

## D7.1: System architecture and design of APIs

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- Roessingh Research and Development (RRD)
- Danish Board of Technology Foundation (DBT)
- Sorbonne University (SU)
- University of Dundee (UDun)
- Universitat Politècnica de València, Grupo SABIEN (UPV)
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## Abstract

This deliverable describes the overall integrated technical architecture of the server and clients (home and mobile) systems as well as provides high-level definitions of the APIs used to communicate between the various modules. The overall architecture is derived from the requirement and design documents and deliverables from the technical modules in WP3, WP4, WP5 and WP6. This document describes the current state of the architecture, which is a work in progress.

## Corrections

v1.0.1      Correctly applied EU logo on header page.

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## Symbols, abbreviations and acronyms

3D	3 dimensional
A	Asset
AIF+	Argument Interchange Format upper ontology
API	Application Programming Interface
BCTT	Behaviour Change Technique Taxonomy
BML	Behaviour Markup Language
BS	Business Service
C.A	Concern Application
C.Q	Concern Quality
C.R	Concern RRI
CMC	Centre for Monitoring and Coaching
COPD	Chronic Obstructive Pulmonary Disease
COUCH	Council of Coaches
CSO	Civil Society Organisation
CSV	Comma-Separated Values
CV.SC	Context Viewpoint Scenarios
CV.ST	Context Viewpoint Stakeholder
CV. UC	Context Viewpoint Use Cases
D	Deliverable
D&AF	Dialogue and Argumentation Framework
DBT	Danish Board of Technology Foundation
EC	European Commission
ECC	Embodied Conversational Coach
EI	Environment Interfacing
FML	Functional Markup Language
GDPR	General Data Protection Regulation
GPS	Global Positioning System
GSR	Galvanic Skin Response
HBAF	Holistic Behaviour Analysis Framework
HCI	Human-Computer Interaction
HMI	Human Machine Interaction
HTTPs	HyperText Transfer Protocol Secure
ID	Identification
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization for Standardization

ISPRINT	Innovation Sprint
JSON	JavaScript Object Notation
KB	Knowledge Base
M	Month
MAS	Multi Agent System
MS	Milestone
MySQL	My Structured Query Language
OWL	Web Ontology Language
PhD	Philosopher's Degree
PPG	PhotoPlethysmoGram
PSD	Persuasive Systems Design
QoS	Quality of Service
R.F	Requirement Functional
R.NF	Requirement Non Functional
RDF	Resource Description Framework
RRD	Roessingh Research and Development
RRI	Responsible Research and Innovation
RS	Resource Service
SMS	Short Messaging Service
SU	Sorbonne University
UDI	Unique Device Identification
UDun	University of Dundee
UPV	Universitat Politècnica de València
UI	User Interface
UMA	Unity Multipurpose Avatar
US	User Service
UT	University of Twente
UUI	Unique User Identification
WP	Work Package

# 1 Introduction

This document is structured in two parts. The first is an explanation of the methodology used to model the architecture of Council of Coaches (Section 3), while the second part is the collection of diagrams and tables that represent the architecture itself (Section 4).

The architecture of Council of Coaches will certainly change and be more complete and concrete as the prototypes evolve, so this document will be updated with future revisions of the architecture with the latest changes and additions.

For first time readers it is recommended to first read Section 3, which describes how the models are structured. Future revisions with updates on the architecture will keep this part unchanged and will update only the models in Section 4.

There are a lot of diagrams and lists in the second architecture part, so it is helpful to use the lists of tables and figures, as well as the index, to navigate them.

## 2 Objectives

In M6 of the Council of Coaches project (February 2018) several deliverables were released describing the initial designs for the core technical components:

- D2.2: Report on user and stakeholder needs and expectations [**Stakeholder Analysis**]
- D3.1: Initial coaching strategies and knowledge base [**Shared Knowledge Base**]
- D4.1: State-of-the-art, requirement analysis and initial specification of the Holistic Behaviour Analysis Framework [**Behaviour Analysis Framework**]
- D5.1: Dialogue and Argumentation Framework Design [**Dialogue Framework**]
- D6.1: Requirements and Concepts for Interaction Mobile and Web [**HCI Design**]

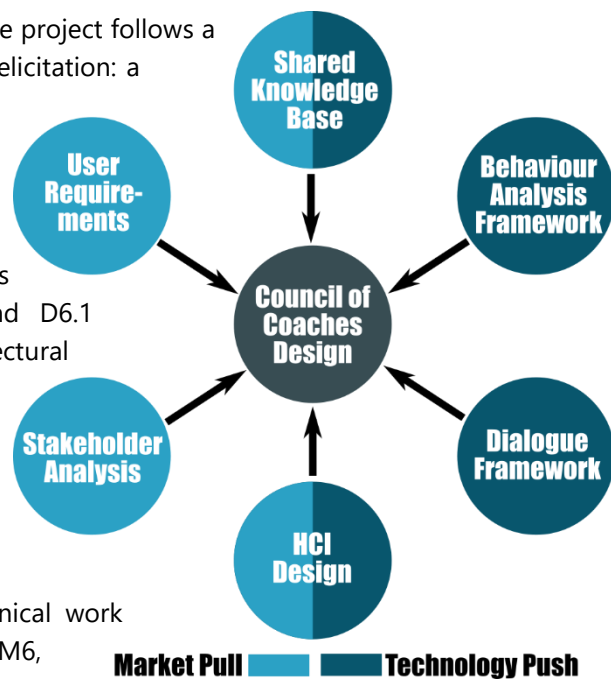
As described in each of their introductory parts, the project follows a twofold strategy for its design and requirements elicitation: a “technology push” and a “market pull”.

Those strategies converge in this deliverable document to define the overall architecture of the system. The purpose of this deliverable is to gather, combine, elaborate and formalize the results of the deliverables D2.2, D3.1, D4.1, D5.1 and D6.1 mentioned above, and give as a result the architectural definition of Council of Coaches. Specifically, the following three objectives are defined for this deliverable:

**Objective 1:** To define the architecture definition methodology (Section 3).

**Objective 2:** To analyse the results of the technical work packages and their deliverables at the milestone of M6, combine them, elaborate them further, and produce in return:

**Objective 3:** A formalized description of the overall architecture of the Council of Coaches, integrating all its components, and defining the interfaces between them and with the actors external to it (Section 4).



**Figure 1: Global design and requirements elicitation process in the Council of Coaches project focusing on a simultaneous market pull and technology push strategy.**

## 3 Methodology

Early in the project, we decided to try to follow a formalized methodology to define the architecture of the Council of Coaches system. WP7 leader UPV suggested using the ARCADE framework based on previous experience in universAAL. ARCADE allows covering the architecture definition from a wide set of angles while being flexible (we will use it as a guide, we do not need to complete every single model defined by it) and facilitating a progressive, iterative process. The next section describes ARCADE in detail.

### 3.1 The ARCADE Framework

ARCADE is an architectural description framework for software systems evolved from the MAFIA (Walderhaug, Stav, Tomassen, Røstad, & Moe, 2006) framework and influenced by the IEEE 1471-2000<sup>1</sup> standard. It is comprised of a set of models that together provide a comprehensive view of an architecture. These are divided into *Concerns* and *Assets* (lists of items that will affect the design going forward), *Reference Architecture* (an abstraction of the architecture applicable to other instances) and *Viewpoints* (sets of models defining the system from multiple points of view).

#### 3.1.1 Concerns

Concerns are things to always take into account when building the system architecture, always related to system functionality. There are two types of concerns in ARCADE, Application and Quality-related, but in Council of Coaches, we are going to add another type: RRI-related.

##### **Application-specific concerns**

Concerns relevant to the final application of the system. In other words, everything you can consider that the system should do (consider this from the point of view of a stakeholder: if you were one, what would you wish the system to do).

##### **Quality-related concerns**

While Application-specific concerns are about what the system should do, Quality-related concerns are about how it should do it. These concerns typically fall into one (or more than one) of the following categories: Communication, Concurrency, Configurability, Distribution, Fault handling, Flexibility, Interoperability, Maintainability, Naming, Performance, Quality of Service (QoS), Reliability, Replication, Safety, Scalability, Security, Synchronisation.

##### **RRI-related concerns**

In order to integrate Responsible Research and Innovation (RRI) into the architecture definition, we will list concerns about RRI and make sure we tackle these throughout the architecture, like the rest of concerns.

#### 3.1.2 Assets

Things and tools that already exist and we can reuse throughout the architecture. Take into account that the existing systems that we are going to integrate into Council of Coaches (e.g. Greta) do not qualify as assets, since they will be actually an integral part of the architecture itself. Instead, assets are more "modular", "off-the-shelf" or "out-of-band" things we can reuse. Think of standards, design patterns, ontologies, libraries, designer applications, etc...

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<sup>1</sup> <https://standards.ieee.org/findstds/standard/1471-2000.html>

### 3.1.3 Reference architecture

An abstract, overall, super-generic depiction of the final architecture that can be adapted and specialized for different situations. If we planned to create a Council of Coaches for, say, elite sports training, then the architecture of that new Council of Coaches would also comply with this reference architecture.

Due to the abstract nature of this reference architecture, its basic components should align or fit into the generic Reference Architecture defined by ARCADE:

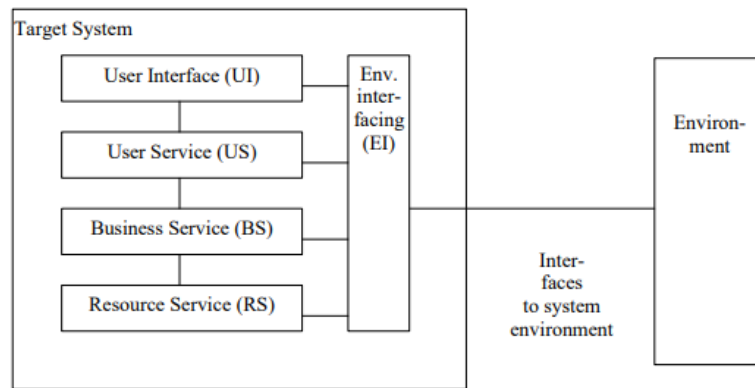


Figure 2: ARCADE Generic Reference Architecture.

### 3.1.4 Viewpoints

Each viewpoint is a collection of views (all diagrams and models). All viewpoints together completely define the architecture. We will define viewpoints iteratively and in order.

#### 3.1.4.1 Context Viewpoint

Describes the environment of the system only, not the system itself. Besides, it is merely conceptual, there is nothing technological about it.

#### Business Aspect Model

Describes the Problem that the system will solve: what it does, who does it and for whom. Includes: Stakeholders, Scenarios, Use Cases.

#### Environment Systems Model

Describes other systems the system will interact with, or it exists besides to.

#### Business-to-System Mapping Model

It assigns the tasks and uses (Use Cases, Scenarios) defined in the Business Aspect Model to the appropriate responsible, whether it is a stakeholder, a part of the system, or other system from the Environment Systems Model.

#### 3.1.4.2 Requirement Viewpoint

All possible types of requirements go here. When adding requirement to the architecture take into account that they always have to be testable.

#### Requirement Model

The classic list of requirements fully described and classified.

#### Target System Interface Model

Requirements that other systems identified in the Environment Systems Model have to fulfil to play a role in the Business-to-System Mapping Model.

### 3.1.4.3 *Component Viewpoint*

Describes the components, subsystems, pieces, etc., and how they interconnect. Preferably from a technology-independent perspective (i.e. you can define what they do and how they connect but leaving out the implementation details, like if it's written in Java or communicating through a particular TCP port).

#### **System Information Model**

In other words, it is the data model – the “format” the information being shared and stored by modules follows.

#### **System Decomposition Model**

Describes the logical components that build the system and how they relate to each other. This is the typical model we think of when we “draw” an architecture or part of it.

#### **System Collaboration Model**

Describes how one or more components perform the actions, roles and use cases defined in the Context Viewpoint. We most commonly picture this as sequence diagrams.

#### **Component and Interface Specification Model**

Completely describes the interfaces of the components (the edges of the links between components depicted in System Decomposition Model and System Collaboration Model).

### 3.1.4.4 *Distribution Viewpoint*

How the components are “logically” placed and separated from each other. In other words, where they would “run” in a hypothetical, “virtual” deployment of the system.

#### **System Distribution Model**

Basically, what was mentioned in the overall viewpoint. Take into account these issues: size, geographical distribution, communication properties, processing capacity. Consider as well that, ideally, distribution should be transparent: for instance, that a component that runs on Windows could be swapped to run on Linux and the system would work the same.

#### **Role Distribution Model**

Only for large systems, where stakeholders or components can have multiple roles. Consider these roles as part of the distribution models.

### 3.1.4.5 *Realization Viewpoint*

How all the above is installed in real life and delivered using real technology.

#### **System Deployment Model**

It is the “real life” version of the System Distribution Model. Instead of placing components in hypothetical containers, you place them into actual, existing hardware or software.

#### **Technology Mapping Model**

Remember how the Component Viewpoint was “technology-independent”? This is where actual technologies and implementations are assigned to components. It can be something as simple as identifying that component X is implemented by the code in repository Y.

#### **System Integration Test Model**

Describes all the tests to perform throughout the finalized implemented system to check that it works as intended and as described by the architecture

## 3.2 Defining the architecture

In ARCADE, Concerns and Assets are “stationary”, in the sense that they are always available, always taken into account, and in theory can be updated any time. The Reference Architecture, being an abstraction, may be better defined once the final architecture is ready. Finally, the viewpoints are better designed in a linear and iterative way: starting with Context all the way to Realization, then starting and refining from Context again.

Following this scheme, we decided to approach the initial definition of the architecture in various stages. First, Concerns and Assets were addressed, surveying partner’s initial thoughts, based on the very first ideas in the project. Then we did the same for the core models that would feed the Context viewpoint: Stakeholders, Scenarios and Use cases.

After this first attempt, the M6 milestone deliverables described the initial technical designs for the core components. These documents were analysed and used to finalize the first versions of the Concerns and Assets lists. After the first plenary meeting, where several new scenarios were defined, there was enough content to shape the models in the Context Viewpoint.

The next stage involved the Requirement Viewpoint. The requirements were elicited from a combination of evolved Concerns, requirements from the M6 deliverables, and an ongoing effort for requirement negotiation among project partners.

Finally, the rest of the more tech-heavy viewpoints were tackled after the final workshop of the Technical Demonstrator Integration Task Force (in April 2018) before the Initial Functional Prototype. At this point, the architecture was clear enough to draw the required models. Other, more close-to-release models are left unfilled and will be completed in future revisions of this document with each update on the prototype.

### 3.2.1 Future work

It is not feasible to have a finalized, definitive description of COUCH architecture in the first stages. There are still many things to be decided, there is only a first integration attempt, and a first functional prototype (see D7.2) that works with mock-up stand-ins and scripted interactions. There are some models that cannot be filled until a more cohesive and practical deployment of the solution is ready, and there will certainly be changes to the ones already contained here. Matching the upcoming consecutive updates to the prototype (D7.3 to D7.5) there will be updates to this document in future revisions. These revisions will only modify the diagrams and tables depicted in the next section, which model the architecture.

As of now, there are a handful of models that cannot be filled. This is explained in each of their sections, and here is a quick reference listing them:

- **Reference architecture:** The Reference Architecture is an abstraction of the specific COUCH architecture. It is mostly of interest to 3<sup>rd</sup> parties and will be better filled once the COUCH’s architecture is completed.
- **Business Aspect Model:** As the different use cases become realized, we will have a better view of which actors are involved and how each use case relates to each other. We will include further diagrams representing these relationships.
- **Target System Interface Model:** The Target System Interface Model defines the interfaces for the external and 3rd party systems identified in the Environment Systems Model. As seen in that model, we currently only have a small view of those external systems, and their interfaces would be placeholders for now.
- **Requirement Model:** As requirements get trimmed down and implemented, we will have a better view of which component is associated to each requirement and figure out a hierarchy

among requirements. This is a process that happens in parallel with user involvement efforts in Work Package 2. We will update this section with diagrams representing those relationships as they become clear.

- **System Collaboration Model:** When we complete the final implementation of each component we will have a more clear and final view of all the interactions between components per use case, instead of an overall sequence.
- **Role Distribution Model:** This model is mostly suited for very large and complex systems. This will not be defined in COUCH architecture.
- **Realization Viewpoint:** This Viewpoint includes the actual hardware the system will run in. We will have a clearer view of this once we approach the final demonstration prototype.

## 4 Architecture

In this section, we describe the architecture definition following the ARCADE framework, describing the following aspects:

- Concerns (Section 4.1)
- Assets (Section 4.2)
- Reference Architecture (Section 4.3)
- Viewpoints (Section 4.4)
  - Context Viewpoint (Section 4.4.1)
  - Requirement Viewpoint (Section 4.4.2)
  - Component Viewpoint (Section 4.4.3)
  - Distribution Viewpoint (Section 0)
  - Realization Viewpoint (Section 4.4.5)

### 4.1 Concerns

Below in Table 1, Table 2 and Table 3 the Application-specific concerns, Quality-related concerns and RRI-related concerns are listed respectively, along with the WP that has to enforce them.

