilizing the available information. Effective data management will help the project partners locate valuable information in large sets of unstructured data and semi-structured data from the variety of sources.

The data management infrastructure in the context of a data science workflow is depicted in the following Figure:

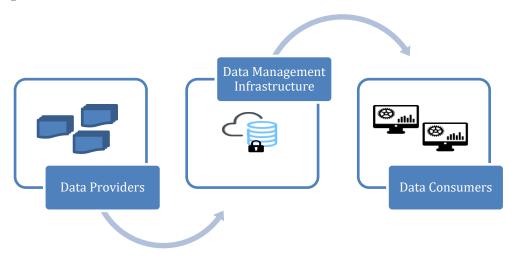


Fig.1 Data Science Workflow

Following the above workflow, the data management infrastructure should meet the following generic requirements:

- 1. Provide a centralized and backed up storage area of research data.
- 2. Provide read & write access to data amongst defined groups of researchers in a secure way.
- 3. Remove data redundancy, by removing the need to store the same data in multiple places.
- 4. Allow the structured annotation of research data to provide context to the data
- 5. Allow the search and dissemination of data
- 6. Provide a system simple enough for users to pick up and utilize without structured training.

In addition, and in the context of the OActive project, the data management infrastructure, should also follow the Data Collection Protocol described in D2.1. The data collection protocol defines the timing, content, screening, assessment, and evaluation tests and other rules relating to the ascertainment and collection of data over the life cycle of OACTIVE.

In the following sections we will describe the Data Management Infrastructure components in detail.

3. Data Management in the Cloud

The start of last decade presented that the pace and volume of data being generated is exceeding the current capacity of "institutions" data management. Cloud-based data management is in turn helping to realize the potential of large-scale data management solutions by giving effective scaling of resources. Data management is one of the most important research areas in cloud computing and cloud computing has become a major influence in data management research and plays a key role.

Data management in the cloud addresses the challenges in managing large collections of data in the cloud computing environment. Huge volumes of data in cloud computing environments pose big infrastructure challenges, including data storage, massively parallel query execution, facilities for analytical processing, and online query processing. There is a high degree of complexity involved in ensuring that they can sustain consistent and reliable operations under peak loads. However, cloud-based data management systems will not replace the traditional RDBMS in the near future; however, it supplies another choice for the applications which are suitable to be deployed in the cloud.

Moving data and critical applications to the cloud though leads to security challenges. The main of these challenges is that the owner of the data may not have control of where the data is placed. Other issues that have been pointed out is that the users are unaware of cloud security and the concern about the protection of confidential data.

OActive's Data Management infrastructure follows a "cloud-based" approach as initially discussed. However, the current datasets examined in the project, in terms of volume and complexity, indicates that it cannot be considered as a Big Data case as initially thought to be. Therefore, more conventional, healthdata-appropriate databases should be considered.

In particular, we have employed the Airtable, which is a cloud collaboration platform for creating, using, and sharing relational databases. It fuses the features of a database and the format of a spreadsheet so as users have always control of the process. We present in details the Airable component and infrastructure in the following sections.

4. Airtable

Airtable is a cloud-based app that combines the functionalities of spreadsheets and databases to create a powerful tool that can be used as a data management infrastructure. Airtable organizes through six components: *Bases, Tables, Fields,* and *Records.* A short description of these components is provided in the following subsections:

4.1 Airtable Base

An Airtable Base contains all of the information required from a project. Each Base should be unique, focus on one key area, and contains all the of the information is available for that key area.

We can consider Bases are simple spreadsheets that can contain any number of Tables. The advantage of Baess is that in contrast to spreadsheets are not simply flat-grids but multi-dimensional, e.g. like a calendar and thus can be more flexible.

4.2 Airtable Table

Tables are the building blocks of Bases and each Base could include any number of Tables. Tables are like worksheets in a spreadsheet. Each Table could hold information concerning one item. For example, a project Base could have a Table for data from different project's domains. These domains are relevant to the project Base, but each is unique from any other domain Table.

4.3 Airable Field

Fields are Airtable's equivalent to columns in a spreadsheet. Each Field communicates the same kind of data across a number of rows. Unlike traditional spreadsheet cells, Fields have a number of different types. These types include file attachments, checkboxes, dropdowns, and more.

4.4 Airtable Record

Records are the second part of an Airbase table. While Fields represent columns in a traditional spreadsheet, Records represent the rows. Each Record is a unique iteration of data defined by the table's rows.

5. Airtable Security And Data Privacy

Airtable platform considers privacy and security as core functions and thus the highest privacy and security standards. In terms of network and system security, transmission of information between the data provider's device and AirTable's servers is servers is protected using 256-bit TLS encryption. At rest, Airtable encrypts data using AES-256. Airtable servers are located in the US, in data centers that are SOC 1, SOC 2 and ISO 27001 certified. Airtable's data centers have round-the-clock security, automatic fire detection and suppression, fully redundant power systems, and strict controls for physical access.

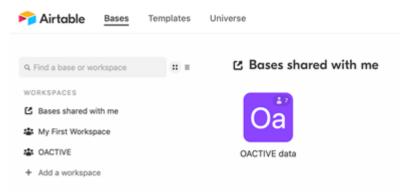
In terms of service reliability and durability, Airtable exploits the Amazon Web Services (AWS) hosting infrastructure. Backups are geo-redundantly replicated across multiple availability zones for data durability and maintains business continuity and disaster recovery plans.

As far as the product security, collaborator permissions can be managed at the workspace level or the base level. These permissions allow you to control who you share a workspace or base with and whether they can modify the workspaces or bases that you've shared with them. Airtable also provides record-level revision history that shows a visual activity feed of the changes made to each record.

Airtable is fully compliant with the General Data Protection Regulation ("GDPR"). and can help you meet your data portability requirements for the GDPR, for example by allowing data export from Airtable to CSV files or by using the Airtable's API.

6. OActive's Airtable Infrastucture

The Data Management infrastructure has been initially built on an Airtable's Base as shown in the following Figure.



In this Base, a number of Tables following the Data Management Protocol have been created to collect the data. As described in the Protocol, the medical visits that lead to data collection from patients are divided into the following main sections: demographics, anamnesis, physical examination, body fluid tests, and functional and psychological scales. The Tables that have been are shown in the Figure and discussed in details below:

9					OACTIVE	data -			
=	Demographics data	Socioeconomics Data	Anamnesis Data	Physical examination	Blood Tests Data	Scales Data	Social participation Data	RX Data	MRI Data

5.1 Demographics Data Table

The Table includes general demographic information about the examined individual, i.e. the institution that performed the experiments, person, such as its sex, age (in years), birth country, ethnicity and occupation.

The Table Fields with their values are given below:

Field Name	Field Type	Values
Identification Code	Text	ID of the examined
		individual
Data Provider	Text (Single Select)	UNIC/HULAFE/ANIMUS
Date	Date	
Sex	Text (Single Select)	Yes/No
Age	Numeric	
Birth Country	Text (Single Select)	Cyprus/Spain/Greece/Other
		EU Countries/Other Non
		EU Countries
Ethnicity	Text (Single Select)	White/Black/Hispanic
		American/Asian/Pacific
		Islander/American
		Indian/Other Race/Two or
		More Races
Occupation	Text	Free Text

9				0	ACTIVE data -			
=	Demographics data	Socioeconomics Data	Anamnesis Data Physical	examination Blood Te	ests Data Scales Data	Social participation Data	RX Data MRI Dat	• 6
• 8	Grid view 😂 🗠	Hide fields 🐨 Filter	Group #† Sorted by 1 field	Q. Color II L				
a 0	A Identification code	- O Data provider	- 🖾 Date -	O Sex -	III Age (years)	O Birth country -	O Ethnicity ·	O Occupation
1	CYU017	UNC	7)18/2019	Male	61	Cyprus	White	Manual Labor
2.12	SPH001	HULAFE	10/24/2018	Female	65	Spain	White	Housewife
8	SPH002	HULAFE	11/7/2018	Female	62	Spain	White	Unemployed
5	SPH003	HULAFE	11/14/2018	Male	46	Spain	White	Plumber
6	SPH004	HULAFE	11/14/2018	Female	55	Other non EU countries	Hispanic American	Unemployed
5	SPH005	HULAFE	12/14/2018	Male	52	Spain	White	Gardener
P	SPH006	HULAFE	11/21/2018	Male	46	Other non EU countries	White	Comercial
1	SPH007	HULAFE	11/30/2018	Male	46	Spain	White	Chain manager
2	SPH008	HULAFE	11/30/2018	Female	57	Spain	White	Housewife
0	SPH009	HULAFE	12/3/2018	Male	54	Spain	White	Comercial
1	SPH010	HULAFE	12/12/2018	Female	40	Spain	White	Housewife
2	SPH011	HULAFE	12/12/2018	Male	51	Spain	White	Electromechanic
3	SPH012	HULAFE	12/19/2018	Female	55	Spain	White	Housewife
4	SPH013	HULAFE	1/16/2019	Male	50	Spain	White	Managing

5.2 Socieconomics Data Table

The Table includes extended demographic information about the examined individual. The Table Fields with their values are given below:

Field Name	Field Type	Values
Name/Identification Code	Text	ID of the examined individual
Level of Education (Individual)	Text (Single Select)	Elementary School
		Completed/Elementary School
		Not Completed/College or
		University
Level of Education (Parents)	Text (Single Select)	Elementary School
		Completed/Elementary School
		Not Completed/College or
		University
Marital Status	Text (Single Select)	Married-civil
		partnership/Single/Window
Residency	Text (Single Select)	Livining with Family/Living
		Independently
Household income	Text (Single Select)	Easily/Fairly Easily/With some
		difficulty/With great difficulty
Housing status	Text (Single Select)	Owing/Renting

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Demographics data	Socioeconomice Data Anomnesis	Data Physical examination Blood Tests	Data Scales Data	Social participation Data RX Data	MRI Data	COM 9 11 1.000
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a A Name	O Level of education (Individual)	O Level of education (Parants)	O Marital status	· O Residency	- O Nousehold income	< O Housing status
SPH001	Elementary school completed	(Elementary school completed)	Willow	Uving independently	With some difficulty	Owning
5894002	Vocational aducation or general sec.	Elementary action completed	Married/civil pertnership	Living with family	With great difficulty	Owning
\$\$94003	Elementary school completed		Married/civil partnership	(Living with family)	Fairly easily	Owning
57H004	Tiamentary school completied	Vocational education or general secondary	Manad/sivil partnership	Living with family	Wes year officulty	Berling
\$PH005	(Dementary school completed)		Single	Living independently	Fairly easily	Owning
\$294006	College or oniversity education	Vocational education or general secondary	Manied/ovil pertnenship	Living with family	With some difficulty	Reiting
SPH007	Vocational education or general sec.	Elementary school completed	Married/civil partmentilp	Using with family	Fairly easily	Owning
5/14008	Vocational education or general sec.		Married/civil partnership	Living with family	Easily	Owning
* SPH009	Elementary school completed		Separates/Divorced	Uving independently	Fairty easily	Owning
\$294010	Vocational education or general sec.	Elementary school completed	Married/civil partnership	(Living with family)	Easily	Owning
525-011	We should be a store or neveral ser-	Versional advertice or several served and	Married tradition	Tables with family	Fairly easily	Dening