#### 4.1.1 Application-specific concerns

ID	Concern	WP
C.A.01	<b>Intrusion A</b> To not be intrusive: Enable use-profiling	WP2
C.A.02	<b>Intrusion B</b> To not be intrusive: Make questions more personal with time / build relationship	WP2
C.A.03	<b>Intrusion C</b> To not be intrusive: Include a “do not disturb option”	WP2
C.A.04	<b>Intrusion D</b> To not be intrusive: Enable “do not record data” for specific conversations	WP2
C.A.05	<b>Intrusion E</b> To not be intrusive: Prompt the user to participate in the conversation	WP2
C.A.06	<b>Intrusion F</b> To not be intrusive: Summary-option for long conversations with intentions of humour that might be annoying to some users	WP2
C.A.07	<b>Annoying reminders</b> reminders can be extremely annoying	All
C.A.08	<b>Avoid negative messages</b> Avoid all kind of negative messages that makes the patient doubt himself or could in any other way reinforce a negative experience for the user.	All
C.A.09	<b>Detect motivation level</b> While listening, the virtual coaches have to detect the level of motivation that the patient is at, for changing his/her lifestyle.	All

C.A.10	<b>Don't make patient feel bad</b> Never make the patient feel bad about him/her, as COUCH then is not advising into the right motivational level. Use empathy and open reflections.	All
C.A.11	<b>Don't push too hard</b> A mistake that is easily made, according to Stakeholder1, is to start pushing too hard when the patient is not ready for it motivational-wise.	All
C.A.12	<b>Educational tool</b> The app has both the potential of becoming an educating tool and a tool that makes people dumber and uncritical. Make sure it comes out as an educational health tool in the end!	All
C.A.13	<b>Empathetic coach</b> The coach has to listen, be empathic and show that it supports the patient before starting to push the patient towards a "better" lifestyle	All
C.A.14	<b>Identify motivation</b> Be able to identify the level of motivation that the patient is at and adapt the coaching to that level.	All
C.A.15	<b>Independence conflict</b> the app shall not conflict with the independence of the patient	All
C.A.16	<b>International label</b> International label for responsible healthcare with some strict requirements for the product to live up to in order to obtain the label. At least stricter than those from the doctor board from his/her country.	All
C.A.17	<b>Is COUCH necessary?</b> Be aware of the patient's needs! Do not try to solve a big problem through COUCH when COUCH isn't necessary.	All
C.A.18	<b>Non-addictive by design</b> Think about a design that will not make people become addicted to the product.	All
C.A.19	<b>Push over pull</b> More effective to push it out than using pull-strategies, but if the technology should be responsible, it had to be verified by experts within the same fields of the virtual coaches. Furthermore, it shall only be implemented with push-strategies if it makes sense for the personnel (doctors, psychiatrists, etc.) to recommend it and use it.	All
C.A.20	<b>References to knowledge</b> app can use the knowledge gathered from when it listens to the patient, to make references and examples to the patient's own relational mind	All
C.A.21	<b>Transparent use of data</b> Make the use of data transparent to the patient. The patient should have a clear idea of everything that can be done with his/her data.	All

C.A.22	<b>Understand the reason</b> The coach should understand the reason for e.g. smoking, drinking, not exercising, etc. (by understanding the motivation level) and should start building an empathic thrust-relationship to the patient by telling that it understands, and that it can be hard to change, etc. Slowly thereafter the coach can carefully work towards open reflections (talks with the patient) that suggest behaviour change	All
C.A.23	<b>Who can use COUCH</b> Not everybody might be able to use COUCH that can lead to certain social groups being forgotten in the healthcare system or marginalized. Be very aware of which people that can use COUCH and which people that can't!	All
C.A.24	<b>Chronic pain - COUCH potentials</b> When treatment for chronic pain commences in a rehabilitation centre, virtual coaches could offer parts of the treatment that can be done at home (physical exercises, psychological exercises)	WP2
C.A.25	<b>Chronic pain - COUCH potentials A</b> When treatment in the rehabilitation centre is concluded, virtual coaches should offer relapse prevention. This includes educating clients about noticing signs of relapse (e.g., noticing new types of pain, change in mood) and application of the right strategies (e.g., breathing exercises).	WP2
C.A.26	<b>Chronic pain - COUCH potentials B</b> The coaches also need to be absent at periods of time. Treatment of chronic pain is aimed at making the patient independent of support.	WP2
C.A.27	<b>Coaching style A</b> The virtual coaches should not mingle themselves in diagnosis and triage.	WP2
C.A.28	<b>Coaching style B</b> On getting the user to act: The app needs many different target groups. Each approach would be coupled to a target group.	WP2
C.A.29	<b>Coaching style C</b> Learning happens better if the new knowledge is relatable to the lifeworld of oneself. If the app can use the knowledge gathered from when it listens to the patient, to make references and examples to the patient's own relational mind, that would be a great way to ensure learning and thereby independence	WP2
C.A.30	<b>COUCH as a supplement to human experts</b> Motivation and voluntariness as a starting point for the implementation	WP2
C.A.31	<b>Health education A</b> Once a diagnosis is made, the coaches should provide health education, since "most people do not know what their diagnosis entails and most care professionals do not take the time to explain things properly"	WP2
C.A.32	<b>Health education B</b> For the case of COPD patients, regular refreshment courses on how to properly inhale their medication would be very worthwhile.	WP2
C.A.33	<b>Implementation</b>	WP2

	On implementing with push-strategies: They will need a workshop or a small course, teaching them about the system behind the app, how it is used, and how they shall convey the app to their patients.	
C.A.34	<b>Intrusion G</b> Dealing with annoying messages: Do like Duolingo! Duolingo is a language school app that reminds you to use it for three days in a row. After the third day, it stops sending notifications. That way the user won't feel bad about not using the app	WP2
C.A.35	<b>Liability A</b> Technically speaking, you should be able to delete the advices by tapping the small red cross and get new advices. In that way you can choose the advices given to you?	WP2
C.A.36	<b>Liability B</b> Political correctness as something that should not necessarily be strived for. A political correct way of talking about smoking would be to always talk about smoking as something bad that should never be done at any occasion. Something that the coach should always advice against. But maybe it is better be more relaxed about it, so that the patient is not terrified of the coaches and feels bad about him- or herself.	WP2
C.A.37	<b>Monitoring</b> With respect to COPD exacerbations, the virtual coaches should have a monitoring role, whereby they detect exacerbations (using simple questionnaires) and monitor the (lack of) effect of interventions (e.g., antibiotics or prednisolone).	WP2
C.A.38	<b>Robot dependency</b> Maybe the system should be able to facilitate meetings with other patients. This is also based on the fact that we know loneliness is a huge issue and, in many cases, leads to an early death. It could also be done through online platforms where the patients can talk with each other.	WP2
C.A.39	<b>Add coach with its knowledge</b> Adding a new embodied conversational coach should include adding the domain knowledge for that coach and relevant specifications for their personality, appearance and behaviours.	WP3
C.A.40	<b>Add/Remove coaches</b> It should be possible to remove or add new embodied conversational coaches to the system.	WP3
C.A.41	<b>Balance coaching and complexity</b> There is a large number of elements that can differ between users and their contexts, and which can be used for tailoring strategies. While these elements can improve coaching, they also increase complexity. Figuring out an ideal balance between the two will be important.	WP3
C.A.42	<b>Coaches can participate out of their domain</b> When a new embodied conversational coach is added, an addition to the general knowledge represented in the system should be made to enable the other embodied conversational coaches to join as a non-expert in a conversation with the user in the new embodied conversational coach's domain.	WP3

C.A.43	<b>Coaching domains</b> To emphasize: Since the groups of users included in the evaluation are Type 2 Diabetes, Chronic Pain and Age-Related Impairments, these are the coaching domains for which knowledge should be included	WP3
C.A.44	<b>Inadvertent ethics</b> Creating realistic coaches that can provide effective tailored coaching inadvertently involves an ethical component.	WP3
C.A.45	<b>KB give access to D&amp;AF</b> The shared knowledge base should provide access to the Dialogue and Argumentation Framework. In doing so the Dialogue and Argumentation Framework should be able to pose a query and the shared knowledge base should be able to return a meaningful answer.	WP3
C.A.46	<b>KB give access to HBAF</b> The shared knowledge base should provide access for the Holistic Behaviour Analysis Framework to the knowledge about previously detected primitive behaviours.	WP3
C.A.47	<b>KB store appearance of coaches</b> The shared knowledge base could include information on the personality and appearance of the coaches that would be required for their presentation using the Greta Framework.	WP3
C.A.48	<b>KB store behaviour sets</b> The shared knowledge base could include the behaviour sets that are currently used by the Greta Framework to convert intents into BML/FML specifications.	WP3
C.A.49	<b>KB store broad data for conversations</b> The shared knowledge base should contain knowledge that will enable the embodied conversational coaches to have conversations with the user (broad, not coaching domain specific).	WP3
C.A.50	<b>KB store domain data for each coach</b> For each embodied conversational coach, the shared knowledge base should contain knowledge that is specific for the domain of that embodied conversational coach.	WP3
C.A.51	<b>KB store long term for HBAF</b> The shared knowledge base should store the long-term behaviours detected by the Holistic Behaviour Analysis Framework.	WP3
C.A.52	<b>KB Store short term for HBAF</b> The shared knowledge base should store the short-term behaviours detected by the Holistic Behaviour Analysis Framework.	WP3
C.A.53	<b>KB store tailoring data</b> The shared knowledge base should contain knowledge that will enable the embodied conversational coaches to tailor their coaching strategies to the user.	WP3
C.A.54	<b>KB updated from D&amp;AF</b> The shared knowledge base should update its knowledge (that is, add, change or delete) based on inputs by the Dialogue and Argumentation Framework.	WP3

C.A.55	<b>KB verifies new data when stored</b> When new knowledge is added to the shared knowledge base this new knowledge should be verified in terms of compliance with existing knowledge.	WP3
C.A.56	<b>Keep motivation</b> keeping up the user's motivation while they are being coached	WP3
C.A.57	<b>Authorize devices</b> The platform shall authorise devices to send data	WP4
C.A.58	<b>Read raw data</b> The platform shall read raw sensory data from authorised devices	WP4
C.A.59	<b>Store raw data</b> The platform shall store raw sensory data from authorised devices	WP4
C.A.60	<b>Raw data from each device</b> The platform shall obtain raw sensory data from each device	WP4
C.A.61	<b>Device UDI</b> The platform shall provide a UDI for each device	WP4
C.A.62	<b>User UUI</b> The platform shall provide a UUI for each user	WP4
C.A.63	<b>Compute from raw data</b> The platform shall compute features based on raw sensory data	WP4
C.A.64	<b>Data for features</b> The platform shall provide the appropriate data for each feature extraction model	WP4
C.A.65	<b>Features for classification</b> The platform shall provide the appropriate features for creating the classification model	WP4
C.A.66	<b>Datasets for classification</b> The platform shall facilitate the generation of datasets for training the classification model	WP4
C.A.67	<b>Update classification</b> The platform shall update the classification model	WP4
C.A.68	<b>Create behaviour logs</b> The platform shall create logs of behaviours	WP4
C.A.69	<b>Update behaviour logs</b> The platform shall update logs of behaviours	WP4
C.A.70	<b>Concurrent access</b> The platform shall allow concurrent access	WP4
C.A.71	<b>Short term behaviour</b> The platform shall identify user's short-term behaviours	WP4
C.A.72	<b>Short term behaviour logs</b>	WP4

	The platform shall provide short-term behaviours for the generation of behaviour logs	
C.A.73	<b>Short-to-long term behaviour</b> The platform shall provide the appropriate short-term behaviours for recognising long-term behaviours	WP4
C.A.74	<b>Long term behaviour</b> The platform shall identify user's long-term behaviours	WP4
C.A.75	<b>Behaviour permissions</b> The platform shall provide to the authorised entities permissions to read, write, delete and update behavioural logs	WP4
C.A.76	<b>Raw data permissions</b> The platform shall provide to the authorised entities permissions to read, write, delete and update raw sensory data	WP4
C.A.77	<b>Behaviour sources</b> The platform shall merge behavioural data coming from external sources	WP4
C.A.78	<b>Link UDI and UUI</b> The platform shall link each UDI with the related UUI	WP4
C.A.79	<b>Manage dialogues</b> The framework shall be capable of creating, managing and terminating coaching dialogues.	WP5
C.A.80	<b>Turn taking</b> The framework shall provide general rules for turn-taking for when these are not explicitly provided in the protocol.	WP5
C.A.81	<b>Start dialog</b> Agents representing virtual coaches shall be capable of autonomously initiating dialogues amongst themselves or with the user.	WP5
C.A.82	<b>Recipients</b> Dialogue moves shall name a recipient, either specific or as a broadcast move to all.	WP5
C.A.83	<b>Receiving dialogue</b> An agent shall be capable of receiving incoming dialogue moves.	WP5
C.A.84	<b>Record dialogue</b> An agent shall keep a record of all dialogues in which it is participating.	WP5
C.A.85	<b>Respond to dialogue</b> An agent shall use its record of dialogue to determine if it is allowed to respond to an incoming dialogue move.	WP5
C.A.86	<b>Choose response</b> An agent shall choose an appropriate response.	WP5
C.A.87	<b>Evaluate info</b> An agent shall be able to argumentatively evaluate incoming information with respect to its existing knowledge base and beliefs.	WP5

C.A.88	<b>Choose move</b> An agent shall query a Coaching Strategy to assist in selecting an appropriate dialogue move.	WP5
C.A.89	<b>Always respond</b> An agent shall always respond when required by the protocol.	WP5
C.A.90	<b>Don't know</b> An agent shall send a “don't know” (or similar) move if it must respond but has no possible moves.	WP5
C.A.91	<b>BML models</b> The framework shall generate BML to model behaviours matching dialogue moves chosen for Embodied Conversational Coaches.	WP5
C.A.92	<b>Accept HBAF info</b> An agent shall be capable of accepting input from the HBAF.	WP5
C.A.93	<b>Handling disagreements between coaches A</b> We need to figure out what the medical principles are, that can then be used to generate preferences in the system, i.e. is there a medical principle that says; this concrete medical advice should be prioritized over a general health advice. An approach could be: a. Arrange dedicated discussion on principles (and preferences) in the consortium - what could they be; produce rough list. b. Take the list to stakeholder workshops - show a scripted demonstrator with extreme examples of conflicting principles. The stakeholder-workshop should help dealing with what sort of principles would solve the specific conflicts. c. With the technical demonstrator (completed in month9), we can in month 10 come up with a more concrete scenarios based on the stakeholder feedback. = A proper, fully functional, technical demonstrator of extreme example on how to deal with conflicting advices. d. Use feedback on the demonstrator to feed into next prototype – constant feedback-loop.	WP2
C.A.94	<b>Handling disagreements between coaches B</b> Development of organizational protocols (or templates for such protocols) for use by downstream actors after implementation. Developing a proper organisational response for handling these conflicts seems to fall in the vicinity of task 8.2 (exploitation and business planning) where criteria for implementation can be set out. However, exactly how to solve this issue remains unclear at the end of the RRI workshop and the STIRRING follow-up (task 2.4) will be charged with following up on this issue	WP2

C.A.95	<b>How to keep healthcare knowledge up to date A</b> That solution in steps would look like this: 1) Re-run all interactions that the system has had (this requires history of interaction). 2) Check if there is now relevant knowledge related to that specific user, which is different from the old knowledgebase. 3) Check if the knowledge differences are conflicting: a. If Solution1 (solution/advice based on old knowledge) is the same as Solution2 (solution/advice based on new knowledge) then there is no problem! b. If Solution1 is different from Solution2, then there might be a problem: 1. Check if it's an issue that the solutions are different. 2. Figure out how to resolve the problem → might mean that Knowledgebase needs changes.	WP2
C.A.96	<b>How to keep healthcare knowledge up to date B</b> Add a new coach that can articulate the new knowledge that is now in the knowledgebase and tell the user that he/she should be aware of that knowledge. The new coach can be very specific and tell the user, that the other coaches don't know about this knowledge.	WP2

Table 1: Application-specific concerns.

#### 4.1.2 Quality-related concerns

ID	Concern	Categories	WP
C.Q.01	<b>Accountability</b> The controller shall be responsible for, and be able to demonstrate compliance with the GDPR	Security	All
C.Q.02	<b>Accuracy</b> Personal data shall be accurate and, where necessary, kept up to date	Maintainability, Reliability	All
C.Q.03	<b>Anonymization and pseudonymisation A</b> anonymise the personal data as far as possible	Distribution, Naming, Security	All
C.Q.04	<b>Anonymization and pseudonymisation B</b> Both the client and the server should incorporate the privacy rules as set out in the GDPR as of May 2018	Security	All
C.Q.05	<b>Confidentiality Agreement</b> All people with access to the personal data files will need to sign a confidentiality agreement.	Security	All
C.Q.06	<b>Data minimisation A</b> The Council of Coaches project won't collect any data that is outside the scope of the project	Security, Scalability	All
C.Q.07	<b>Data minimisation B</b> Personal data shall be adequate, relevant and limited to what is necessary in relation to the purposes for which they are processed	Security, Scalability	All

C.Q.08	<b>Data minimisation C</b> Only data that is relevant for the project's research questions and the required coaching strategies will be collected	Security, Scalability	All
C.Q.09	<b>Deletion</b> These copies must be deleted as soon as possible and cannot be shared with anyone outside the consortium or within the consortium without the proper authorization	Security, Replication	All
C.Q.10	<b>Dropbox</b> Data sets with personal information could further be shared through the Council of Coaches Dropbox folder, only if the datasets are sufficiently encrypted. The key to the encryption will be handed out by the project management and will be changed when access needs to be revoked	Security	All
C.Q.11	<b>Encryption A</b> These data files cannot be copied, unless stored encrypted on a password protected storage device. In case of theft or loss, these files will be protected by the encryption	Security, Replication	All
C.Q.12	<b>Encryption B</b> When you want to share personal data files through Dropbox, the data files will need to be encrypted	Security	All
C.Q.13	<b>End users' access to data</b> The user can submit a request to see which information about him is being kept on our files through the contact person on the consent form. He can request to delete his information up to 48 hours after the experiment has taken place	Security	All
C.Q.14	<b>GDPR ISO 27001</b> Data sets with personal data will be stored at a SharePoint server at the UT that complies with all GDPR regulations and is ISO 27001 certified	Security	All
C.Q.15	<b>Informed consent A</b> require informed consent of the test subjects, patients, or other individuals who are engaged in the project	Security, Safety	All
C.Q.16	<b>Informed consent B</b> When collecting personal information, researchers are required to get informed consent from the patients.	Security, Safety	All
C.Q.17	<b>Integrity and confidentiality A</b> Personal data shall be processed in a manner that ensures appropriate security of the personal data, including protection against unauthorised or unlawful processing and against accidental loss, destruction or damage, using appropriate technical or organisational measures	Security	All
C.Q.18	<b>Integrity and confidentiality B</b>	Security, Communication	All

	In exceptional cases where the dataset is too large, or it cannot be transferred securely, each partner can share their own datasets through channels that comply with the GDPR		
C.Q.19	<b>Lawfulness, fairness and transparency</b> Personal data shall be processed lawfully, fairly and in a transparent manner in relation to the data subject	Security	All
C.Q.20	<b>Personal information</b> Sensitive data should be either stored at the dedicated SharePoint server at the University of Twente, or encrypted on Dropbox. In the case of personal data collected in physical form (e.g. on paper), it shall be stored in a restricted-access area	Security	All
C.Q.21	<b>Purpose limitation</b> Personal data shall be collected for specified, explicit and legitimate purposes and not further processed in a manner that is incompatible with those purposes	Security	All
C.Q.22	<b>SharePoint</b> Access to this SharePoint will be managed by the project management and will be given only to people who need to access the data. Access can be retracted if necessary.	Security	All
C.Q.23	<b>Storage and researchers' access to data</b> Personal data will need to be stored safely and in a secure environment. This can either be the SharePoint server hosted by the UT, or a partner's own solution that complies with the GDPR. Backups of Dropbox and the UT's SharePoint are made every 24 hours by the system itself. The UT's SharePoint server is a secure environment that is ISO 27001 certified.	Security	All
C.Q.24	<b>Storage limitation</b> Personal data shall be kept in a form which permits identification of data subjects for no longer than is necessary for the purposes for which the personal data are processed	Security, Scalability	All
C.Q.25	<b>WP3 Data security</b> Non-sensitive data is stored on a Dropbox folder for the entire consortium to access. Sensitive data, in terms of personal data and privacy is stored on a SharePoint portal, hosted at the University of Twente. Backups are made through Dropbox and the UT ICT systems every 24 hours. After the project, the data files will be anonymised	Security	WP3
C.Q.26	<b>WP4 Data interoperability</b> We use standard models for encoding the data (e.g., JSON, CSV).	Interoperability	WP4

C.Q.27	<b>WP4 Data security A</b> An anonymised universal unique identifier will be used to identify the data collected from each user. This identifier will in no way allow revealing the identity of the user. However, there might be a combination of data possible, with which you can identify a person, for example 24-hour location tracking. The raw sensor data will be transmitted over HTTPs in the form of data objects (e.g., JSON) to a secure server where it is persisted in another relational database management system (e.g., MySQL).	Security	WP4
C.Q.28	<b>WP6 Data security B</b> Personal data that is collected goes on an encrypted hard disk that we can carry around from location to location; a backup will then be made (encrypted as well) and stored at HMI in a safe place, and password to encryption stored behind lock and key. The consent forms used for the video, audio and experimental data collection will be stored in locked cupboard at HMI. In case of pseudonymisation, the key to the consent / participant number is stored at a physically different location.	Security	WP6
C.Q.29	<b>WP7 Data interoperability</b> System/User logs: These can follow established formats for logging that are widely used and known by developers and technicians. Knowledge base: Almost all possible options of technologies to be used in the knowledge base follow a well-known format or query language.	Interoperability	WP7
C.Q.30	<b>Integrity and confidentiality C</b> Stored knowledge should be secure.	Security	WP3
C.Q.31	<b>Integrity and confidentiality D</b> The shared knowledge base will inevitably contain personal information and within that personal information possibly medical information (for example, that a user has Type 2 Diabetes). This knowledge should be treated carefully and should not be stored lightly (what is stored should be thought through).	Security	WP3
C.Q.32	<b>Real time A</b> Response/processing time should be real-time in order to not slow down other system components.	Performance	WP3
C.Q.33	<b>Raw data delay</b> The platform shall read the raw sensory data of the user from his/her personal device in real-time with a delay of no more than 3 seconds	Performance	WP4
C.Q.34	<b>Raw data reliability</b> The platform shall maintain the consistency, integrity, and reliability of raw sensory data in non-volatile storage	Reliability	WP4

C.Q.35	<b>Short term accuracy</b> Overall the accuracy of short-term behaviour detection shall be greater than or equal to 80%	Performance	WP4
C.Q.36	<b>Long term accuracy</b> Overall the accuracy of long-term behaviour detection shall be greater than or equal to 70%	Performance	WP4
C.Q.37	<b>Missing data accuracy</b> Overall the percentage of missing data that is allowed shall be less than 20%	Fault handling, Reliability, QoS	WP4
C.Q.38	<b>Consistency of copies</b> The platform shall ensure consistency of distributed copies of behavioural data.	Reliability	WP4
C.Q.39	<b>Data request delay</b> The platform response time to a data request shall be below 30 seconds	Performance	WP4
C.Q.40	<b>Real time B</b> The framework should provide responses as close to real-time as possible to ensure a seamless user experience	Performance	WP5
C.Q.41	<b>Dangerous advice</b> Dialogues in the framework must never terminate with advice that could endanger a user	Safety	WP5
C.Q.42	<b>Secure communication</b> All internal and external communication involving the framework should be secure	Security	WP5
C.Q.43	<b>Data mgmt. plan storage</b> All data stored by the framework will be done so in accordance with the COUCH data management plan	Security	WP5

Table 2: Quality-related concerns.