5.3 Anamnesis Data Table

This Table includes the results obtained by clinical interviews regarding the Familial OA, defined as parents, siblings or grandparents having a diagnosis of OA, and the individual's history of OA. The Table Fields with their values are given below:

Field Name	Field Type	Value
Identification Code	Text	ID of the examined individual
Group	Text (Single Select)	Established OA/Initial
		OA/Healthy/Athlete
Current Medication	Text	
High Blood Pressure	Text (Single Select)	Yes/No
Family OA History	Text (Single Select)	Yes/No
Personal History of hand OA	Text (Single Select)	Yes/No
Personal History of hip OA	Text (Single Select)	Yes/No
Knee OA diagnosis	Text (Single Select)	Yes/No
Knee OA diagnosed by a doctor	Text (Single Select)	Yes/No
Occupational risk	Text (Single Select)	Never/Always/Seldom/Once twice/week
Smoking	Text (Single Select)	Yes/No
Number of cigarettes	Number	
Alcohol	Text (Single Select)	Never/Always/Seldom/Once twice/week
Hormonal status (women)	Text (Single Select)	Premenopause/Postmenopausal
Previous Knee Injury (left)	Text (Single Select)	Yes/No
Previous Knee Injury (right)	Text (Single Select)	Yes/No
Regular Sport leisure activity	Text (Single Select)	Yes/No
Type of Sport	Text	
Sports frequency	Text (Single Select)	Daily/Once-twice week/Once- twice month
Knee Pain	Text (Single Select)	Yes/No
Pain Side	Text (Single Select)	Left/Right/Both
Time since pain start	Number	
Resting VAS	Number	
Walking VAS	Number	
Knee pain (NHANES) left	Text (Single Select)	A/C/No pain
Knee pain (NHANES) right	Text (Single Select)	A/C/No pain
Knee instability left	Text (Single Select)	Yes/No
Knee instability right	Text (Single Select)	Yes/No
Pain rhythm	Text (Single Select)	Mechanical/Inflammatory
Neuropathic Component	Text (Single Select)	Yes/No

				04	CTIVE data -				HELP.
emographics data	Socioeconomics Data	Anamnesis Data Physica	examination (Rood Tes	ts Deta Scales Data	Social participation Data	RK Detail MRI Da		
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A Identification code CYU017	- O Oroup 3. Established OA	 A Any current medica + No 	O High blood pres	iune : - :	O Family OA history -	O Personal Natory of	O Personal history of	Do you have knee D	- O Have y
SPH001	2, Initial DA	Openves, Natecal	(Yes)		30	(No)	Ne	(Yes)	(Yes)
SPH002	2. Initial DA	Enalapril, Heipram, Diaze	(Yes)		30	No	Yes	No	No
5894003	(1, Healthy)	OMEPRAZOL.	No		(30)	No	No	No	No
SPH004	Z. INRIAL CA	Acovil, esidnex,pristiq, alo	(Yes)		No	(No)	Ne	(744)	No
SPH005	Z. Millel GA	Nexium, atenciol, ramipril	(Yes)		No	No	Ne	(No)	No
5214006	2. Initial DA	No	No		No	No	No	(996)	Yes
SPH007	2. Initial CA	No	No		30	(No)	(No.	(799.6.)	Nes
SPHOOR	(5.Heathy)	Adire, vit D	(No.)		(\$0)	(No)	(No)	No	No
5PH009	2. Initial OA	No	No		3	No	(No)	(1946)	(Yes)
5814010	2. Initial CA	No	No		No	(No.:	(No.)	(Mg)	No
SPH011	(1.Healthy)	Simustina, zyloric, lanso	(Nil)		30	(366)	(No.)	Mo	(346)
SPH012	2. Initial DA	Ancoxia	No		(\$1)	(966)	No	No	No
SPH013	Z. Initial DA	No	No		(No)	No	(No)	No	No
SPH014	2. Initial CA	No	No		(30)	(No)	(No.)	(No)	No
SPH015	2. Initial DA	No	No		No	(No)	(NE)	No	No
SPH016	(S.Healthy)	Eutiros 150, bisoproiol 5,	(960)		(2)	No	(No)	No	No

5.4 Physical Examination Table

This Table includes the results from the general physical examination, and the knee specific exploration. The Table Fields with their values are given below:

Field Name	Field Type	Value
Identification Code	Text	ID of the examined individual
Mass	Number	
Height	Number	
BMI	Number	
Joint Line Tenderness (Left)	Text (Single Select)	Yes/No
Joint Line Tenderness (Right)	Text (Single Select)	Yes/No
Patellofemoral Pain (Left)	Text (Single Select)	Yes/No
Patellofemoral Pain (Right)	Text (Single Select)	Yes/No
Crepitus (Left)	Text (Single Select)	Yes/No
Crepitus (Right)	Text (Single Select)	Yes/No
Right Flexion Angle	Number	
Right Extension Angle	Number	
Flexion Deformity (Right)	Text (Single Select)	Yes/No
Left Flexion Angle	Number	
Left Extension Angle	Number	
Flexion Deformity (Left)	Text (Single Select)	Yes/No
Muscle Atrophy	Text (Single Select)	Yes/No
Measurement of Left Limp	Number	
Measurement of Right Limp	Number	
Knee Laxity (Left)	Text (Single Select)	Yes/No
Knee Laxity (Right)	Text (Single Select)	Yes/No
Joint Proprioception (Left)	Text (Single Select)	Yes/No
Joint Proprioception (Right)	Text (Single Select)	Yes/No
Abdominal Perimeter (in cm)	Number	
Left Extension Dynamometric	Number	

Right Extension Dynamometric	Number	
5 Sit to Stand Test	Number	
Walking Speed (10m walk)	Number	
Knee Morphology	Text (Single Select)	Normal/Altered
Joint Effusion	Text (Single Select)	Yes/No
Increased Local Temperature	Text (Single Select)	Yes/No
Local Redness	Text (Single Select)	Yes/No
Bakers Cyst	Text (Single Select)	Yes/No
Muscle Strength MRC (Left Hip Flexors)	Number	
Muscle Strength MRC (Left Hip Abductors)	Number	
Muscle Strength MRC (Left Knee Extensors)	Number	
Muscle Strength MRC (Left Knee Flexors)	Number	
Muscle Strength MRC (Left Plantar Flexors)	Number	
Muscle Strength MRC (Right Hip Flexors)	Number	
Muscle Strength MRC (Right Hip Abductors)	Number	
Muscle Strength MRC (Right Knee Extensors)	Number	
Muscle Strength MRC (Right Knee Flexors)	Number	
Muscle Strength MRC (Right Plantar Flexors)	Number	

Demographics data	S	ocioecono	mics Data	Anamne	sis Data	Physical	examin	ation	Blood Te	sts Data	Scales Data	Social participation Data	RX Data	MRI Da
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A Identification cod	de -	# Mass	(Kg)	- # H	eight (m)	*	# вмі			0 [Left]	Joint line ten	O [Right] Joint line te	O Patellofemor	al pain
SPH001				67.5		1.640			25.097	No		No		
SPH002				78.5		1.580			31.445	No		No		
SPH003				78.0		1.735			25.912	No		No		
SPH004				81.0		1.580			32.447	No		Yes		
SPH005				75.0		1.600			29.297	No		No		
SPH006				84.0		1.740			27.745	No		No		
SPH007				73.5		1.710			25.136	No		No		
SPH008				81.5		1.735			27.074	No		No		
SPH009				76.0		1.720			25.690	No		No		
SPH010				60.0		1.650			22.039	No		No	No	
SPH011				92.0		1.790			28.713	No		No	No	
SPH012				54.0		1.580			21.631	No		No	No	
SPH013				77.5		1.710			26.504	No		No	No	
SPH014				70.5		1.720			23.830	No		No	No	
SPH015				62.0		1.780			19.568	No		No	No	
SPH016				78.0		1.650			28.650	No		No	No	
SPH017				61.0		1.610			23.533	No		No	No	
SPH018				73.0		1.650			26.814	No		No	No	
SPH019				66.5		1.700			23.010	No		No	No	
SPH020				89.5		1.790			27.933	No		No	No	
SPH021				83.0		1.800			25.617	No		No	No	

5.5 Blood Tests Table

The Blood Tests Table includes the results from the patients' blood samples needed for the search of biomarkers. The Table Fields with their values are given below:

Field Name	Field Type	Value
Identification Code	Text	ID of the examined individual
Uric Acid (mg/dL)	Number	
Total Cholesterol (mg/dL)	Number	
HDL-cholesterol (mg/dL)	Number	
LDL-cholesterol (mg/dL)	Number	
Triglycerides (mg/dL)	Number	
Protein C reactive (mg/L)	Number	
Vitamine D (mg/dL)	Number	
PTH (pg/mL)	Number	
Glycated hemoglobin (%)	Number	
Serum COMP	Number	
Serum HA	Number	
PIICP	Number	
IL-1β	Number	
TNF-α	Number	
IL-6	Number	

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	v	# Uric acid	d (mg/dL)		# Total cholest		# HDL-	cholest	erol (m	# LDL-c	holesterol (m., -	## Triglycerides (mg/dL) -	\$\$ Protein C reactive (# Vitamine D (mg/L) -
						196			5	5	125	60		30.6
						177			3	4		420		14.2
						113			4	7	54	61		30.4
				4.7		159			6	1	82	80	1.8	23.1
						207			5	4	136	84	0.7	35.9
						124			6	1	53	54	0.7	24.0
				5.7		152			4	В	83	105		
						213			11	6	85	69	0.9	24.0
				7.0		208			4	5	135	135	6.2	35.6
				3.0		188			7	3	92	89	1.0	8.8
				5.1		220			7	>	136	69	3.5	21.0
				3.6		216			7	3	92	255	0.6	23.1
				4.0		260			13	9	108	69	0.3	26.0
				4.6		239			5	7	159	119	3.1	33.1
				4.4		100					92	210	0.6	6.0

5.5 Scales Data Table

Scales Data Table includes the results from the assessment of limitations in functioning among patients with OA of the lower extremities., such as Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) or the Knee Injury and Osteoarthritis Outcome Score (KOOS). The Table Fields with their values are given below:

Field Name	Field Type	Value
Identification Code	Text	ID of the examined individual
FACHS	Number	
WOMAC	Number	
KOOS Pain (%)	Number	
KOOS Symptoms (%)	Number	
KOOS ADL (%)	Number	
KOOS QOL (%)	Number	
KOOS Sport/Rec (%)	Number	
HAD Anxiety	Text	Normal/Abnormal/Borderline Abnormal
HAD Depression	Text	Normal/Abnormal/Borderline Abnormal
GADS	Text	Anxiety/Depression/No anxiety or depression
CSI A	Text	
CSI B	Text	

omics Data Anamnesis D	ata Physical examination	on Blood Tests Data	Scales Data Social p	participation Data RX D	ata MRI Data 🔮
∓ Filter 🖽 Group 4†	Sort 🗣 Color 🗐 🕻	s			
# WOMAC	# KOOS PAIN (%)	# KOOS SYMPTOMS ·	# KOOS ADL (%) -	# KOOS QOL (%)	# KOOS SPORT/REC (
27.00	56%	89%	60%	44%	50%
73.00	67%	68%	37%	25%	0%
0.00	100%	100%	100%	100%	100%
39.00	47%	46%	59%	6%	0%
9.00	83%	96%	94%	63%	95%
17.00	83%	89%	84%	6%	5%
1.00	100%	100%	100%	92%	100%
15.00	64%	79%	81%	50%	55%
4.00	97%	89%	97%	88%	80%

5.6 Social Participation Table

Social Participation Table includes the replies regarding the social activities of the patients. The Table Fields with their values are given below:

Field Name	Field Type	Value
Identification Code	Text	ID of the examined individual
Social Membership Participation	Text	Not/Less than 1-week/1-2 a
		week
Social Activity Participation	Text	Not/Less than 1-week/1-2 a
		week
Eating out	Text	Not/Less than 1-week/1-2 a
		week
Drinking out	Text	Not/Less than 1-week/1-2 a
		week
Public events	Text	Not/Less than 1-week/1-2 a
		week
Social Games (cards etc)	Text	Not/Less than 1-week/1-2 a
		week

Social trips	Text	Not/Less than 1-week/1-2 a
		week
Social work	Text	Not/Less than 1-week/1-2 a
		week
Voluntary work	Text	Not/Less than 1-week/1-2 a
		week

loeconomics Data Ar	namnesis Data Physical exami	nation Blood Tests Data	a Scales Data	Social participation Data	RX Data MRI Data
fields \Xi Filter 🗐	Group 🕴 Sort 🔍 Color 🗐	e			
Have you taken par	O Have you been to a cultur	O Have you eaten out? -	O Have you been out	- O Have you been to a	Have you taken par
Not	Not	Less than 1/week	1 or 2 a week	Less than 1/week	Not
Not	Not	> twice a week	> twice a week	Less than 1/week	Not
Not	Less than 1/week	Less than 1/week	1 or 2 a week	Not	Not
Not	Not	1 or 2 a week	1 or 2 a week	Not	Not
Not	Less than 1/week	1 or 2 a week	> twice a week	Less than 1/week	Not
Not	Less than 1/week	Less than 1/week	1 or 2 a week	Not	Not
Not	Less than 1/week	Not	1 or 2 a week	Not	Not
Not	> twice a week	1 or 2 a week	1 or 2 a week	Not	Not
Less than 1/week	1 or 2 a week	> twice a week	1 or 2 a week	Less than 1/week	Not
Not	1 or 2 a week	1 or 2 a week	> twice a week	Not	Not
Not	Less than 1/week	Less than 1/week	Less than 1/week	Less than 1/week	Not
Not	Less than 1/week	Less than 1/week	1 or 2 a week	Less than 1/week	Not
Not	Less than 1/week	> twice a week	Less than 1/week	Less than 1/week	Not
Not	Less than 1/week	1 or 2 a week	1 or 2 a week	Less than 1/week	Not
1 or 2 a week	Less than 1/week	1 or 2 a week	Not	Less than 1/week	Not

5.6 RX Data Table

RX Data Table includes the results from the Radiographic examinations performed in patients. The Table Fields with their values are given below:

Field Name	Field Type	Value		
Identification Code	Text	ID of the examined individual		
Leg-length inequality	Text	Yes/No		
Leg-length inequality measure	Text	4 R>L/2 R <i< td=""></i<>		
Right Knee alignment	Text	Varus/Valgus/Neutral		
Right radiographic angle (Knee alignment)	Number			
Left Knee alignment	Text	Varus/Valgus/Neutral		
Left radiographic angle (Knee alignment)	Number			
Right Kellgren and Lawrence (KL) (in points)	Number			
Left Kellgren and Lawrence (in points)	Number			