#### 4.1.3 RRI-related concerns

ID	Concern	WP
C.R.01	<b>Public communication</b> make information about the project, its processes, results, and long-term perspectives available to the interested public through a number of different channels, including a website, social media, press releases, journal publications, and more	WP2
C.R.02	<b>Public activism</b> Involve decision-makers, including developers, vendors, service providers and stakeholders, in the development of the ecosystem of the Open Agent Platform. Makes it possible – if relevant – that the Council of Coaches may engage in the work of further developing eHealth/eCare standards.	WP2

C.R.03	<b>Public deliberation</b> Facilitate deliberation with societal stakeholders on the ambitions and development strategies set out by the Council of Coaches in the context of societal development in the eHealth and eCare areas.	WP2
C.R.04	<b>Public participation</b> Include professional users and end users in reflection and practical testing of development plans and prototypes.	WP2
C.R.05	<b>Science education</b> Co-fund the training of a number of PhD's	WP2
C.R.06	<b>Co-production of knowledge</b> facilitate the co-creation of knowledge about user preferences and stakeholder preferences with users and stakeholders	WP2
C.R.07	<b>Gender in content</b> COUCH ensures gender balance as part of its platform, through incorporating gender balance principles as part of its user-centred design and implementation methodology	WP2
C.R.08	<b>Ethical governance</b> Design choices and exploitation continually takes into account medical devices regulation. All user interaction (in T2.3) takes into account medical ethics principles as elaborated in the Helsinki Declaration.	WP2
C.R.09	<b>Ethical deliberation</b> Ethics debate that raise issues in science and technological developments in science, technology and innovation policies	WP2
C.R.10	<b>Ethical reflection</b> T2.1 and T2.4 facilitates debate and critical reflection among the consortium members regarding standards for ethical research, substantive issues having to do with the specific technological solutions emerging through the project, and issues of social justice in relation to their implementation	WP2
C.R.11	<b>Privacy and Informed Consent - A</b> In order to function optimally, the Council of Coaches must be able to collect and process multiple kinds of personal and medical data (including physical and mental health data) and share this data with multiple actors, e.g. general physicians. At the same time, users must be able to understand how data is used and retain control over the data	WP2
C.R.12	<b>Trust (not too little, not too much) - A</b> On the one hand, if users don't trust the advice given by the virtual coaches, they won't use it. On the other hand, if the users trust the advice too much, it might impede health or create social addiction to using the Council. The issue is thus one of handling trust-building in a reflected manner, where the design choices in the project and the exploitation choices after the project should all support a balanced approach to the relationship between the Council and its users.	WP2

C.R.13	<b>Handling disagreement between coaches - A</b> An interdisciplinary Council of Coaches will necessarily produce conflicting advice at some point. This demands a solution to solving conflicts arising between lines of argument modelled on different professions. For example, a patient with a cardiovascular disease and asthma profile is recommended to drink coffee by one coach but another couch may recommend the opposite.	WP2
C.R.14	<b>How to keep healthcare knowledge up to date?</b> Healthcare knowledge is fluid. System should give advice based on the latest medical knowledge. Adding a new coach or new “medical” insight results in a change in knowledge base. Such a change can cause unforeseen issues in the interaction between different domain knowledge bases. Bottom line: This can lead to the wrong advice.	WP2
C.R.15	<b>Intrusion - A</b> There are several ways the coaches’ behaviour can become intrusive. The coach may ask questions that are deemed too personal. The frequency of the information or questions provided on daily basis can be perceived as ‘pushy’. Long talks/messages can be annoying.	WP2
C.R.16	<b>Personalisation</b> Who decides how the coaches are personalised and on what background? Are they individually shaped or even for all?	WP2
C.R.17	<b>Consistency/honesty - A</b> What if there is a discrepancy between sensory information and what the user says? If the user lies then the coaches may advice wrongly.	WP2
C.R.18	<b>Privacy by design</b> How and to which extent can we ensure that organisations implementing Council of Coaches software downstream are not able, without proper legal authorisation, to mine personal data for other uses than those to which the user has given consent? This issue is especially important if the Council of Coaches were ever implemented in an ecosystem of other digital services, e.g. the national health care system.	WP2
C.R.19	<b>Illegitimate exploitation</b> What can we do to prevent sharing / theft of the application?	WP2
C.R.20	<b>Economic vs health incentives</b> How do we balance the need for the coaches to refer to GPs and other healthcare personnel in situations that go beyond the expertise of the coaches? This goes against the policy-level need to stimulate self-management and health to lessen the strain on public health resources	WP2
C.R.21	<b>Equality</b> What can we do to ensure that the Council is adopted and used by those who need it the most, not only those for whom use of the system is easiest	WP2
C.R.22	<b>Liability - A</b> Who is responsible in cases of damage due to wrong advice?	WP2

C.R.23	<b>Consistency/honesty - B</b> Consistency/honesty: We need a solution to the issue of discrepancies between sensory information and what the user says? If the user lies then the coaches may advice wrongly.	All
C.R.24	<b>Intrusion - B</b> Intrusion: COUCH needs to figure out a way of not being too intrusive.	All
C.R.25	<b>Liability - B</b> Liability: COUCH should make an agreement of who is responsible in cases of damage due to wrong advice (and other mistakes that can happen)?	All
C.R.26	<b>Privacy and informed consent - B</b> Privacy and informed consent: LEGO system of consent	All
C.R.27	<b>Trust (not too little, not too much) - B</b> Trust: Quality assurance of knowledge provided by the coaches	All
C.R.28	<b>Trust (not too little, not too much) - C</b> Trust: We need the coaches to make matches between user-characteristics and advice given	All
C.R.29	<b>Trust (not too little, not too much) - D</b> Trust: Transparency of what information will be shared with e.g. GPs or other actors and with other coaches	All
C.R.30	<b>Trust (not too little, not too much) - E</b> Trust: Avoid likenesses with real doctors, too great realism in looks, etc.	All
C.R.31	<b>Trust (not too little, not too much) - F</b> Trust: Remind users to visit human experts	All
C.R.32	<b>Trust (not too little, not too much) - G</b> Trust: To avoid overreliance an initial explanation of how the system works would be a good starting point	All
C.R.33	<b>Trust (not too little, not too much) - I</b> Trust: Establishing rapport with the user, e.g. through small talk where appropriate	All
C.R.34	<b>Trust (not too little, not too much) - J</b> Trust: Enlisting advice from external actors when necessary	All
C.R.35	<b>Access</b> How do you decide who is given access to the technology and who is not?	WP2
C.R.36	<b>Chronic pain - COUCH potentials - B</b> When treatment in the rehabilitation centre is concluded, virtual coaches should offer relapse prevention. This includes educating clients about noticing signs of relapse (e.g., noticing new types of pain, change in mood) and application of the right strategies (e.g., breathing exercises).	WP2
C.R.37	<b>Chronic pain - COUCH potentials - C</b> The coaches also need to be absent at periods of time. Treatment of chronic pain is aimed at making the patient independent of support.	WP2

C.R.38	<b>Chronic pain - COUCH potentials -A</b> When treatment for chronic pain commences in a rehabilitation centre, virtual coaches could offer parts of the treatment that can be done at home (physical exercises, psychological exercises)	WP2
C.R.39	<b>Coach hierarchy</b> In real life there can be hierarchies between the coaches related to a disease - should this also be the case with COUCH?	WP2
C.R.40	<b>Coaching style - A</b> The virtual coaches should not mingle themselves in diagnosis and triage.	WP2
C.R.41	<b>Coaching style - B</b> Should the underlying values of the coaches be made explicit to the patient and how?	WP2
C.R.42	<b>Coaching style - C</b> Where is the line between manipulation and not making the underlying values of the coaches transparent?	WP2
C.R.43	<b>Coaching style - D</b> Which advice is the most important? E.g., should we tell the patient to stop smoking or start exercising first?	WP2
C.R.44	<b>Coaching style - E</b> How do the coaches know what to recommend when there is no common solution and it depends on the patient, what he is motivated for and when?	WP2
C.R.45	<b>Coaching style - F</b> How to get the user to act? The user may get an advice and then shut down the computer and do something completely different – how do we make sure that doesn't happen? Knowledge alone is not enough. We all know it is bad for your health to smoke, but many people still do it.	WP2
C.R.46	<b>Coaching style - G</b> The coach has needs to understand the motivation of the user and (sometimes) go forward very slowly	WP2
C.R.47	<b>Coaching style - H</b> Getting reminders about using the app can be extremely annoying and push the patient away or give them bad conscious	WP2
C.R.48	<b>Coaching style - I</b> the app should avoid all kind of negative messages that makes the patient doubt himself or could in any other way reinforce a negative experience for the user	WP2
C.R.49	<b>Coaching style - J</b> The coaching strategy should be flexible both due to the course and development of the patient's disease and due to the patient's level of motivation	WP2
C.R.50	<b>Data issues - A</b> Who has access to the data on the patient generated by COUCH?	WP2
C.R.51	<b>Data issues - B</b> The patient should always know how the data is used	WP2

C.R.52	<b>Data issues - C</b> Does the patient have access to his/her data (and will they be able to understand it)?	WP2
C.R.53	<b>Digital divide - A</b> Not everybody might be able to use COUCH (digital divide)	WP2
C.R.54	<b>Digital divide - B</b> There is an issue in the early user perspective, as if we only study those who want to think along which are often the resourceful ones, then we might miss out on the not so resourceful ones.	WP2
C.R.55	<b>Health education - A</b> Once a diagnosis is made, the coaches should provide health education, since "most people do not know what their diagnosis entails and most care professionals do not take the time to explain things properly"	WP2
C.R.56	<b>Health education - B</b> For the case of COPD patients, regular refreshment courses on how to properly inhale their medication would be very worthwhile.	WP2
C.R.57	<b>Implementation</b> COUCH shall only be implemented with push-strategies if it makes sense for the human personnel (doctors, psychiatrists, etc.) to recommend it and use it.	WP2
C.R.58	<b>Informed consent - A</b> Do other adults understand that they are interacting with technology and not a real person?	WP2
C.R.59	<b>Informed consent - B</b> Do they understand the consequences of use?	WP2
C.R.60	<b>Monitoring</b> With respect to COPD exacerbations, the virtual coaches should have a monitoring role, whereby they detect exacerbations (using simple questionnaires) and monitor the (lack of) effect of interventions (e.g., antibiotics or prednisolone).	WP2
C.R.61	<b>Overreliance - A</b> COUCH should be a supplement to human experts	WP2
C.R.62	<b>Overreliance - B</b> the app shall not conflict with the independence of the patient	WP2
C.R.63	<b>Overreliance - C</b> COUCH needs to deal with issues concerning overreliance and addicting effects the app might have on patients	WP2
C.R.64	<b>Ranking</b> How do we make sure that the patient uses the different advices in a right way, when their advices point in different directions? Which advice is the most important?	WP2

C.R.65	<b>User interface - A</b> Problem with button knowledge and information skills? Older people can have a problem understanding what the different buttons do on a computer or a smartphone. Therefore, they have a hard time navigating the software. However, they are good at knowing what kind of knowledge is trustworthy and professional, and what information they should check up on.	WP2
C.R.66	<b>User interface - B</b> Many patients want to speak with a real person, to feel the care of a real person and for the love of small conversations that can be a rare joy, when the patient is no longer able to work and lives alone.	WP2
C.R.67	<b>User involvement</b> Will people actually use the technology?	WP2
C.R.68	<b>Verified - A</b> If the technology shall be responsible, it has to be verified by experts within the same fields of the virtual coaches.	WP2
C.R.69	<b>Verified - B</b> the product shall be certified in various ways	WP2
C.R.70	<b>Wrong use</b> Maybe it can have a harmful effect or lead to very wrong health decisions from the patient if he/she closes the app before the council is done speaking and the patient only listens to half of the dialogue between the coaches	WP2
C.R.71	<b>Privacy and informed consent - C</b> Privacy and Informed Consent: make sure we don't ask for "more than we need".	All
C.R.72	<b>Privacy and informed consent - D</b> Privacy and informed consent: Consent-reminders once per 6 months or so to keep the patient informed	All
C.R.73	<b>Privacy and informed consent - E</b> Privacy and informed consent: There should be potential per-coach consent; for sure if a new coach joins, a full review for that coach is necessary.	All
C.R.74	<b>Handling disagreements between coaches - B</b> Handling disagreements between coaches: Give the different medical advices to the user from different perspectives, and let him decide which one to follow	All
C.R.75	<b>Handling disagreements between coaches - C</b> Handling disagreements between coaches: We need to figure out what the medical principles are, that can then be used to generate preferences in the system, i.e. is there a medical principle that says; this concrete medical advice should be prioritized over a general health advice	All
C.R.76	<b>Handling disagreements between coaches - D</b> Handling disagreements between coaches: development of organizational protocols (or templates for such protocols) for use by downstream actors after implementation	All

C.R.77	<b>Handling disagreements between coaches - E</b> How to keep healthcare knowledge up to date: add a new coach that can articulate the new knowledge that is now in the knowledgebase and tell the user that he/she should be aware of that knowledge. The new coach can be very specific and tell the user, that the other coaches don't know about this knowledge.	All
C.R.78	<b>Handling disagreements between coaches - F</b> How to keep healthcare knowledge up to date: make a system that can somehow compare the old knowledgebase and the advices given to the user based on that old knowledgebase, to the new knowledgebase and new advices.	All
C.R.79	<b>Trust (not too little, not too much) - H</b> Trust (and also privacy): instead of giving away data to putative future 3rd party providers of coaches for their algorithms, we could ask for their algorithm, feed it our data and only give them the outcome (which most likely is what they say they need)	All

Table 3: RRI-related concerns.

## 4.2 Assets

In Table 4 below a list of all currently identified possible assets is given, categorized by type.

ID	Asset	Category
A.01	<b>Dropbox</b> Content sharing application. <a href="https://www.dropbox.com/">https://www.dropbox.com/</a>	Tools & platforms
A.02	<b>MySQL</b> Relational Database management system. <a href="https://www.mysql.com/">https://www.mysql.com/</a>	Tools & platforms
A.03	<b>SharePoint</b> Content sharing application. <a href="https://products.office.com/en-us/sharepoint/collaboration">https://products.office.com/en-us/sharepoint/collaboration</a>	Tools & platforms
A.04	<b>Cyc</b> knowledge base that represents human common sense	Tools & platforms
A.05	<b>Affectiva</b> socio-emotional analysis by extracting features from the video data	Tools & platforms
A.06	<b>EmoVoice</b> socio-emotional analysis by extracting features from the audio data	Tools & platforms
A.07	<b>Fubi</b> socio-emotional analysis by extracting features from the video data	Tools & platforms
A.08	<b>Kairos</b> socio-emotional analysis by extracting features from the video data	Tools & platforms
A.09	<b>openEAR</b> socio-emotional analysis by extracting features from the audio data	Tools & platforms
A.10	<b>openFACE</b> socio-emotional analysis by extracting features from the video data	Tools & platforms

A.11	<b>openSMILE</b> socio-emotional analysis by extracting features from the audio data	Tools & platforms
A.12	<b>OpenVokaturi</b> socio-emotional analysis by extracting features from the audio data	Tools & platforms
A.13	<b>ASPIC+</b> Structured argumentation framework. <a href="http://www.cs.uu.nl/groups/IS/archive/henry/aspicAF.pdf">http://www.cs.uu.nl/groups/IS/archive/henry/aspicAF.pdf</a>	Tools & platforms
A.14	<b>TOAST2</b> Implementation of ASPIC+. Proceedings of the Fourth International Conference on Computational Models of Argument (COMMA 2012) (pp. 509-510). Vienna, Austria: IOS Press	Tools & platforms
A.15	<b>ASAP platform</b> BML realizer	Tools & platforms
A.16	<b>Autodesk Character Generator</b> Character creator toolkit. <a href="https://charactergenerator.autodesk.com/">https://charactergenerator.autodesk.com/</a>	Tools & platforms
A.17	<b>Flipper</b> dialogue manager	Tools & platforms
A.18	<b>Greta platform</b> BML realizer	Tools & platforms
A.19	<b>UMA</b> Unity Multipurpose Avatar. Character creator asset for Unity Editor. <a href="https://unity3d.com/es/unity/editor">https://unity3d.com/es/unity/editor</a>	Tools & platforms
A.20	<b>Unity Editor</b> Unity creation editor tool. <a href="https://unity3d.com/en/unity/editor">https://unity3d.com/en/unity/editor</a>	Tools & platforms
A.21	<b>Unity3D</b> 3D Rendering and game engine. <a href="https://unity3d.com">https://unity3d.com</a>	Tools & platforms
A.22	<b>Accelerometer</b> Smartwatch, Smartphone, physical activity, cognitive, emotional, social status	Sensor
A.23	<b>Barometer</b> Smartwatch, cognitive status	Sensor
A.24	<b>Bluetooth</b> Smartphone, physical activity, cognitive, emotional, social status	Sensor
A.25	<b>GPS</b> Smartphone, physical activity, cognitive, emotional, social status	Sensor
A.26	<b>GSR</b> Smartwatch, cognitive status	Sensor
A.27	<b>Heartrate sensor</b> Smartwatch, physical activity, emotional status	Sensor

A.28	<b>Light sensor</b> Smartphone, physical activity, cognitive, emotional, social status	Sensor
A.29	<b>Magnetometer</b> Smartphone, physical activity, cognitive, emotional, social status	Sensor
A.30	<b>Microphone</b> Smartwatch, Smartphone, physical activity, cognitive, emotional, social status	Sensor
A.31	<b>PPG</b> Smartwatch, cognitive status	Sensor
A.32	<b>Proximity sensor</b> Smartphone, physical activity, cognitive, emotional, social status	Sensor
A.33	<b>SMS</b> Smartphone, cognitive, emotional, social status	Sensor
A.34	<b>Temperature sensor</b> Smartwatch, physical activity	Sensor
A.35	<b>Wi-Fi</b> Smartphone, physical activity, cognitive, emotional, social status	Sensor
A.36	<b>GDPR</b> EU's General Data Protection Regulation. <a href="https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32016R0679">https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32016R0679</a>	Regulations & standards
A.37	<b>ISO 27001</b> Information security standard. <a href="https://www.iso.org/isoiec-27001-information-security.html">https://www.iso.org/isoiec-27001-information-security.html</a>	Regulations & standards
A.38	<b>HTTP/S</b> Hypertext Transfer Protocol (Secure). <a href="https://tools.ietf.org/html/rfc2616">https://tools.ietf.org/html/rfc2616</a>	Protocols & specifications
A.39	<b>RDF</b> Resource Description Framework is used to represent ontological data and can be used as the core of a semantic knowledge base. <a href="https://www.w3.org/RDF/">https://www.w3.org/RDF/</a>	Protocols & specifications
A.40	<b>OWL</b> Web Ontology Language. <a href="https://www.w3.org/TR/owl-features/">https://www.w3.org/TR/owl-features/</a>	Protocols & specifications
A.41	<b>PSD Model</b> Persuasive Systems Design (PSD) Model ( (Lehto & Oinas-Kukkonen, 2011)) ( (Oinas-Kukkonen & Hajumaa, 2009))	Models & references
A.42	<b>The Behaviour Change Technique Taxonomy (v1) (BCTTv1)</b> A list of 93 behaviour change techniques grouped in 16 categories. (Michie, et al., 2013)	Models & references
A.43	<b>CSV</b> Comma-Separated Values. Data tabulation format.	Formats & ontologies

A.44	<b>JSON</b> JavaScript Object Notation. Data serialization format. <a href="https://json.org">https://json.org</a>	Formats & ontologies
A.45	<b>AIF+</b> Argument Interchange Format upper ontology	Formats & ontologies
A.46	<b>Flipper templates</b> templates for Flipper dialogue manager for COUCH	Formats & ontologies

Table 4: Assets.

### 4.3 Reference architecture

*The Reference Architecture is an abstraction of the specific COUCH architecture. It is mostly of interest to 3<sup>rd</sup> parties and will be better filled once the COUCH's architecture is completed. **This will be completed in a future revision of this document.***

### 4.4 Viewpoints

In the following five sections, the architecture definition is provided from the five different system viewpoints:

- Context Viewpoint (Section 4.4.1)
- Requirement Viewpoint (Section 4.4.2)
- Component Viewpoint (Section 4.4.3)
- Distribution Viewpoint (Section 0)
- Realization Viewpoint (Section 4.4.5)

#### 4.4.1 Context Viewpoint

##### 4.4.1.1 Business Aspect Model

This model consists of a list of stakeholders and actors and their relationships, a list of currently identified atomic use cases, and a list of overall scenarios describing the exemplary usage of the system.

Stakeholders		
ID	Stakeholder	Parent
CV.ST.01	<b>Patient</b> The subject being coached	
CV.ST.02	<b>Ageing patient</b> End-User Group 1: Older adults, aged 55 and above, that are faced with one or more physical, cognitive, mental or social impairments related to their stage of life (age-related impairments).	Patient
CV.ST.03	<b>Chronic pain patient</b> End-User Group 2: Older adults, aged 55 and above, suffering from chronic pain (and possible other age-related impairments).	Patient
CV.ST.04	<b>Diabetes patient</b> End-User Group 3: Older adults, aged 55 and above, suffering from Diabetes Type 2 (and possible other age-related impairments).	Patient
CV.ST.05	<b>Family member</b>	

	Family of a patient	
CV.ST.06	<b>CSOs</b> CSOs represent societal needs in more or less organised forms. They will be interested to be included in the identification and assessment of risks and benefits, of conflicting values and interests, etc.	
CV.ST.07	<b>Cluster</b> Would be interested in eHealth and mHealth knowledge and development	
CV.ST.08	<b>Patient organization</b> Patient organisations help patients by providing information about living with their conditions, raise awareness about screening and prevention, and offer a number of support tools. Their interest in COUCH is linked to assisting developing a tool their members can benefit from.	
CV.ST.09	<b>Health authority</b> Have an interested in influencing development within eHealth and mHealth	
CV.ST.10	<b>Government</b> Government agencies has an interest in promoting public health and establishing good frameworks for the health services. Their interest in COUCH is related to promoting good public health solutions and frameworks	
CV.ST.11	<b>Health professional</b> mHealth and eHealth professionals hold practical knowledge relevant to the early development of the prototype. We assume their interest to be in the knowledge exchange during the multi stakeholder engagement process, which they themselves can benefit from.	
CV.ST.12	<b>General practitioner</b>	Health professional
CV.ST.13	<b>Dietician</b>	Health professional
CV.ST.14	<b>Endocrinologist</b>	Health professional
CV.ST.15	<b>Informal Caregiver</b>	Health professional
CV.ST.16	<b>Community nurse</b>	Health professional
CV.ST.17	<b>Hospital manager</b>	Health professional
CV.ST.18	<b>Psychologist</b>	Health professional
CV.ST.19	<b>Industry</b>	

	Industry actors will have an interest in exploiting the outcome of the demonstration project.	
CV.ST.20	<b>Developer</b>	Industry
CV.ST.21	<b>Game developer</b>	Developer
CV.ST.22	<b>Chain Info. Sys. Developer</b>	Developer
CV.ST.23	<b>Policy maker</b> Health policy makers at all levels have an important role to play developing health systems and promoting public health. Their interest in COUCH is influence new eHealth and mHealth devices to fit their values.	
CV.ST.24	<b>Municipality</b>	Policy maker
CV.ST.25	<b>Researcher</b> Research on the effect and use of eHealth and mHealth is still in its nascent phase. Researcher will be interested in studying the development and pilots of the prototypes.	
CV.ST.26	<b>Consortium partner</b> In the stakeholder workshops, the consortium will be represented by RDD; DBT and iSPRINT. They will secure, stakeholder input is shared among the consortium and incorporated into the prototypes.	
CV.ST.27	<b>International org.</b> Organizations such as the WHO both hold important knowledge and has great agenda-setting power. Organizations are assumed to be interested in providing input to state-of-the-art mHealth and eHealth solutions	

Table 5: Stakeholders / Actors.

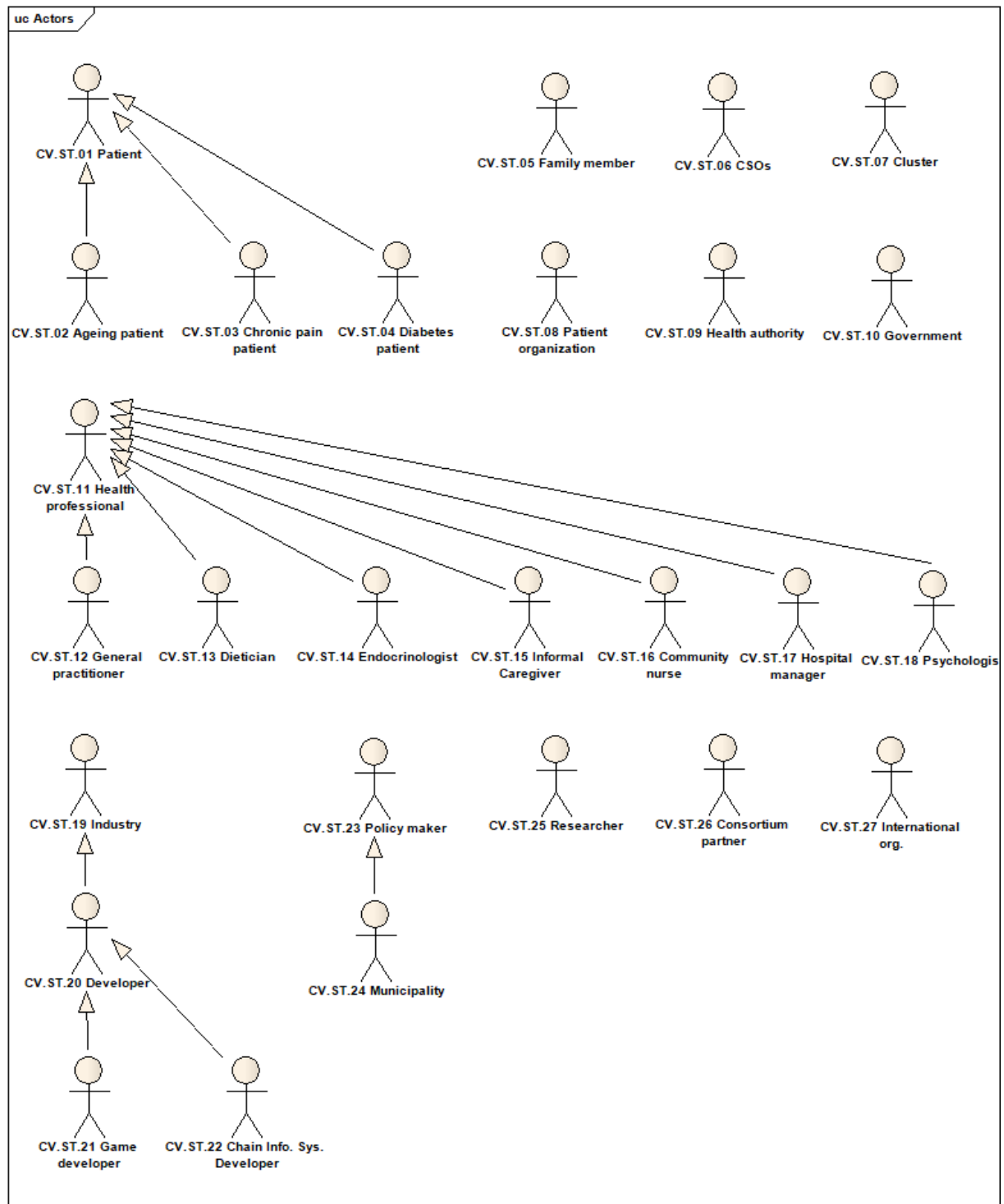


Figure 3: Actors Diagram.

Use Cases	
ID	Use Case
CV.UC.01	<b>Distinguish between users</b> The shared Knowledge Base is able to distinguish between different users (and thus this also needs to hold for the information relating to them, the information that is received/returned through the API for them, and coaches defined/tuned to them).
CV.UC.02	<b>Receive and store sensed behaviour.</b> The behaviours that are detected by the Holistic Behaviour Analysis Framework (WP4) are stored by the Shared Knowledge Base; therefore, there should be API functionality to receive the data, and underlying data structures and functions to store the data. (This involves both short- and long-term behaviours)
CV.UC.03	<b>Receive and store sensed changes in behaviour.</b> The changes in behaviour that are detected by the Holistic Behaviour Analysis Framework (WP4) should be stored by the Shared Knowledge Base; therefore, there should be API functionality to receive the data, and underlying data structures and functions to store the data.
CV.UC.04	<b>Provide 'knowledge' when queried by the D&amp;AF.</b> The relevant knowledge in the KB should be returned when queried by the Dialogue and Argumentation Framework (WP5); therefore, there should be API functionality to receive the query and provide the information.
CV.UC.05	<b>Save 'knowledge' when returned</b> When relevant new knowledge is measured (e.g. through interaction with the user) the KB should allow for that information to be stored or the existing information to be updated. * The updates are either performed by Flipper or the Dialogue and Argumentation Framework; I assume.
CV.UC.06	<b>Update the current coaching goal for coach</b> The KB has a representation of what the current coaching goal is, and how that goal relates to the goals of other coaches. This information has to be kept up to date (based on updates that were performed following information received from interactions/sensors).
CV.UC.07	<b>Provide relevant strategies to Flipper</b> The KB can return the relevant strategies for the current situation/goal on a query from Flipper; therefore, there should be API functionality to receive the query and provide the information.
CV.UC.08	<b>Filter strategies on relevance</b> The KB should be able to filter the entire set of strategies to come to a subset of relevant strategies, which could, for example, be returned.
CV.UC.09	<b>Deduce best new goal</b> The KB needs to deduce which goal is the best new goal to focus on based on present information.
CV.UC.10	<b>Know who a coach is</b> The KB needs to contain information on the coach's personality, etc. (E.g. behaviour sets, etc. Whatever Flipper needs to create the FML/intents.)

CV.UC.11	<b>Know its interaction history</b> The KB needs to have an interaction history.
CV.UC.12	<b>Be aware of 'supposed known facts'.</b> The KB needs to know what knowledge the Mobile Agent is assumed to have by the user based on Home UI interactions and vice versa.
CV.UC.13	<b>Authorise user's device for gaining access to the platform</b> The necessary credentials are required in order to establish a connection between the data source and the HBAF platform
CV.UC.14	<b>Receive and store raw sensory data from the authorised device</b> Raw sensory data are sent from an authorised user's device to the platform
CV.UC.15	<b>Associate user identifier to each connected device</b> The platform is able to receive raw sensory data from simultaneously connected devices and differentiate each user and his/her device based on a unique identifier.
CV.UC.16	<b>Extract features from raw sensory data</b> The platform computes features from raw data in order to classify and detect behaviours
CV.UC.17	<b>Select relevant features for short/long-term behaviour detection</b> The platform selects the most relevant features in order to classify accurately and detect short/long-term behaviours
CV.UC.18	<b>Train the behaviour detection model</b> The behaviour detection model is trained in order to detect short-term /long term behaviour
CV.UC.19	<b>Update the behaviour detection model</b> The behaviour detection model is updated in order to detect short-term /long term behaviour
CV.UC.20	<b>Detect short/long-term behaviours</b> The platform detects physical/cognitive/emotional/social behaviours and creates or updates logs of short and long-term behaviours
CV.UC.21	<b>Detect behaviour changes</b> The HBAF detects behaviour changes based on a time series and notifies the Council of Coaches System
CV.UC.22	<b>Dialogue management</b> The framework must implement all the mechanisms required to create, manage and terminate dialogues. These mechanisms will largely lie with the agent in the multi-agent system, however the MAS itself must provide a means of controlling turn-taking for situations where this isn't explicitly specified in the protocol; for instance, where more than one participant can legitimately reply to another participant.
CV.UC.23	<b>Incoming dialogue move processing</b> When an agent receives a dialogue move, either from a human user or another agent, it must be able to process it and determine what, if any, moves it can make in response
CV.UC.24	<b>Argument-based evaluation</b>

	Incoming dialogue moves may contain propositional content. An agent must be able to evaluate such propositions with respect to its own knowledge base and the beliefs derived from it. This connected to the selection of an appropriate response (see below) but is a standalone component because an agent must be able to evaluate information that it “hears”, independent of selecting a response to a dialogue move specifically addressed to it.
CV.UC.25	<b>Dialogue move selection</b> If an agent is able to respond to an incoming move, it must then decide its response. If multiple move types are available, it must first choose which move type to respond with; in all cases, it must also choose the actual content of the move (the formula that constitutes the response).
CV.UC.26	<b>Behaviour generation</b> The final COUCH system will rely heavily on the Embodied Conversational Coaches expressing human-like behaviours. It is therefore necessary for the dialogue framework to generate suitable behaviours that accompany an agent’s chosen (spoken) dialogue interactions.
CV.UC.27	<b>Sensor input processing</b> When selecting a response to an incoming dialogue move, an agent must be aware of the physical context of the dialogue. A sensing platform will provide this data and it will be necessary to convert it into meaningful parameters that influence the dialogue move selection.
CV.UC.28	<b>Initiate a dialogue</b> A human user of the COUCH platform can initiate a dialogue via the higher-level act of starting a coaching session, or ECCs can initiate a dialogue either with the user or within themselves
CV.UC.29	<b>Join a dialogue</b> Once a coaching session has been initiated by a human user, an Embodied Conversational Coach can join a dialogue in order to participate in that session
CV.UC.30	<b>Determine response</b> Upon receiving an incoming dialogue move, an Embodied Conversational Coach can determine an appropriate response, including the response content and appropriate corresponding behaviours
CV.UC.31	<b>Argument evaluation</b> Upon receiving an incoming dialogue move, a Dialogue Agent representing an Embodied Conversational Coach can argumentatively evaluate the content of the move with respect to its existing knowledge base

Table 6: Use cases.



Figure 4: Use Cases Diagram.

As the different use cases become realized, we will have a better view of which actors are involved and how each use case relates to each other. We will include further diagrams representing these relationships. **This will be completed in a future revision of this document.**

Scenario	CV.SC.01
Actors	<p><b>Jenny:</b> is 64 years old and entering the last few months of her working life as a Sales &amp; Marketing Manager of a major hotel chain. Due to her life-long desk job, she is suffering from chronic low back pain.</p> <p><b>Yao Quai:</b> Head of the Council of Coaches</p> <p><b>Sgt Brady:</b> Activity Coach</p> <p><b>Sonja:</b> Social Coach</p>
Pre-Conditions	<p>Jenny has just returned to her desk from a meeting with the HR department to discuss her last three months of work before retirement. Although she's always been excited about the prospect of having more time to work in the garden and having more time to spend with her granddaughter, she is beginning to worry a little about the upcoming major change in her life. She didn't always enjoy her working days but she liked biking to the city, the coffee breaks with Matthew and Abby and of course the contact with the customers. With her final workday rapidly approaching, Jenny is starting to worry about missing the social contacts, getting out of the house, and getting the exercise needed to get her back pain under control.</p> <p>Looking through the pile of paperwork she received from the HR manager, she finds a brochure that catches her eye: "Worried about a major upcoming life event? Go to <a href="http://www.council-of-coaches.eu">www.council-of-coaches.eu</a>!". Later that evening at home, Jenny visits the website and reads up on the Council of Coaches application. The website says the first month of usage is free, so she decides to give it a try and creates an account. She fills in some of her user details and launches the application.</p> <p style="text-align: right;"><i>- Table continued on next page -</i></p>

Flow	<p>act Scenario CV.SC.01</p> <pre> graph TD     Start((Open Application)) --&gt; Q1[Yao Quai: Greetings, and welcome to the council of coaches it seems that you are in need of some counselling, hmm? Well, you've come to the right place?]     Q1 --&gt; Wait([Wait])     Wait --&gt; Q2[Yao Quai: Hmm? Well do you have some time?]     Q2 --&gt; Q1{Question 1}     Q1 -- No --&gt; Start     Q1 -- Yes --&gt; Q3[Initial Questionnaire]     Q3 --&gt; Q4[Yao Quai: Based on what you say I suggest following. Do not worry Jenny we have a team of experts here to help you. I recommend you discuss your worries about your physical activity with Sgt Brady, he is a retired army drill instructor, but I'm sure you will find h]     Q4 --&gt; Q5[Sgt Brady: So you are afraid of becoming unfit for duty?! Start exercising, walking, cycling! In fact, give me 100 push ups right now!]     Q5 --&gt; Q6[Sonja: Whoa there, Brady, take a deep breath. We've not even been introduced! That was Sgt Brady and you have to excuse his enthusiasm, he hasn't had the opportunity to coach anyone for a long time. Besides, we don't even know how active Jenny is?]     Q6 --&gt; Q7[Physical activity stage of change questionnaire]     Q7 --&gt; Q8[Sgt Brady: That's good to know, but I need more information to work with. If you're planning to become more physically active, I need to know how active you are now. Do you have an activity tracking device, Jenny?]     Q8 --&gt; End((Close Application))   </pre>
Post-Condition	<p>Jenny indicates that she hasn't got one yet, but that she may look for one in town on Saturday. The discussion between the council members continues for some time as they are discussing what seems to be the right approach for Jenny. Tracy makes sure the other coaches take into account Jenny's chronic pain. Jenny listens and intervenes every now and then, until she decides that she has to go. She says goodbye to the council, and the council members wish her a nice day and good luck. Curious as to what Sgt Brady will have to say, she decides to bike to the local electronics store to buy an activity tracker and plans to talk to the council again later that evening.</p>

Table 7: Scenario 01.