Right patellofemoral angle	Number	
Left patellofemoral angle	Number	
Right lateral deviation patella (mm)	Number	
Left lateral deviation patella (mm)	Number	
Right Congruence angle	Number	
Left Congruence angle	Number	

kamination	Blood Tes	sts Data	Scales Data	Social participation Data	RX Data	MRI Data	SHAR	🕒 🕥 👬 віоска
≣I (2								Q
Right Knee	alignment -	# Right r	adiographic 👻	O Left Knee alignment 👒	# Left radiogram	phic a v	Right Kellgren and	C Left Kellgren and
Varus			6	Varus		4	0= 0 points	0= 0 points
Valgus			1	Valgus		1	0= 0 points	0= 0 points
Valgus			1	Valgus		1	0= 0 points	0= 0 points
Neutral			0	Valgus		1	0= 0 points	0= 0 points
Neutral			0	Valgus		1	0= 0 points	0= 0 points
Varus			3	Varus		3	0= 0 points	0= 0 points
Varus			3	Neutral		0	1= 1-2 points	0= 0 points
Valgus			1	Neutral		0	0= 0 points	0= 0 points
Neutral			0	Valgus		1	0= 0 points	0= 0 points
Varus			2	Varus		1	0= 0 points	0= 0 points
Varus			1	Neutral		0	0= 0 points	0= 0 points
Varus			3	Varus		3	0= 0 points	0= 0 points
Varus			6	Varus		7	0= 0 points	0= 0 points
Neutral			0	Neutral		0	0= 0 points	0= 0 points
Varus			1	Varus		1	0= 0 points	0= 0 points
Valgus			3	Valgus		6	0= 0 points	0= 0 points
Neutral			0	Varus		1	0= 0 points	0= 0 points
Varus			3	Neutral		0	0= 0 points	0= 0 points

5.7 MRI Data Table

MRI Data Table includes the results from the MRI examinations performed in patients. The Table Fields with their values are given below:

Field Name	Field Type	Value
Identification Code	Text	ID of the examined individual
R- Bone marrow lesions (BMLs)	Number	
and cyst		
R- Bone marrow lesions (BMLs)	Number	
and cyst: Trochlea medial. BML		
size		

R-Bone marrow lesions (BMLs)	Number	
and cyst: Trochlea medial. BML		
number		
R- Bone marrow lesions (BMLs)	Number	
and cyst: Trochlea medial.		
BML%V.Cyst		
R- Bone marrow lesions (BMLs)	Number	
. ,	INUITIBEI	
and cyst: Trochlea lateral. BML		
size		
R-Bone marrow lesions (BMLs)	Number	
and cyst: Trochlea lateral. BML		
number		
R-Bone marrow lesions (BMLs)	Number	
and cyst: Trochlea lateral.		
BML%V.Cyst		
R- Bone marrow lesions (BMLs)	Number	
and cyst: Patella lateral: BML		
size	NT 1	
R-Bone marrow lesions (BMLs)	Number	
and cyst: Patella lateral: BML		
number		
R- Bone marrow lesions (BMLs)	Number	
and cyst: Patella lateral: BML		
%V.Cyst		
R- Bone marrow lesions (BMLs)	Number	
and cyst: Patella medial: BML	Number	
size		
R-Bone marrow lesions (BMLs)	Number	
and cyst: Patella medial: BML		
number		
R- Bone marrow lesions (BMLs)	Number	
and cyst: Patella medial: BML		
%V.Cyst		
R- Bone marrow lesions (BMLs)	Number	
and cyst: Other subregions		
	Number	
R- Articular cartilage		
R- Articular cartilage: Femur:	Number	
central medial: Cartilage loss %		
(full + partial)		
R- Articular cartilage: Femur:	Number	
central medial: Cartilage loss %		
(full)		
R- Articular cartilage: Trochlea	Number	
medial: Cartilage loss % (full +		
partial)		
	Number	
R- Articular cartilage: Trochlea	INUIIIDEI	
medial: Cartilage loss % (full)	N.T. 1	
R- Articular cartilage: Patella	Number	
lateral: Cartilage loss % (full +		
partial)		
R- Articular cartilage: Patella	Number	
lateral: Cartilage loss % (full)		
R- Articular cartilage: Patella	Number	
medial: Cartilage loss % (full +		
partial)		
[partial)		