Scenario	CV.SC.02
Actors	<p><b>Andrew:</b> 58 yrs. old man, active entrepreneur, ex-smoker; we could say he follows a healthy and sporty lifestyle.</p> <p><b>Betty:</b> Physical Coach, a fit and young personal trainer.</p> <p><b>Ernest:</b> Social Coach: a retired business coach, with industrial experience</p> <p><b>Anita:</b> Medical Coach: a senior neurologist/neurosurgeon</p> <p><b>Amanda:</b> Psychological Coach, a behavioural psychologist</p>
Pre-Conditions	<p>Andrew has been diagnosed with lung cancer one and half year ago. Fortunately, the staging of the disease at the moment of diagnosis was favourable and he could go through a treatment plan with “radical intent” i.e. with good chances to be cured. Surgery was performed and due to the pathological staging of the cancer he underwent a first consolidation radiation treatment protocol and after that, 6 cycles of chemotherapy.</p> <p>The overall reaction to the diagnosis and subsequent treatment was very positive and constructive. Andrew continued to perform functionally at the social, mental/psychological, business and family level.</p> <p>Unfortunately, at the first follow up visit, radiological exams have shown a tumour relapse with appearance of a single brain metastasis, amenable of elective neurosurgery, with curative intent. A thorough oncological consultation, participated functionally by Andrew outlined the subsequent therapeutic steps.</p> <p>Andrew got all the medical information about his case and faces the challenge in a positive way. He is offered Council of Coaches as a tool to further engage, in an acknowledged way, his therapeutic pathway that poses himself in front of a step – the neurosurgical act – which he considers as a major event that could possibly change his lifestyle and social performances.</p> <p style="text-align: right;"><i>- Table continued on next page -</i></p>

Flow	<p>act Scenario CV.SC.02</p> <pre> graph TD     Start(( )) --&gt; Open[Open Application]     Open --&gt; Anita1[Anita (medical): Hi Andrew, I see you have had your final consultation with my fellow colleagues. Have you got all the info you needed about the planned operation?¶]     Anita1 --&gt; Andrew1[Andrew: yes, I admit I feel a bit scared but I see a very good opportunity of being cured, so I am ok.¶]     Andrew1 --&gt; Anita2[Anita: I know you are well centered and empowered in your experience, are you scared about the operation?¶]     Anita2 --&gt; Andrew2[Andrew: not really, albeit I have been explained that the operation will not affect any of my sensory-motor and cognitive functionalities, I am a bit concerned about the consequences that having my brain "touched" could impair my lifestyle and business pe]     Andrew2 --&gt; Council[Council of Coaches understands it is not a strictly medical issue, so Anita goes in background; Amanda and Ernest kick in]     Council --&gt; Amanda[Amanda (psychological): Andrew, you are a very active and successful person and you have the tools to overcome this concern by facing them setting up the right behavioural attitude, what do you think?¶]     Amanda --&gt; Andrew3[Andrew: yes but, you know, for me business is very important...¶]     Andrew3 --&gt; Ernest[Ernest: (business coach): Andrew, I would not worry about your business performance, you have time to set up continuity and you will be back operational very soon. Let's discuss this together with Amanda and set up a positive attitude around this.¶]     Ernest --&gt; Andrew4[Andrew: yes, ok let's start working on this.¶]     Andrew4 --&gt; Betty[Betty: (physical) steps in: Andrew, how about now some exercise?]     Betty --&gt; End(((End)))   </pre>
Post-Condition	<p>Council of Coaches has quickly focused Andrew's attitude (in this case positive) and underlined the centeredness of Andrew himself in his "medical" process. Council of Coaches has immediately set the (operational) perimeter of the situation outside the medical field.</p> <p>Council of Coaches has balanced the discrete equilibrium among psychological / social functioning – business concerns of the subject and quickly focused on the latter. Council of Coaches has leveraged on the subject's attitude to limit the issue and propose an executive plan right away, simple and focused.</p> <p>Council of Coaches has de-focused the attention of the subject from the issue (by providing first an immediately credible and actionable plan) and moved towards a pleasant activity.</p>

Table 8: Scenario 02.

Scenario	CV.SC.03
Actors	<b>Ella:</b> 70-something woman living alone <b>Zuckerberger:</b> social coach <b>Olympia:</b> activity coach
Pre-Conditions	Detected low activity during last 2 weeks.
Flow	<p>act Scenario CV.SC.03</p> <pre> graph TD     Start(( )) --&gt; Open[Open Application]     Open --&gt; Z1[Zuckerberger: Hello Ella, you have not been going out too often lately, how do you feel?]     Z1 --&gt; E1[Ella: Fine]     E1 --&gt; Z2[Zuckerberger: Are your friends having any plans any time soon? Maybe you should join them or call to see if they are going out]     Z2 --&gt; E2[Ella: OK I will do that]     E2 --&gt; Wait[Wait]     Wait --&gt; Z3[Zuckerberger : Ella you told me you would contact your friends to go out but looks like you haven't called them or talked to them]     Z3 --&gt; MultipleOptions{Multiple Options}     MultipleOptions -- "Ella: No, I don't like that, do I really have to?" --&gt; Z4[Zuckerberger: Going out with your friends will cheer you up]     MultipleOptions -- "Ella: OK I will do that" --&gt; O1[Olympia : If you go out you could try to reach your activity goals. You should take XXXX steps to maintain a healthy life.]     Z4 --&gt; E3[Ella: OK I will do that]     E3 --&gt; O1     O1 --&gt; E4[Ella: No, shut up]     E4 --&gt; Detect[Detect mobile activity]     Detect --&gt; O2[Olympia : If you go out you could try to reach your activity goals. You should take XXXX steps to maintain a healthy life.]     O2 --&gt; Fire[Fire Olympia]     Fire --&gt; End(( ))     End --&gt; Close[Close Application]   </pre>
Post-Condition	Activity Coach Olympia is removed and will be impersonated by a new Activity Coach personality. User feedback will be accounted for in future Activity Coach strategies.

Table 9: Scenario 03.

Scenario	CV.SC.04
Actors	<b>Sandra:</b> User <b>Eric:</b> Chair of the council <b>Jane:</b> Sports Coach (Personal trainer) <b>John:</b> Diet Coach (Nutritionist) <b>Alex:</b> Motivational Coach
Pre-Conditions	User has set a goal of losing 5 kilos.  <i>- Table continued on next page -</i>

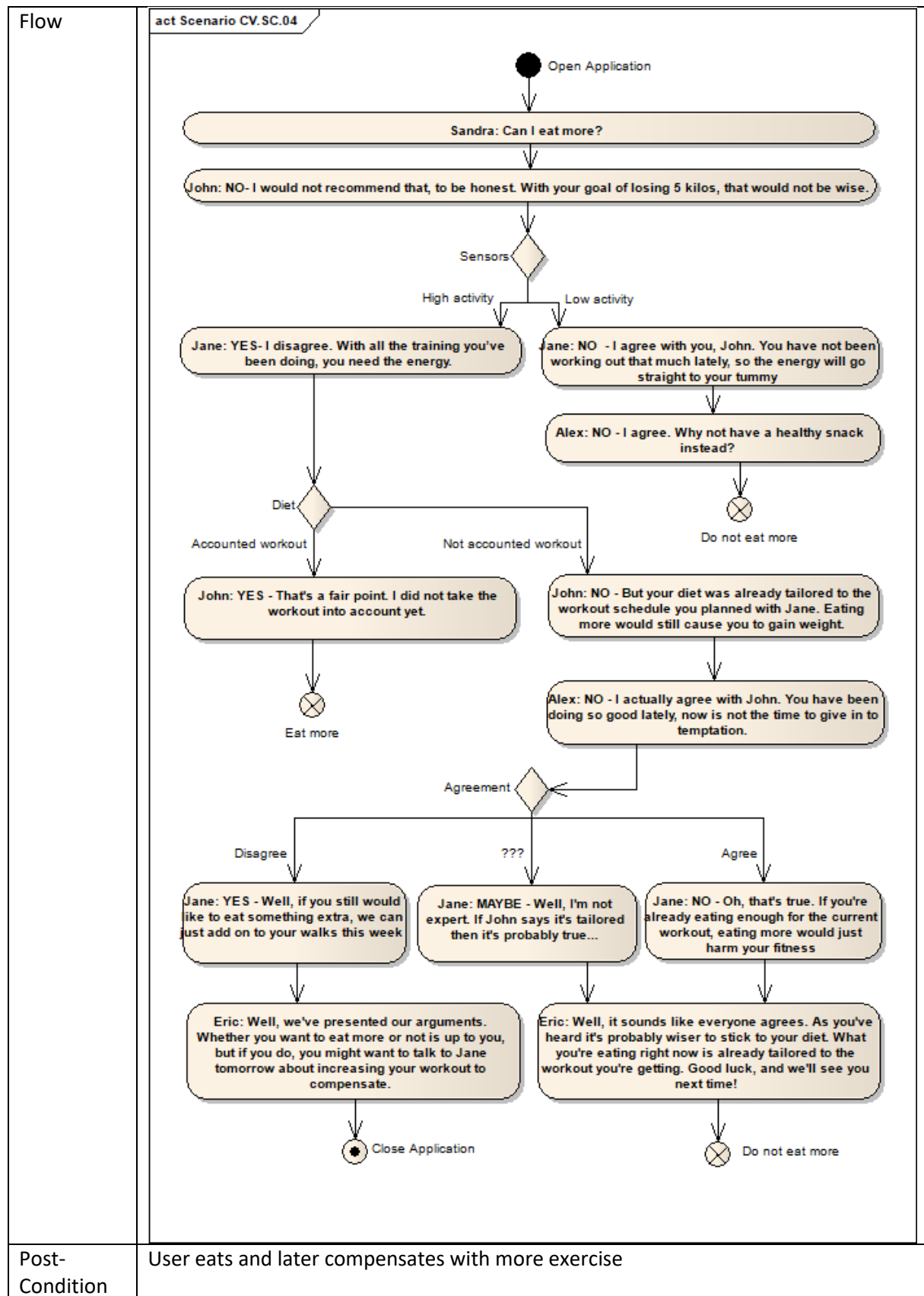


Table 10: Scenario 04.

Scenario	CV.SC.05
Actors	User Coach
Pre-Conditions	User reports low activity
Flow	<p>act Scenario CV.SC.05</p> <pre> graph TD     Start(( )) --&gt; Open[Open Application]     Open --&gt; C1[Coach: Did you know that you only walk 4.000 steps per day?]     C1 --&gt; U1[User: No]     U1 --&gt; C2[Coach: We recommend that you do 10.000 steps a day.]     C2 --&gt; U2[User: Well...]     U2 --&gt; C3[Coach: If you do, you would be more fit and your wife would probably be happy about that.]     C3 --&gt; U3[User: Stop talking about my wife!]     U3 --&gt; C4[Coach: You should really listen to us!]     C4 --&gt; U4[User: But I am listening -- I just don't agree... I think...]     U4 --&gt; C5[Coach: Well -- we will remind you of this recommendation in a couple of days -- maybe you will be more motivated then... We know you can do it!]     C5 --&gt; End((( )))     End --- Close[Close Application]   </pre>
Post-Condition	Coaching session postponed.

Table 11: Scenario 05.

Scenario	CV.SC.06
Actors	User Coach
Pre-Conditions	User reports pain.
Flow	<p>act Scenarios CV.SC.06</p> <pre> graph TD     Start(( )) --&gt; Open[Open Application]     Open --&gt; C1[Coach: How are you doing?]     C1 --&gt; U1[User: My hip hurts badly]     U1 --&gt; C2[Coach: That sound's bad – do you know why?]     C2 --&gt; U2[User: It always seems to do that during rainy weather.]     U2 --&gt; C3[Coach: Does your pain get in the way of anything that you would like to do?]     C3 --&gt; U3[User: I can do most stuff, actually, but I miss my walks along the beach.]     U3 --&gt; C4[Coach: Mhm? I see? What do you like about walking on the beach?]     C4 --&gt; U4[User: I really love setting my mind free – I guess the fresh air and a good long walk doesn't hurt either]     U4 --&gt; C5[Coach: Do you know of any good alternatives, then?]     C5 --&gt; U5[User: Well.. I'm not sure.]     U5 --&gt; C6[Coach: Perhaps you would like to explore alternatives with us? We're sure you can come up with another way of getting what you like while your hip gets better...]     C6 --&gt; End((( )))     End --&gt; Close[Close Application]   </pre>
Post-Condition	Coaching analysis for alternatives.

Table 12: Scenario 06.

Scenario	CV.SC.07
Actors	<b>Bob:</b> User, 62, Consultant in technology company, Wife and dog. Was always moving from client to client, now... mostly in the office due to new managerial position <b>Ben:</b> Social coach <b>Florence:</b> Activity coach <b>Richard:</b> Diet coach <b>Alice:</b> COPD Expert
Pre-Conditions	Bob acquired the system with the goal to become physically active given the new working situation, and keep desired work-private balance. <p style="text-align: center;">- Table continued on next page -</p>

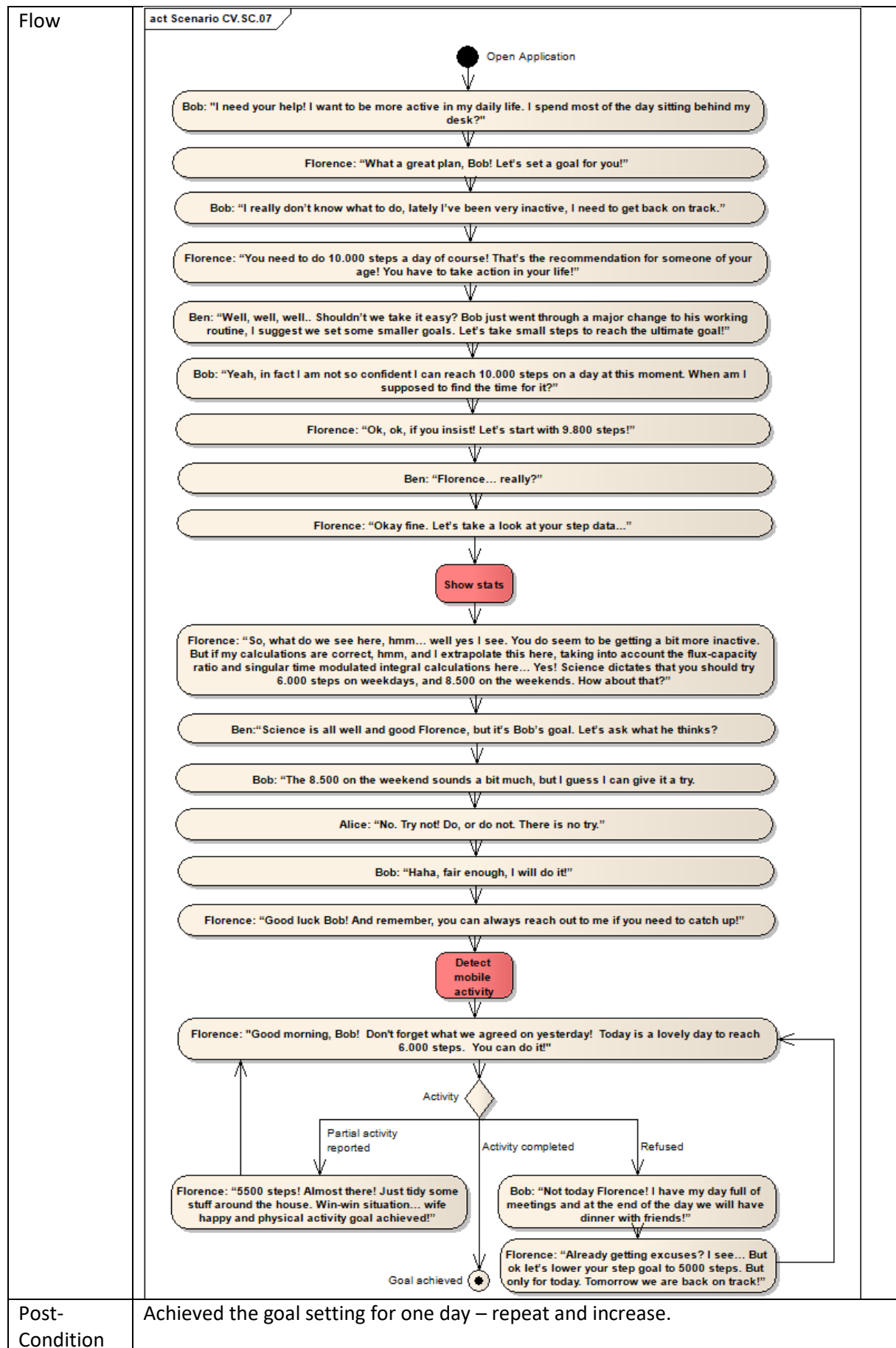


Table 13: Scenario 07.

Scenario	CV.SC.08
Actors	<p><b>Ron Melcher:</b> User, 55 years old, bank officer, Diagnosed with Diabetes Type 2 at 15 years old. Suffering from arrhythmias during the last 5 years. Received his pacemaker 6 months ago.</p> <p><b>Ben:</b> Social coach</p> <p><b>Florence:</b> Activity coach</p> <p><b>Richard:</b> Diet coach</p> <p><b>Sandra:</b> Diabetes Expert</p>
Pre-Conditions	<p>Ron Melcher has been diagnosed with diabetes type 2 when he was 15 years old. He follows his doctor's directions to maintain as low an average blood glucose as possible. He exercises regularly and he is following a healthy diet that is high in vegetables and complex carbohydrates and low in saturated fats and sodium.</p> <p>One of his hobbies is to run and he has participated in 50 marathons so far. During the last 5 years and due to stress at work, he was diagnosed with heart failure. In order to overcome the arrhythmias, he received a pacemaker 6 months ago. However, the number of hospital visits has increased, as well as the number of taking drugs. As a result, he lost his motivation for running and he has not taken part in marathon runs for the last year.</p> <p>Three months ago, Ron started using Council of Coaches in order to receive help in finding a balance in his personal life. Additionally, his heart rate will be monitoring with real-time feedback, making him feel safer.</p> <p>You should feel back to your usual self – or even better – very quickly. It's best to avoid reaching up on the side you had your operation for four to six weeks – that means not hanging out washing or lifting anything from a high shelf, for example.</p> <p>However, it's important to keep your arm mobile by gently moving it to avoid getting a frozen shoulder. A physiotherapist can show you how to do this. You'll usually be able to do all the things you want to do after around four weeks.</p> <p>You should avoid strenuous activities for around four to six weeks after having your pacemaker fitted. After this, you should be able to do most activities and sports.</p> <p>However, if you play contact sports such as football or rugby, it's important to avoid collisions. You may want to wear a protective pad. Avoid very energetic activities, such as squash.</p> <p style="text-align: center;">- Table continued on next page -</p>

Flow	<div>act Scenario CV.SC.08</div> <pre> graph TD     Start(( )) --&gt; Open[Open Application]     Open --&gt; F1[Florence: "Hey Ron, good afternoon! How was your day?"]     F1 --&gt; R1[Ron: "It could have been better... A colleague passed away yesterday"]     R1 --&gt; B1[Ben: "Oh, this is so sad. We are really sorry. Do you know the cause of death?"]     B1 --&gt; R2[Ron: "Heart attack"]     R2 --&gt; Ri1[Richard: "What a pity. But you do not have to worry about that as long as your pacemaker is powered on."]     Ri1 --&gt; D1[Detect sadness]     D1 --&gt; Ri2[Richard: "Don't be sad Ron... I mean that your pacemaker is continuously taking care of your arrhythmias."]     Ri2 --&gt; F2[Florence: "And we are also continuously monitoring your heart rate.unfortunately, we cannot predict how Richard expresses himself."]     F2 --&gt; B2[Ben: "Hahaha. I hope to upgrade his vocabulary in the next firmware."]     B2 --&gt; Ri3[Richard: "So funny, I forgot to laugh.Maybe not the right time to mention it, but as a diabetes patient, you still have to take care of your healthy diet."]     Ri3 --&gt; S1[Sandra: "Not the right time Richard. Indeed. We will come back to this later."]     S1 --&gt; A1[Analyze vital signs]     A1 --&gt; F3[Florence: "Ron, I just performed your daily heart rate check. You are healthy as a horse! Why don't you go for your daily jogging? You will relax and feel much better"]     F3 --&gt; R3[Ron: "Great idea. See you later"]     R3 --&gt; End((( )))     </pre> <p>Open Application</p> <p>Florence: "Hey Ron, good afternoon! How was your day?"</p> <p>Ron: "It could have been better... A colleague passed away yesterday"</p> <p>Ben: "Oh, this is so sad. We are really sorry. Do you know the cause of death?"</p> <p>Ron: "Heart attack"</p> <p>Richard: "What a pity. But you do not have to worry about that as long as your pacemaker is powered on."</p> <p>Detect sadness</p> <p>Richard: "Don't be sad Ron... I mean that your pacemaker is continuously taking care of your arrhythmias."</p> <p>Florence: "And we are also continuously monitoring your heart rate.unfortunately, we cannot predict how Richard expresses himself."</p> <p>Ben: "Hahaha. I hope to upgrade his vocabulary in the next firmware."</p> <p>Richard: "So funny, I forgot to laugh.Maybe not the right time to mention it, but as a diabetes patient, you still have to take care of your healthy diet."</p> <p>Sandra: "Not the right time Richard. Indeed. We will come back to this later."</p> <p>Analyze vital signs</p> <p>Florence: "Ron, I just performed your daily heart rate check. You are healthy as a horse! Why don't you go for your daily jogging? You will relax and feel much better"</p> <p>Ron: "Great idea. See you later"</p> <p>Close Application</p>
Post-Condition	<p>Feel safer through heart rate monitoring</p> <p>Motivate to gain a healthy lifestyle</p> <p>Motivate to eat a healthy diet</p> <p>Motivate to exercise regularly</p> <p>Become again a runner</p>

Table 14: Scenario 08.

#### 4.4.1.2 Environment Systems Model

This model depicts the interactions with external and third party systems identified so far.

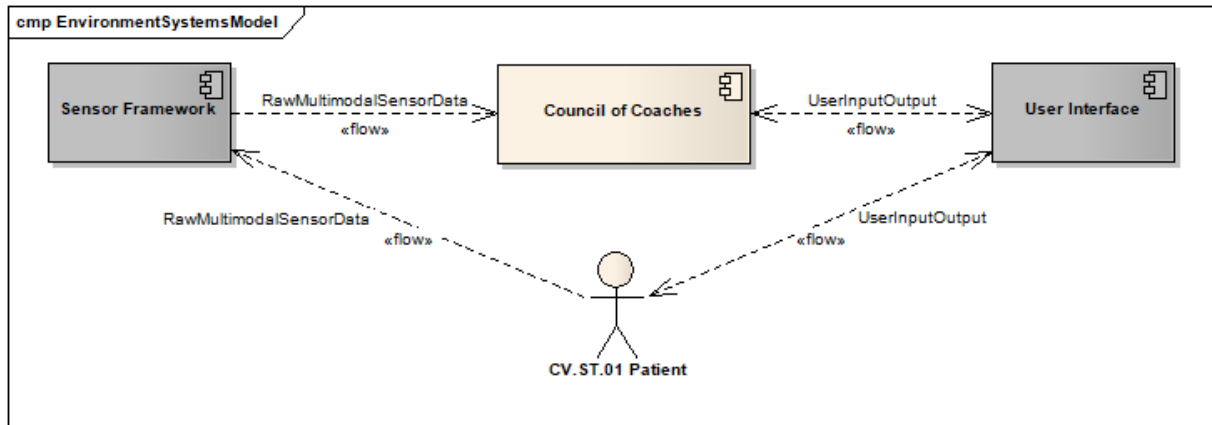


Figure 5: Environment Systems Diagram.

#### 4.4.1.3 Business-to-System Mapping Model

This model assigns use cases to components and actors inside and outside the system.

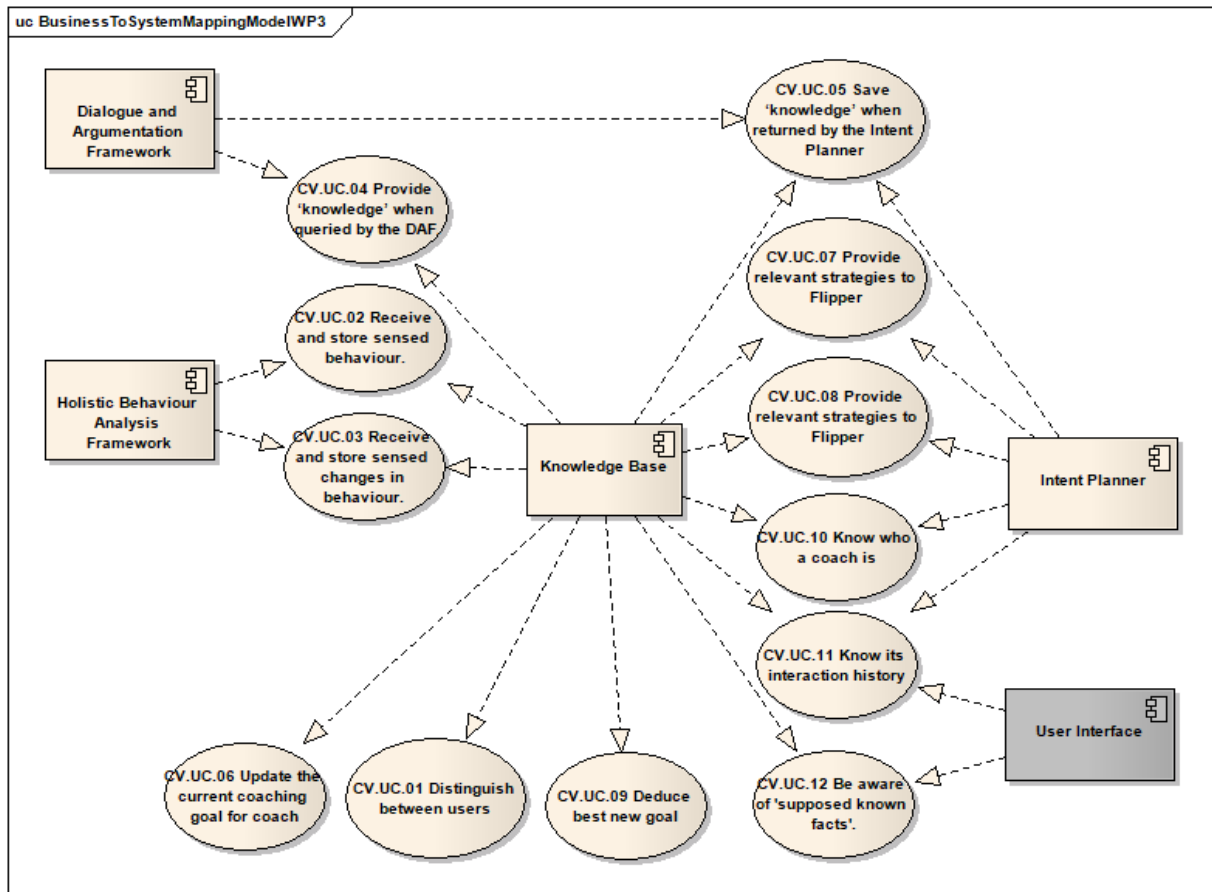


Figure 6: Business to System Diagram: Knowledge Base-centric.

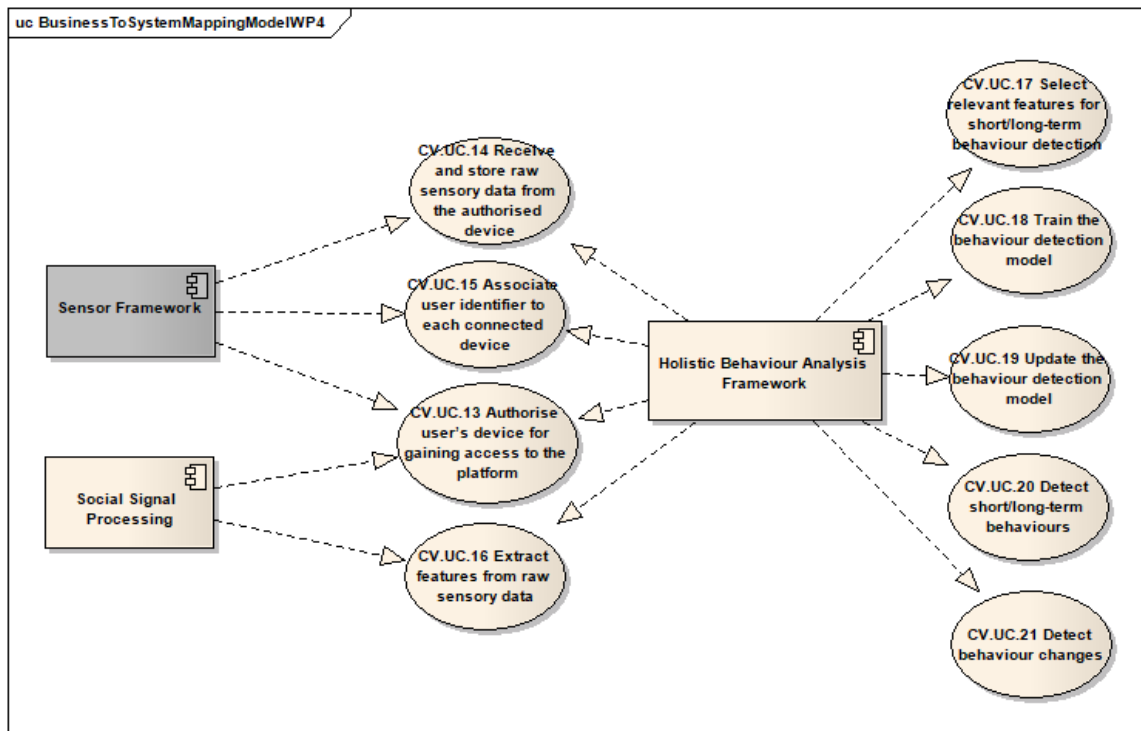


Figure 7: Business to System Diagram: HBAF-centric.

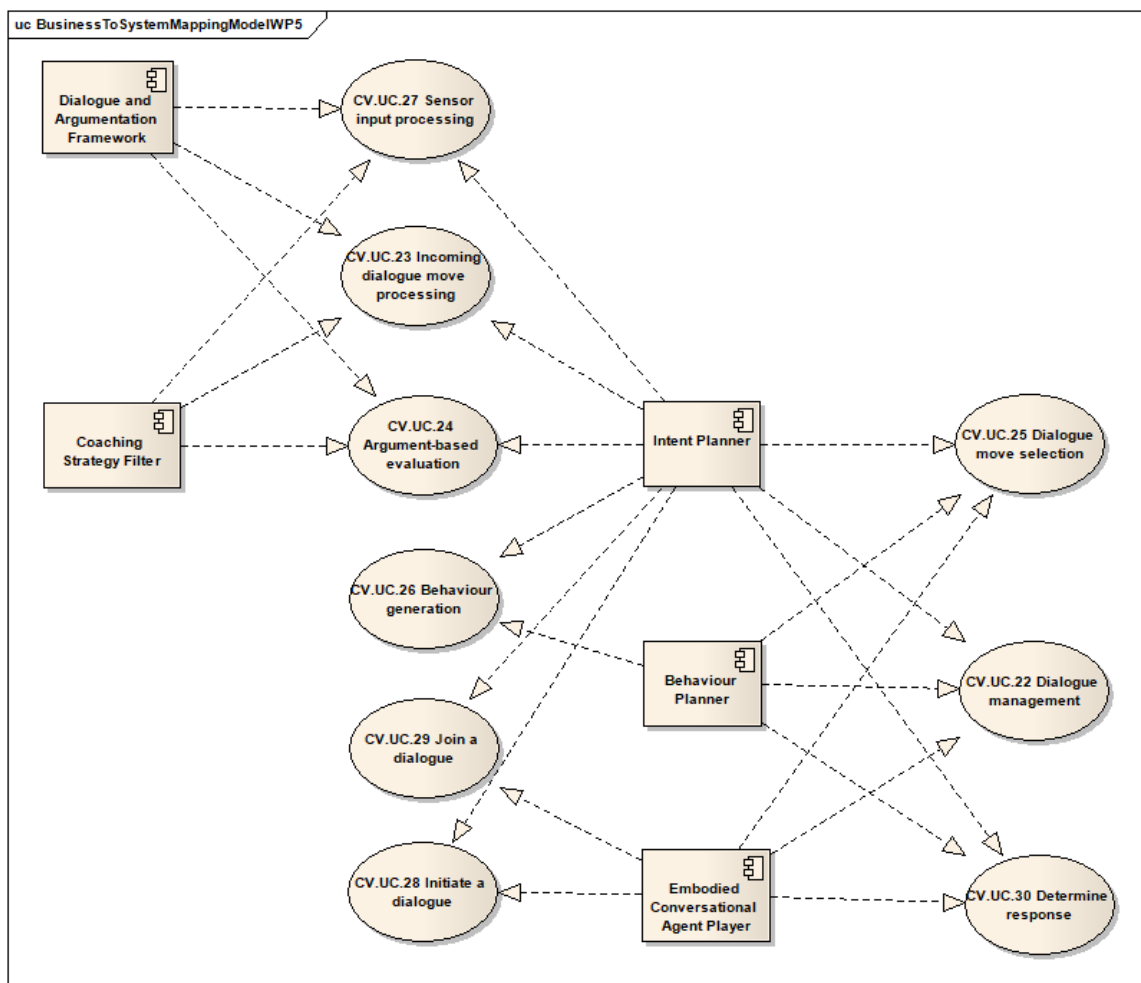


Figure 8: Business to System Diagram: Dialogue-centric.

## 4.4.2 Requirement Viewpoint

### 4.4.2.1 Requirement Model

This model lists functional and non-functional requirements, assigning them to a WP.

Functional Requirements		
ID	Requirement	WP
R.F.01	<b>Intrusion A</b> To not be intrusive: Enable use-profiling	WP2
R.F.02	<b>Intrusion C</b> To not be intrusive: Include a “do not disturb option”	WP2
R.F.03	<b>Intrusion D</b> To not be intrusive: Enable “do not record data” for specific conversations	WP2
R.F.04	<b>Intrusion E</b> To not be intrusive: Prompt the user to participate in the conversation	WP2
R.F.05	<b>Intrusion F</b> To not be intrusive: Summary-option for long conversations with intentions of humour that might be annoying to some users	WP2
R.F.06	<b>Detect motivation level</b> While listening, the virtual coaches have to detect the level of motivation that the patient is at, for changing his/her lifestyle.	All
R.F.07	<b>Identify motivation</b> Be able to identify the level of motivation that the patient is at and adapt the coaching to that level.	All
R.F.08	<b>References to knowledge</b> app can use the knowledge gathered from when it listens to the patient, to make references and examples to the patient’s own relational mind	All
R.F.09	<b>Transparent use of data</b> Make the use of data transparent to the patient. The patient should have a clear idea of everything that can be done with his/her data.	All
R.F.10	<b>Add coach with its knowledge</b> Adding a new embodied conversational coach should include adding the domain knowledge for that coach and relevant specifications for their personality, appearance and behaviours.	WP3
R.F.11	<b>Add/Remove coaches</b> It should be possible to remove or add new embodied conversational coaches to the system.	WP3
R.F.12	<b>Coaches can participate out of their domain</b> When a new embodied conversational coach is added, an addition to the general knowledge represented in the system should be made to enable the other embodied conversational coaches to join as a non-expert in a conversation with the user in the new embodied conversational coach’s domain.	WP3

R.F.13	<b>Coaching domains</b> To emphasize: Since the groups of users included in the evaluation are Type 2 Diabetes, Chronic Pain and Age-Related Impairments, these are the coaching domains for which knowledge should be included	WP3
R.F.14	<b>KB give access to D&amp;AF</b> The shared knowledge base should provide access to the Dialogue and Argumentation Framework. In doing so the Dialogue and Argumentation Framework should be able to pose a query and the shared knowledge base should be able to return a meaningful answer.	WP3
R.F.15	<b>KB give access to HBAF</b> The shared knowledge base should provide access for the Holistic Behaviour Analysis Framework to the knowledge about previously detected primitive behaviours.	WP3
R.F.16	<b>KB store appearance of coaches</b> The shared knowledge base could include information on the personality and appearance of the coaches that would be required for their presentation using the Greta Framework.	WP3
R.F.17	<b>KB store behaviour sets</b> The shared knowledge base could include the behaviour sets that are currently used by the Greta Framework to convert intents into BML/FML specifications.	WP3
R.F.18	<b>KB store broad data for conversations</b> The shared knowledge base should contain knowledge that will enable the embodied conversational coaches to have conversations with the user (broad, not coaching domain specific).	WP3
R.F.19	<b>KB store domain data for each coach</b> For each embodied conversational coach, the shared knowledge base should contain knowledge that is specific for the domain of that embodied conversational coach.	WP3
R.F.20	<b>KB store long term for HBAF</b> The shared knowledge base should store the long-term behaviours detected by the Holistic Behaviour Analysis Framework.	WP3
R.F.21	<b>KB Store short term for HBAF</b> The shared knowledge base should store the short-term behaviours detected by the Holistic Behaviour Analysis Framework.	WP3
R.F.22	<b>KB store tailoring data</b> The shared knowledge base should contain knowledge that will enable the embodied conversational coaches to tailor their coaching strategies to the user.	WP3
R.F.23	<b>KB updated from D&amp;AF</b> The shared knowledge base should update its knowledge (that is, add, change or delete) based on inputs by the Dialogue and Argumentation Framework.	WP3
R.F.24	<b>KB verifies new data when stored</b> When new knowledge is added to the shared knowledge base this new knowledge should be verified in terms of compliance with existing knowledge.	WP3