R- Articular cartilage: Patella	Number	
medial: Cartilage loss % (full)	NT 1	
R- Articular cartilage: other	Number	
areas		
R- Osteophytes: score	Number	
R- Osteophytes: superior patela	Number	
R- Osteophytes: inferior patela	Number	
R- Osteophytes: other	Number	
subregions		
R- Meniscal extrusion: score	Number	
R- Meniscal extrusion: medial	Number	
meniscus: medial extrusion		
R- Meniscal extrusion: medial	Number	
meniscus: anterior extrusion		
R- Meniscal extrusion: lateral	Number	
meniscus		
R- Meniscal morphology	Number	
R- Meniscal morphology:	Number	
Lateral		
R- Meniscal morphology:	Text	Yes/No
Lateral: Anterior: Signal		
R- Meniscal morphology:	Text	Yes/No
Lateral: Anterior: Meniscal cyst		
R- Meniscal morphology:	Text	Yes/No
Lateral: Anterior: Other menisci		
morfology		
R- Meniscal morphology:	Text	Yes/No
Lateral: Body: Signal		
R- Meniscal morphology:	Text	Yes/No
Lateral: Body: Meniscal cyst		
R- Meniscal morphology:	Text	Yes/No
Lateral: Body: Meniscal		
hipertrophy		
R- Meniscal morphology:	Text	Yes/No
Lateral: Body: Other menisci		,
morfology		
R- Meniscal morphology:	Text	Yes/No
Lateral: Posterior		,
R- Meniscal morphology: Medial	Text	Yes/No
R- Meniscal morphology:	Text	Yes/No
Medial: Body: Signal		
R- Meniscal morphology:	Text	Yes/No
Medial: Body: Tear		
R- Meniscal morphology:	Text	Yes/No
Medial: Body: Parcial		
maceration		
R- Meniscal morphology:	Text	Yes/No
Medial: Body: Meniscal cyst		
R- Meniscal morphology:	Text	Yes/No
Medial: Body: Meniscal		200/210
hypertophy		
R- Meniscal morphology:	Text	Yes/No
Medial: Posterior horn: Signal		200/210
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	2T	V /N
R- Meniscal morphology:	Text	Yes/No
Medial: Posterior horn: Vertical		
tear		
R- Meniscal morphology:	Text	Yes/No
Medial: Posterior: Horizontal		
tear		
R- Meniscal morphology:	Text	Yes/No
Medial: Posterior: Radial tear		100/110
	Text	Yes/No
R- Meniscal morphology:	Text	ies/no
Medial: Posterior horn: Root		
tear		
R- Meniscal morphology:	Text	Yes/No
Medial: Posterior horn: Meniscal		
cyst		
R- Meniscal morphology:	Text	Yes/No
Medial: Posterior horn: Meniscal	Text	103/110
hypertrophy	-	×
R- Meniscal morphology:	Text	Yes/No
Medial: Posterior: Other		
meniscal morphology		
R- Meniscal morphology:	Text	Yes/No
Medial: Anterior horn		
R- Ligaments and tendons:	Number	
0	i vuinber	
score	NT 1	
R- Ligaments and tendons: ACL	Number	
and PCL: score		
R- Ligaments and tendons:	Text	Yes/No
BML/cyst		
R- Ligaments and tendons:	Text	Yes/No
repair		
R- Ligaments and tendons:	Number	
Patellar tendon	INUMBER	
R- Periarticular features:	Number	
R- Periarticular features:	Text	Present/Absent
Infrapatelar bursa signal:		
R- Periarticular features:	Text	Present/Absent
Popliteal cyst		
R- Periarticular features: Other	Text	Present/Absent
periarticular features	Text	r resent/ russent
1	Number	
R- Hoffa's fat synovitis	Number	
R- Synovitis / effsuion	Number	
L-Bone marrow lesions (BMLs)	Number	
and cyst		
L- Bone marrow lesions (BMLs)	Number	
and cyst: Trochlea medial. BML		
size		
L- Bone marrow lesions (BMLs)	Number	
and cyst: Trochlea medial. BML		
number		
L- Bone marrow lesions (BMLs)	Number	
and cyst: Trochlea medial.		
BML%V.Cyst		
L- Bone marrow lesions (BMLs)	Number	
and cyst: Trochlea lateral. BML		
-		
size		

		·
L- Bone marrow lesions (BMLs)	Number	
and cyst: Trochlea lateral. BML		
number		
L- Bone marrow lesions (BMLs)	Number	
	Number	
and cyst: Trochlea lateral.		
BML%V.Cyst		
L-Bone marrow lesions (BMLs)	Number	
and cyst: Patella lateral: BML		
size		
L- Bone marrow lesions (BMLs)	Number	
and cyst: Patella lateral: BML		
number		
L- Bone marrow lesions (BMLs)	Number	
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and cyst: Patella lateral: BML		
%V.Cyst		
L-Bone marrow lesions (BMLs)	Number	
and cyst: Patella medial: BML		
size		
L- Bone marrow lesions (BMLs)	Number	
and cyst: Patella medial: BML		
number		
	Number	
L-Bone marrow lesions (BMLs)	Inumber	
and cyst: Patella medial: BML		
%V.Cyst		
L- Bone marrow lesions (BMLs)	Number	
and cyst: Other subregions		
L- Articular cartilage	Number	
L- Articular cartilage: Femur:	Number	
central medial: Cartilage loss %	i valiber	
Ũ		
(full + partial)	NT 1	
L- Articular cartilage: Femur:	Number	
central medial: Cartilage loss %		
(full)		
L- Articular cartilage: Trochlea	Number	
medial: Cartilage loss % (full +		
partial)		
L- Articular cartilage: Trochlea	Number	
medial: Cartilage loss % (full)		
	Number	
L- Articular cartilage: Patella	INUIIIDEI	
lateral: Cartilage loss % (full +		
partial)		
L- Articular cartilage: Patella	Number	
lateral: Cartilage loss % (full)		
L- Articular cartilage: Patella	Number	
medial: Cartilage loss % (full +		
partial)		
L- Articular cartilage: Patella	Number	
0		
medial: Cartilage loss % (full)	NT 1	
L- Articular cartilage: other areas	Number	
L- Osteophytes: score	Number	
L- Osteophytes: superior patela	Number	
L- Osteophytes: inferior patela	Number	
L- Osteophytes: other	Number	
subregions		
L- Meniscal extrusion: score	Number	
17- Memoral CAUGION, SCOLE	1 NULLIDEL	

		[]
L- Meniscal extrusion: medial	Number	
meniscus: medial extrusion		
L- Meniscal extrusion: medial	Number	
meniscus: anterior extrusion	X X	
L- Meniscal extrusion: lateral	Number	
meniscus		
L- Meniscal morphology	Number	
L- Meniscal morphology: Lateral	Number	
L- Meniscal morphology:	Number	
Lateral: Anterior: Signal		
L- Meniscal morphology:	Number	
Lateral: Anterior: Meniscal cyst		
L- Meniscal morphology:	Number	
Lateral: Anterior: Other menisci		
morfology		
L- Meniscal morphology:	Number	
Lateral: Body: Signal		
L- Meniscal morphology:	Number	
Lateral: Body: Meniscal cyst		
L- Meniscal morphology:	Number	
Lateral: Body: Meniscal		
hipertrophy		
L- Meniscal morphology:	Number	
Lateral: Body: Other menisci		
morfology		
L- Meniscal morphology:	Number	
Lateral: Posterior		
L- Meniscal morphology: Medial	Number	
L- Meniscal morphology:	Number	
Medial: Body: Signal		
L- Meniscal morphology:	Number	
Medial: Body: Tear		
L- Meniscal morphology:	Number	
Medial: Body: Parcial		
maceration		
L- Meniscal morphology:	Number	
Medial: Body: Meniscal cyst		
L- Meniscal morphology:	Number	
Medial: Body: Meniscal		
hypertophy		
L- Meniscal morphology:	Number	
Medial: Posterior horn: Signal		
L- Meniscal morphology:	Number	
Medial: Posterior horn: Vertical		
tear		
L- Meniscal morphology:	Number	
Medial: Posterior: Horizontal		
tear		
L- Meniscal morphology:	Number	
Medial: Posterior: Radial tear		
L- Meniscal morphology:	Number	
Medial: Posterior horn: Root		
tear		
		I

L- Meniscal morphology:	Number
Medial: Posterior horn: Meniscal	
cyst	
L- Meniscal morphology:	Number
Medial: Posterior horn: Meniscal	
hypertrophy	
L- Meniscal morphology:	Number
Medial: Other meniscal	
morphology	
L- Meniscal morphology:	Number
Medial: Anterior horn	
L- Ligaments and tendons: score	Number
L- Ligaments and tendons: ACL	Number
and PCL: score	
L- Ligaments and tendons:	Number
BML/cyst	
L- Ligaments and tendons:	Number
repair	
L- Ligaments and tendons:	Number
Patellar tendon	
L- Periarticular features:	Number
L- Periarticular features:	Number
Infrapatelar bursa signal:	
L- Periarticular features:	Number
Popliteal cyst	
L- Periarticular features: Other	Number
periarticular features	
L- Hoffa's fat synovitis	Number
L- Synovitis / effsuion	Number

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nomics Data Anamnesis	Data Physical examinat	tion Blood Tests Data	Scales Data Social	participation Data RX	Data MRI Data
Hide fields 😇 Filter 🖽	Group 🕴 Sort 🐥 Color	≌ II			
· O R- Bone marrow les ·	C R- Bone marrow les	C R- Bone marrow les	C R- Bone marrow les	C R- Bone marrow les	C R- Bone marrow les
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7. Conclusions and future work

In this document we presented the current data management infrastructure of OActive project. This is based on the current flow of data samples and we have concluded that Airtable is the best solution that we could employ to handle their current volume.

In the future, as already mentioned in the description of work (DoW), another online infrastructure and in particular VPH-Share¹ could be used given that the volume of available data samples would be increased. VPH-Share is an online infrastructure that offers *data services, tools, metadata management and security* for sharing and accessing biomedical data.

In terms of data services, VPH-Share supports handling of *structured data* and *Large Binary Data*. Structured data are record collections that share a common schema such as those found in comma-separated values (CSV) files and relational databases. VPH-Share could access and query those interfaces via SPARQL Protocol and RDF (Resource Description Framework) Query Language and SQL (Structured Query Language). These two interfaces sit on top of MySQL databases for each individual data set. *Large Binary Data*, such as images, computational models and physiological signals are stored in a cloud based file-system and could be accessed through the Web Distributed Authoring and Versioning (WebDAV) protocol.

In terms of tool provisioning, VPH-Share cloud-based approach supports the sharing of tools and applications using virtualisation technologies, in particular those used in the OpenStack11 cloud model.

Metadata management for VPH-Share is relatively simple and integration with it, is a relatively simple task. There are many search services offered over this data in terms of semantic search, free text search, and faceted search for specific resource types.

Finally, VPH-Share's security has been developed as its own proprietary model based on the requirements of its user base. The model is distributed in its enforcement, simple to use and precluded the use of strong authentication such as certificate based access. This is due to the fact that VPH-Share should not contain any sensitive information, especially regarding clinical data. The data publication process should remove this before it reaches the network. VPH-Share supports the concept of a security proxy that sits in front of every service and evaluates an access policy against the security ticket contained in the web service request. This ticket contains all of the roles the user has in the VPH-Share network and access policies are distributed across the network to these proxies from a central repository. This approach of using a proxy means that the developers of applications and tools are completely unaware that their

applications are being protected and have no integration overheads from a security perspective, which is highly desirable. It also means that access policies are made local to the resource, thereby removing the dependence of a central authority making the decisions, which, on a large scale, makes the system perform much better.

¹ http://www.vph-share.eu/