R.F.25	<b>Authorize devices</b> The platform shall authorise devices to send data	WP4
R.F.26	<b>Read raw data</b> The platform shall read raw sensory data from authorised devices	WP4
R.F.27	<b>Store raw data</b> The platform shall store raw sensory data from authorised devices	WP4
R.F.28	<b>Raw data from each device</b> The platform shall obtain raw sensory data from each device	WP4
R.F.29	<b>Device UDI</b> The platform shall provide a UDI for each device	WP4
R.F.30	<b>User UUI</b> The platform shall provide a UUI for each user	WP4
R.F.31	<b>Compute from raw data</b> The platform shall compute features based on raw sensory data	WP4
R.F.32	<b>Data for features</b> The platform shall provide the appropriate data for each feature extraction model	WP4
R.F.33	<b>Features for classification</b> The platform shall provide the appropriate features for creating the classification model	WP4
R.F.34	<b>Datasets for classification</b> The platform shall facilitate the generation of datasets for training the classification model	WP4
R.F.35	<b>Update classification</b> The platform shall update the classification model	WP4
R.F.36	<b>Create behaviour logs</b> The platform shall create logs of behaviours	WP4
R.F.37	<b>Update behaviour logs</b> The platform shall update logs of behaviours	WP4
R.F.38	<b>Concurrent access</b> The platform shall allow concurrent access	WP4
R.F.39	<b>Short term behaviour</b> The platform shall identify user's short-term behaviours	WP4
R.F.40	<b>Short term behaviour logs</b> The platform shall provide short-term behaviours for the generation of behaviour logs	WP4
R.F.41	<b>Short-to-long term behaviour</b> The platform shall provide the appropriate short-term behaviours for recognising long-term behaviours	WP4
R.F.42	<b>Long term behaviour</b>	WP4

	The platform shall identify user's long-term behaviours	
R.F.43	<b>Behaviour permissions</b> The platform shall provide to the authorised entities permissions to read, write, delete and update behavioural logs	WP4
R.F.44	<b>Raw data permissions</b> The platform shall provide to the authorised entities permissions to read, write, delete and update raw sensory data	WP4
R.F.45	<b>Behaviour sources</b> The platform shall merge behavioural data coming from external sources	WP4
R.F.46	<b>Link UDI and UUI</b> The platform shall link each UDI with the related UUI	WP4
R.F.47	<b>Manage dialogues</b> The framework shall be capable of creating, managing and terminating coaching dialogues.	WP5
R.F.48	<b>Turn taking</b> The framework shall provide general rules for turn-taking for when these are not explicitly provided in the protocol.	WP5
R.F.49	<b>Start dialog</b> Agents representing virtual coaches shall be capable of autonomously initiating dialogues amongst themselves or with the user.	WP5
R.F.50	<b>Recipients</b> Dialogue moves shall name a recipient, either specific or as a broadcast move to all.	WP5
R.F.51	<b>Receiving dialogue</b> An agent shall be capable of receiving incoming dialogue moves.	WP5
R.F.52	<b>Record dialogue</b> An agent shall keep a record of all dialogues in which it is participating.	WP5
R.F.53	<b>Respond to dialogue</b> An agent shall use its record of dialogue to determine if it is allowed to respond to an incoming dialogue move.	WP5
R.F.54	<b>Choose response</b> An agent shall choose an appropriate response.	WP5
R.F.55	<b>Evaluate info</b> An agent shall be able to argumentatively evaluate incoming information with respect to its existing knowledge base and beliefs.	WP5
R.F.56	<b>Choose move</b> An agent shall query a Coaching Strategy to assist in selecting an appropriate dialogue move.	WP5
R.F.57	<b>Always respond</b> An agent shall always respond when required by the protocol.	WP5

R.F.58	<b>Don't know</b> An agent shall send a “don't know” (or similar) move if it must respond but has no possible moves.	WP5
R.F.59	<b>BML models</b> The framework shall generate BML to model behaviours matching dialogue moves chosen for Embodied Conversational Coaches.	WP5
R.F.60	<b>Accept HBAF info</b> An agent shall be capable of accepting input from the HBAF.	WP5
R.F.61	<b>Handling disagreements between coaches A</b> a. Arrange dedicated discussion on principles (and preferences) in the consortium - what could they be; produce rough list. b. Take the list to stakeholder workshops - show a scripted demonstrator with extreme examples of conflicting principles. The stakeholder-workshop should help dealing with what sort of principles would solve the specific conflicts. c. With the technical demonstrator (completed in month9), we can in month 10 come up with a more concrete scenarios based on the stakeholder feedback. = A proper, fully functional, technical demonstrator of extreme example on how to deal with conflicting advices. d. Use feedback on the demonstrator to feed into next prototype – constant feedback-loop.	WP2
R.F.62	<b>How to keep healthcare knowledge up to date A</b> That solution in steps would look like this: 1) Re-run all interactions that the system has had (this requires history of interaction). 2) Check if there is now relevant knowledge related to that specific user, which is different from the old knowledgebase. 3) Check if the knowledge differences are conflicting: a. If Solution1 (solution/advice based on old knowledge) is the same as Solution2 (solution/advice based on new knowledge) then there is no problem! b. If Solution1 is different from Solution2, then there might be a problem: 1. Check if it's an issue that the solutions are different. 2. Figure out how to resolve the problem → might mean that Knowledgebase needs changes.	WP2
R.F.63	<b>How to keep healthcare knowledge up to date B</b> Add a new coach that can articulate the new knowledge that is now in the knowledgebase and tell the user that he/she should be aware of that knowledge. The new coach can be very specific and tell the user, that the other coaches don't know about this knowledge.	WP2
R.F.64	<b>Ethical governance</b> Design choices and exploitation continually takes into account medical devices regulation. All user interaction (in T2.3) takes into account medical ethics principles as elaborated in the Helsinki Declaration.	WP2

R.F.65	<b>How to keep healthcare knowledge up to date?</b> Healthcare knowledge is fluid. System should give advice based on the latest medical knowledge. Adding a new coach or new “medical” insight results in a change in knowledge base. Such a change can cause unforeseen issues in the interaction between different domain knowledge bases. Bottom line: This can lead to the wrong advice.	WP2
R.F.66	<b>Privacy and informed consent - B</b> Privacy and informed consent: LEGO system of consent	All
R.F.67	<b>Trust (not too little, not too much) - D</b> Trust: Transparency of what information will be shared with e.g. GPs or other actors and with other coaches	All
R.F.68	<b>Trust (not too little, not too much) - E</b> Trust: Avoid likenesses with real doctors, too great realism in looks, etc	WP6
R.F.69	<b>Trust (not too little, not too much) - F</b> Trust: Remind users to visit human experts	All
R.F.70	<b>data issues - B</b> The patient should always know how the data is used	WP2
R.F.71	<b>Health education - A</b> Once a diagnosis is made, the coaches should provide health education, since “most people do not know what their diagnosis entails and most care professionals do not take the time to explain things properly”	WP2
R.F.72	<b>Monitoring</b> With respect to COPD exacerbations, the virtual coaches should have a monitoring role, whereby they detect exacerbations (using simple questionnaires) and monitor the (lack of) effect of interventions (e.g., antibiotics or prednisolone).	WP2
R.F.73	<b>Privacy and informed consent - C</b> Privacy and Informed Consent: make sure we don't ask for "more than we need".	All
R.F.74	<b>Privacy and informed consent - D</b> Privacy and informed consent: Consent-reminders once per 6 months or so to keep the patient informed	All
R.F.75	<b>Privacy and informed consent - E</b> Privacy and informed consent: There should be potential per-coach consent; for sure if a new coach joins, a full review for that coach is necessary.	All
R.F.76	<b>Handling disagreements between coaches - B</b> Handling disagreements between coaches: Give the different medical advices to the user from different perspectives, and let him decide which one to follow	All
R.F.77	<b>Handling disagreements between coaches - D</b> Handling disagreements between coaches: development of organizational protocols (or templates for such protocols) for use by downstream actors after implementation	WP3

R.F.78	<b>Handling disagreements between coaches - F</b> How to keep healthcare knowledge up to date: make a system that can somehow compare the old knowledgebase and the advices given to the user based on that old knowledgebase, to the new knowledgebase and new advices.	WP3
R.F.79	<b>Huber's Model of Health</b> The Huber's Model of Health' aspects: bodily functions, mental functions & perception, spiritual/existential dimension, quality of life, social & societal participation, and daily functioning will be the 6 criteria used to assess effectiveness of the system as a whole. Use the 6 criteria to create a profile of end-user's health.	All
R.F.80	<b>Disagreement between coaches</b> A holistic model of health including various sources of health knowledge may generate various and even conflicting answers to a specific problem. How to deal with conflicting advice in practice?	All
R.F.81	<b>Addressed Health Topics</b> The project should address the defined domains (physical, cognitive, mental, social) and defined target groups (elderly, diabetes type2, chronic pain). In order to address these criteria, we need to define a list of specific topics (addressing health behaviours) that the prototype should support (i.e. is able to discuss). These topics can either be defined as "problems", "solutions", or "issues", as a strict separation may be hard to define. Examples include: Diet, Weight Loss, Medication Intake, Coping with Pain, etc...	All
R.F.82	<b>"Deep" character (coach) design</b> The engagement of the end user should be increased to provide the added value of a council of coaches. The virtual coaches should be more than just a 'talking head'. Virtual coaches should be designed as interesting "characters".	All
R.F.83	<b>Choosing the visual / thematic style</b> What should be the visual / thematic style of the whole prototype? What is the effect of "cartoony" vs "realistic" styles on e.g. trust, engagement?	WP6
R.F.84	<b>Privacy-by-design in data collection</b> Data collection through sensors and dialogue history should be done in a privacy-by-design way (e.g. quickly derive higher level conclusions and disregard raw input data: how can we aggregate "personal" information to "non-personal" knowledge)	All
R.F.85	<b>Built-in informed consent</b> Providing informed consent for collecting and storing data should be an integral part of the coaching process, not an auxiliary process.	All
R.F.86	<b>Coach-as-a-Sensor</b> We need a number of examples cases in which we extract "health" information from the user through a dialogue interaction (without sensors) and develop it into "knowledge" that can be used in the knowledge database – the "Coach-as-a-Sensor" concept	WP4
R.F.87	<b>Sports coach style vs. motivational interviewing style</b>	All

	Should it be possible to choose between coaching styles? Who should decide on the style in each case? Should a choice between styles of coaching be built in the application?	
R.F.88	<b>Course of coaching sessions</b> In real-life coaching, ethical conduct implies that the course of coaching sessions discontinues when the original problem initiating the relation between a coach and client is solved. Old age, diabetes and chronic pain do not go away. Should there be an end point for a clients' involvement with a council of coaches?	All

Table 15: Functional requirements.

Non-Functional Requirements			
ID	Requirement	Type	WP
R.NF.01	<b>Accuracy</b> Personal data shall be accurate and, where necessary, kept up to date	Reliability	All
R.NF.02	<b>Anonymization and pseudonymisation A</b> anonymise the personal data as far as possible	Security	All
R.NF.03	<b>Anonymization and pseudonymisation B</b> Both the client and the server should incorporate the privacy rules as set out in the GDPR as of May 2018	Security	All
R.NF.04	<b>Data minimisation B</b> Personal data shall be adequate, relevant and limited to what is necessary in relation to the purposes for which they are processed	Security	All
R.NF.05	<b>Integrity and confidentiality A</b> Personal data shall be processed in a manner that ensures appropriate security of the personal data, including protection against unauthorised or unlawful processing and against accidental loss, destruction or damage, using appropriate technical or organisational measures	Security	All
R.NF.06	<b>Lawfulness, fairness and transparency</b> Personal data shall be processed lawfully, fairly and in a transparent manner in relation to the data subject	Security	All
R.NF.07	<b>Purpose limitation</b> Personal data shall be collected for specified, explicit and legitimate purposes and not further processed in a manner that is incompatible with those purposes	Security	All
R.NF.08	<b>Storage limitation</b> Personal data shall be kept in a form which permits identification of data subjects for no longer than is necessary for the purposes for which the personal data are processed	Security	All
R.NF.09	<b>WP4 Data interoperability</b> We use standard models for encoding the data (e.g., JSON, CSV).	Interop.	WP4

R.NF.10	<b>WP4 Data security A</b> An anonymised universal unique identifier will be used to identify the data collected from each user. This identifier will in no way allow to reveal the identity of the user. However, there might be a combination of data possible, with which you can identify a person, for example 24hour location tracking. The raw sensor data will be transmitted over HTTPs in the form of data objects (e.g., JSON) to a secure server where it is persisted in another relational database management system (e.g., MySQL).	Security	WP4
R.NF.11	<b>WP7 Data interoperability</b> System/User logs: These can follow established formats for logging that are widely used and known by developers and technicians. Knowledge base: Almost all possible options of technologies to be used in the knowledge base follow a well-known format or query language.	Interop.	WP7
R.NF.12	<b>Integrity and confidentiality C</b> Stored knowledge should be secure.	Security	WP3
R.NF.13	<b>Integrity and confidentiality D</b> The shared knowledge base will inevitably contain personal information and within that personal information possibly medical information (for example, that a user has Type 2 Diabetes). This knowledge should be treated carefully and should not be stored lightly (what is stored should be thought through).	Security	WP3
R.NF.14	<b>Real time A</b> Response/processing time should be real-time in order to not slow down other system components.	Performance	WP3
R.NF.15	<b>Raw data delay</b> The platform shall read the raw sensory data of the user from their personal device in real-time with a delay of no more than 3s.	Performance	WP4
R.NF.16	<b>Raw data reliability</b> The platform shall maintain the consistency, integrity, and reliability of raw sensory data in non-volatile storage	Reliability	WP4
R.NF.17	<b>Short term accuracy</b> Overall the accuracy of short-term behaviour detection shall be greater than or equal to 80%	Performance	WP4
R.NF.18	<b>Long term accuracy</b> Overall the accuracy of long-term behaviour detection shall be greater than or equal to 70%	Performance	WP4
R.NF.19	<b>Missing data accuracy</b> Overall the percentage of missing data that is allowed shall be less than 20%	Reliability	WP4
R.NF.20	<b>Consistency of copies</b>	Reliability	WP4

	The platform shall ensure consistency of distributed copies of behavioural data.		
R.NF.21	<b>Data request delay</b> The platform response time to a data request shall be below 30 seconds	Performance	WP4
R.NF.22	<b>Real time B</b> The framework should provide responses as close to real-time as possible to ensure a seamless user experience	Performance	WP5
R.NF.23	<b>Dangerous advice</b> Dialogues in the framework must never terminate with advice that could endanger a user	Safety	WP5
R.NF.24	<b>Secure communication</b> All internal and external communication involving the framework should be secure	Security	WP5
R.NF.25	<b>Data management plan storage</b> All data stored by the framework will be done so in accordance with the COUCH data management plan	Security	WP5

Table 16: Non-functional requirements.

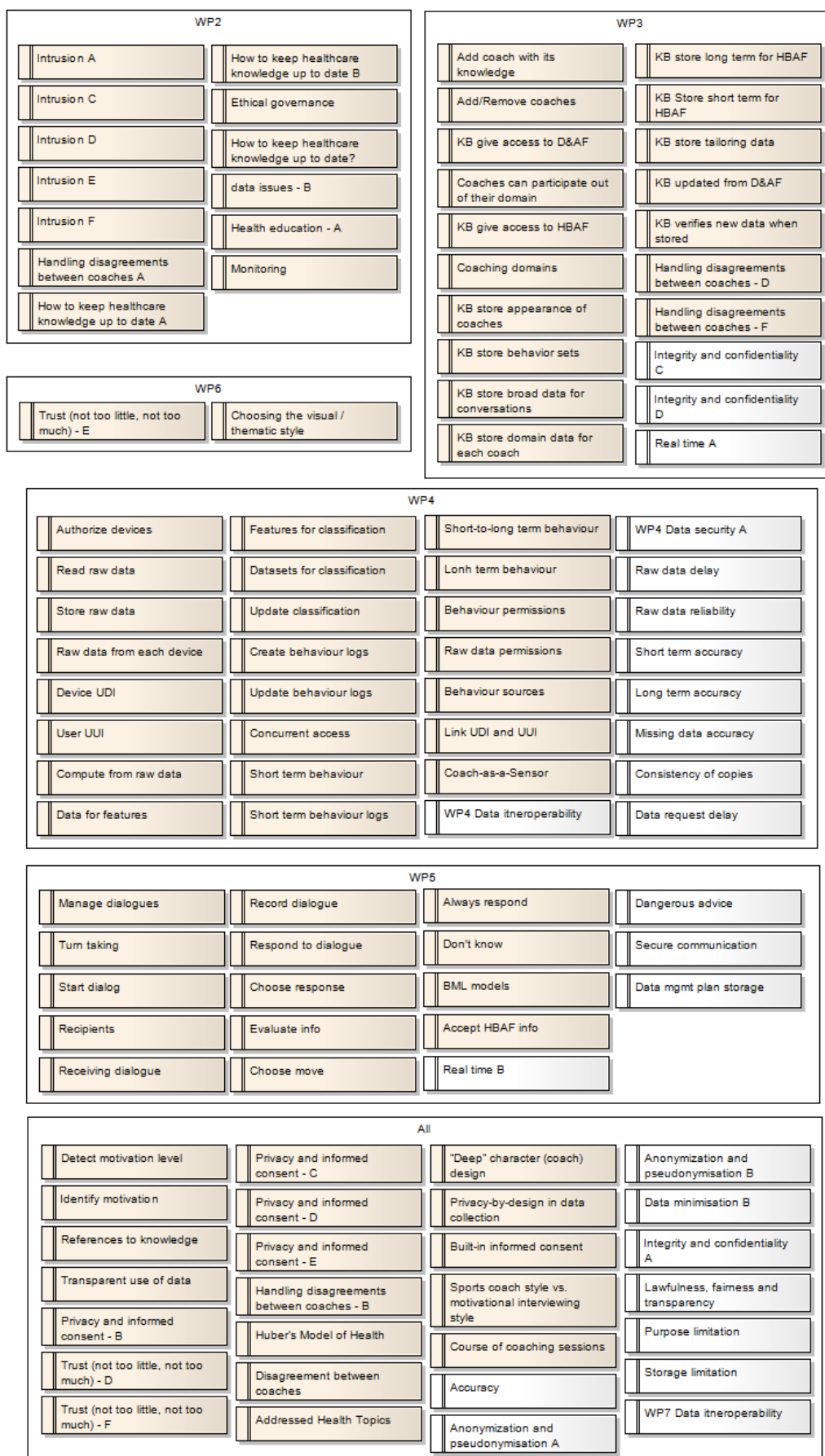


Figure 9: Requirements Diagram. Functional: Brown. Non-Functional: White.

As requirements get trimmed down and implemented, we will have a better view of which component is associated to each requirement, and figure out a hierarchy among requirements. We will update this section with diagrams representing those relationships. **This will be completed in a future revision of this document.**

#### 4.4.2.2 Target System Interface Model

The Target System Interface Model defines the interfaces for the external and 3<sup>rd</sup> party systems identified in the Environment Systems Model. As seen in that model, we currently only have a small view of those external systems, and their interfaces would be placeholders for now. **This will be completed in a future revision of this document.**

### 4.4.3 Component Viewpoint

#### 4.4.3.1 System Information Model

This represents the data model used for the information items shared across the system.

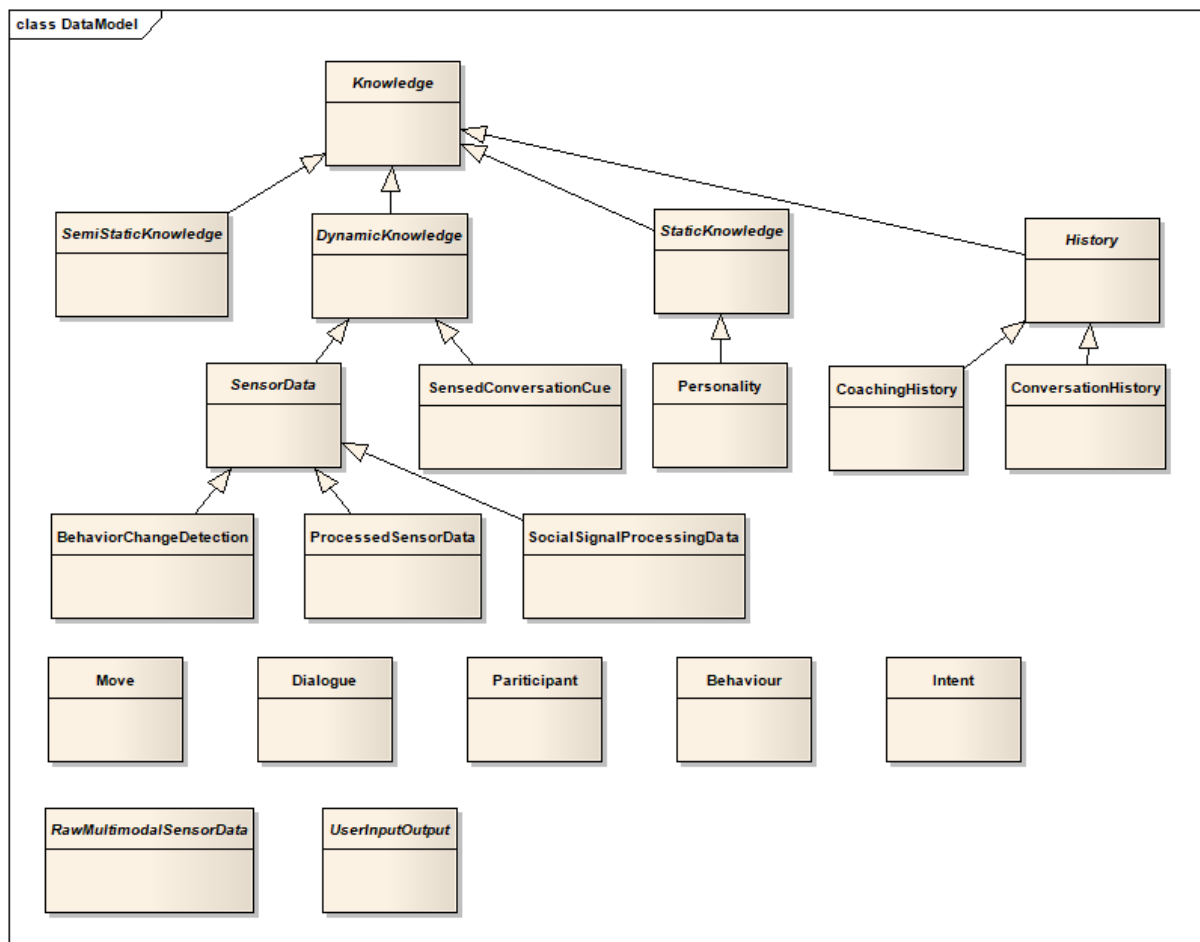


Figure 10: Data Model Diagram.

#### 4.4.3.2 System Decomposition Model

This model is a component diagram showing the modules of the system and how they are connected.

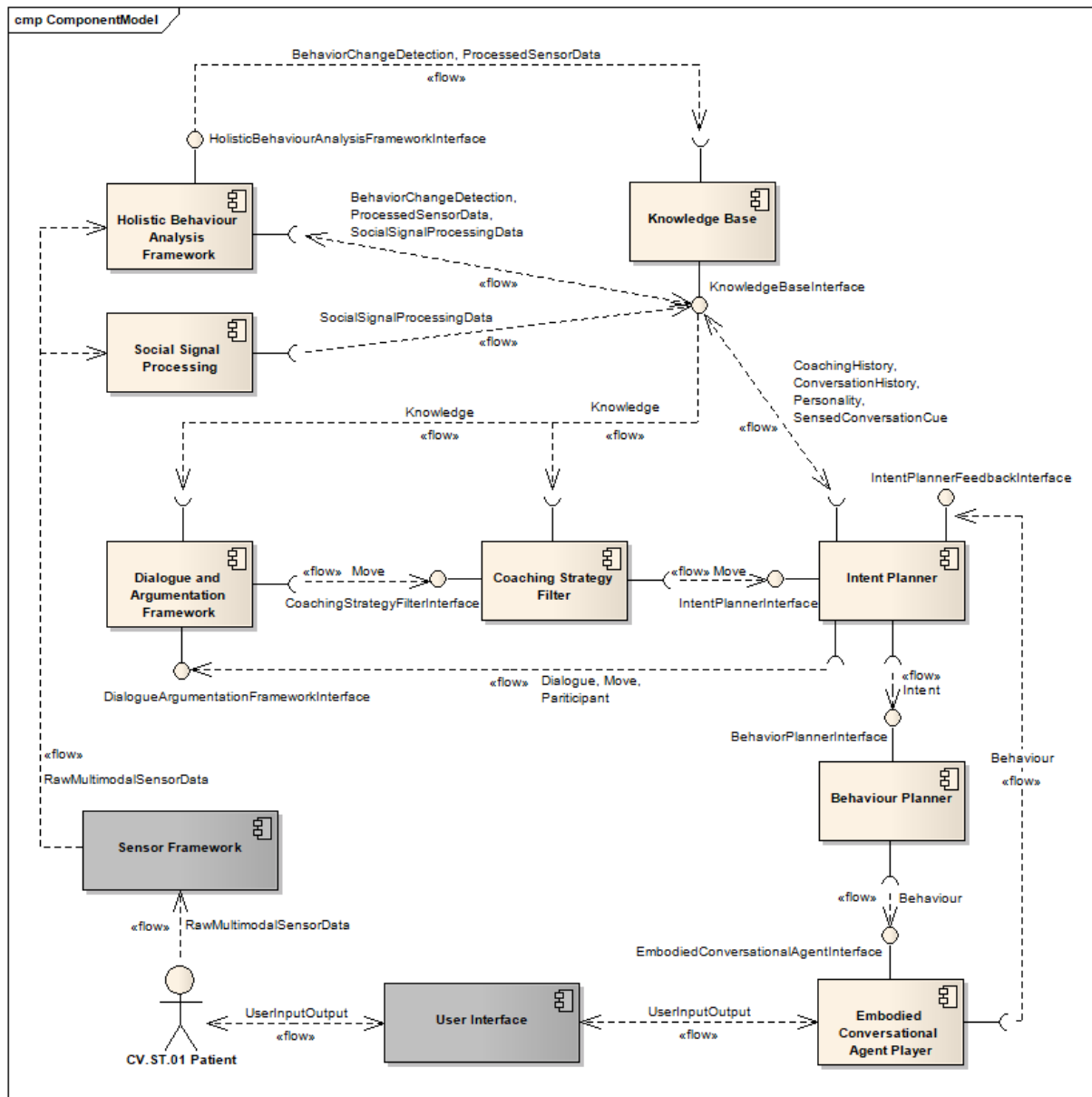


Figure 11: Component Diagram.

#### 4.4.3.3 System Collaboration Model

This model contains sequence diagrams for the core interaction and use cases.

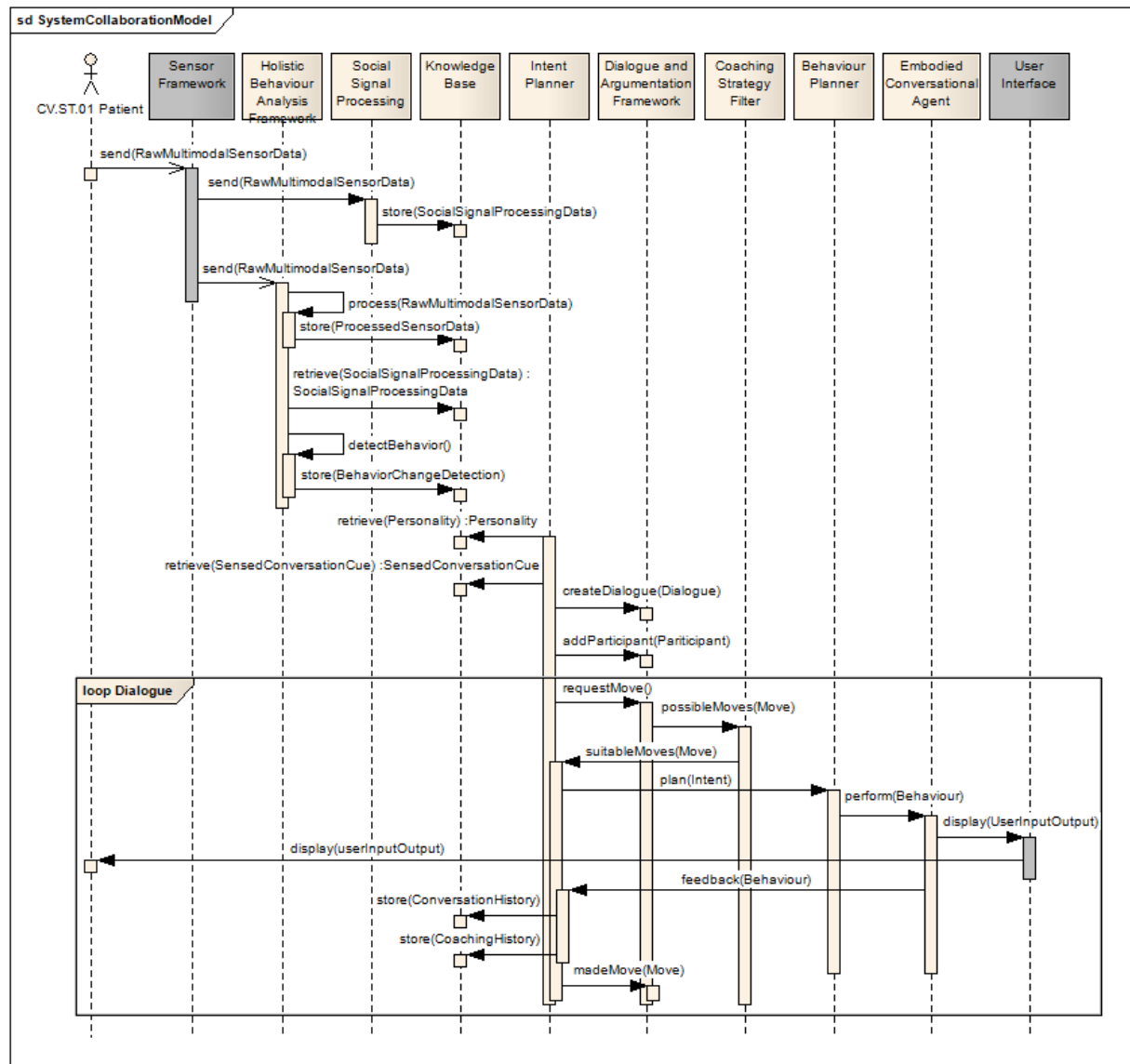


Figure 12: Sequence Diagram: Typical data storage and dialogue.

When we complete the final implementation of each component we will have a more clear and final view of all the interactions between components *per use case*, instead of an overall sequence. **This will be completed in a future revision of this document.**

#### 4.4.3.4 Component and Interface Specification Model

The class diagrams in this model detail the interfaces through which modules are connected.

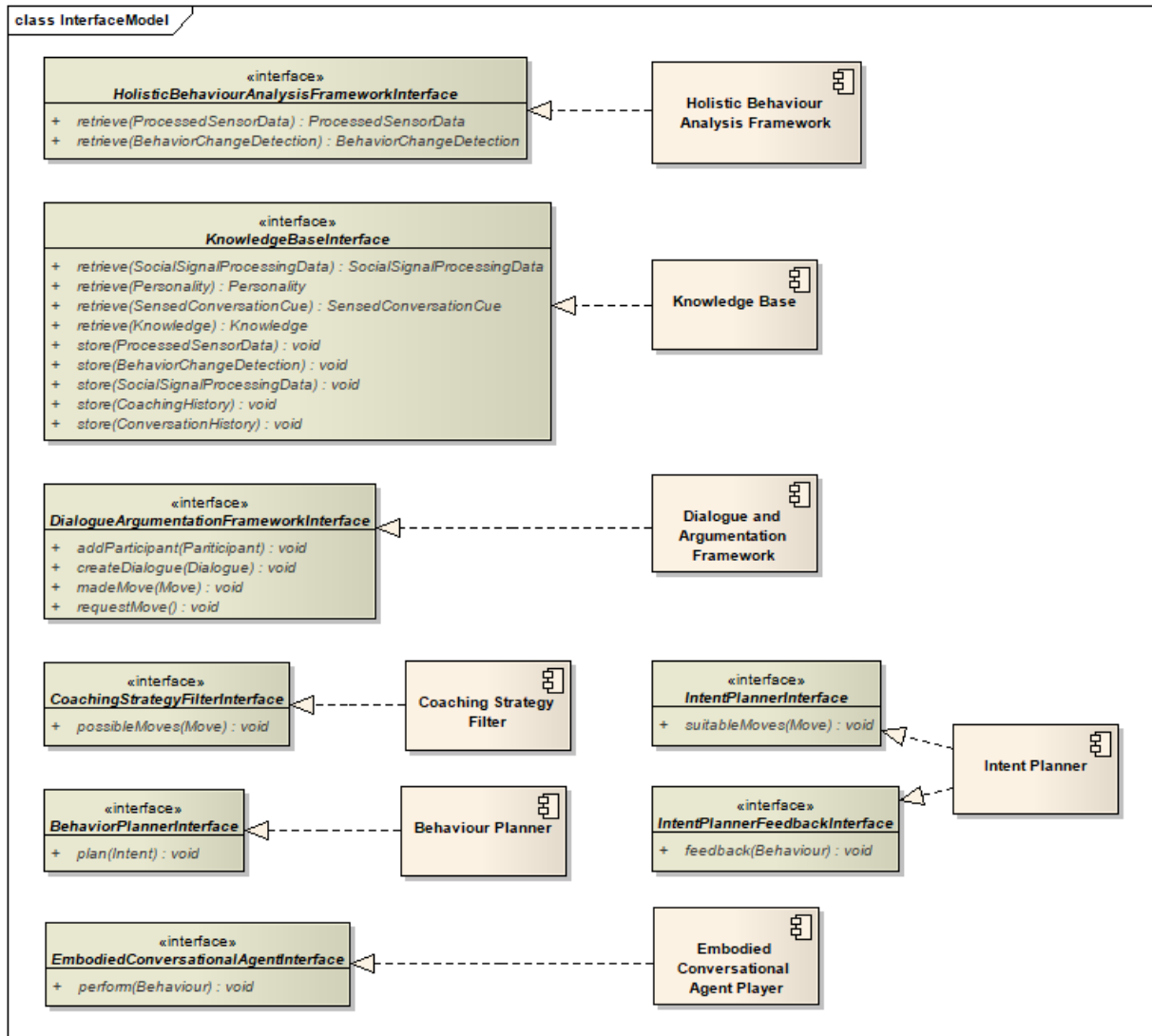


Figure 13: Interfaces Diagram.

## 4.4.4 Distribution Viewpoint

### 4.4.4.1 System Distribution Model

This deployment diagram shows where each module will be logically deployed (see Figure 14).

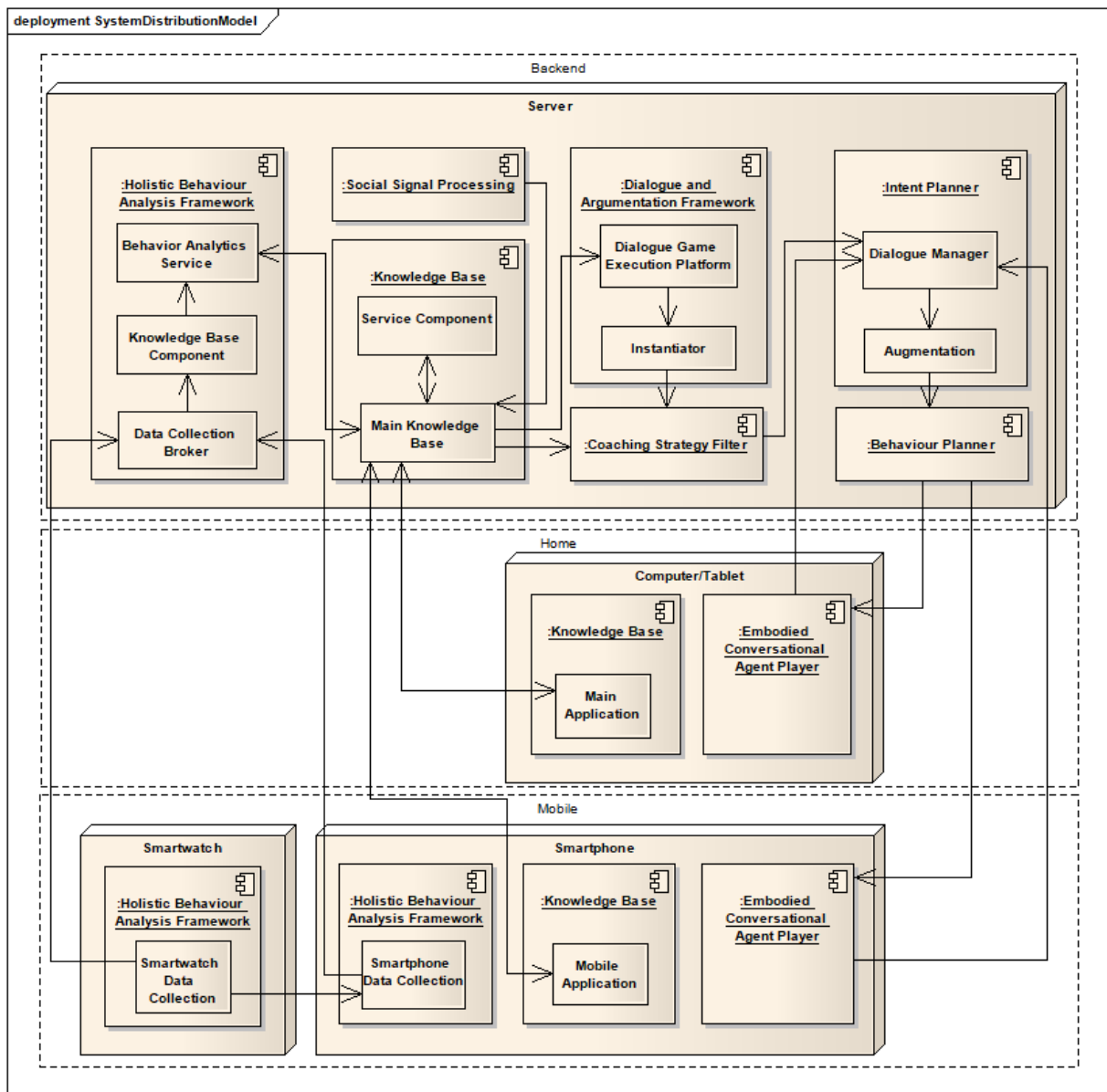


Figure 14: Deployment Diagram.

### 4.4.4.2 Role Distribution Model

This model is mostly suited for very large and complex systems. **This will not be defined in COUCH architecture.**

## 4.4.5 Realization Viewpoint

This Viewpoint includes the actual hardware the system will run in. We will have a clearer view of this once we approach the final demonstration prototype. **This will be completed in a future revision of this document.**

#### *4.4.5.1 System Deployment Model*

***This will be completed in a future revision of this document.***

#### *4.4.5.2 Technology Mapping Model*

***This will be completed in a future revision of this document.***

#### *4.4.5.3 System Integration Test Model*

***This will be completed in a future revision of this document.***

## 5 Bibliography

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