FURNIT-SAVER

Smart Augmented and Virtual Reality Marketplace for Furniture Customisation

D2.1 System Architecture

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Document change record

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05/05/2015	V0.1	ASCAMM	Working document for D2.1 and D2.2 circulated to ACS
29/05/2015	V0.2	ACS	Contributions provided for system architecture and modules definition.
22/05/2015	V0.3	ACS	New proposal of document structure with more detail in the modules definition. Potential content to D2.2 included.
29/05/2015	V0.4	ASCAMM	Architecture schematics provided for discussion.
2/06/2015	V0.5	ACS	Modifications added to modules descriptions based on discussions.
6/06/2015	V0.6	ASCAMM	New description of the Back-office
7/06/2015	V0.7	ACS	Modifications added to modules descriptions based on discussions.
26/06/2015	V0.8	ACS	Modification in modules descriptions. All sections affected.
03/07/2015	V1.0	ASCAMM	First complete draft
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14/07/2015	V2.1	ASCAMM	All sections affected. Minor corrections. Final revision and acceptance of final document
23/11/2014	V2.2	ACS	Application structure model added.
4/12/2015	V3.0	Eurecat	References to requirements as defined D1.1 added. Revision. Minor modifications. Submission

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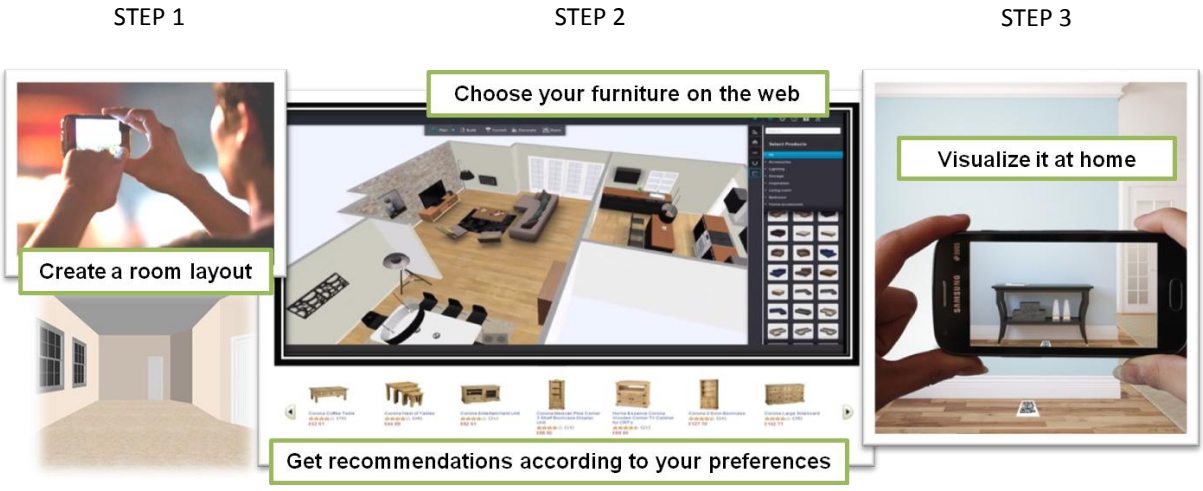
1 FurnIT-SAVER project introduction

The traditional nature of the furniture industry and the limited incorporation of ICT tools have reduced the ability of SMEs in the sector to innovate and respond to the competition coming from larger companies. These specialised furniture shops and small furniture manufacturers have been unable to compete with the economies of scale advantages that larger furniture retailers can offer.

On the other hand, smaller furniture companies can offer higher levels of personalization and quality of customized goods that truly meet customers' preferences and needs which represents a potential competitive advantage over larger furniture providers. Nevertheless, as it is impossible to envisage how the furniture will look and fit into the customers home, customised furniture also bears an expensive risk if the final piece of furniture does not meet the customer's needs or does not complement other furniture. Furthermore, these customised services are predominantly provided on a face-to-face basis in local and fragmented markets which prevents small manufacturers to benefit from ecommerce growth and limit their international reach.

The FURNIT-SAVER project makes use of innovative ICT solutions based on a combination of Virtual and Augmented Reality (VR/AR) technologies, recommendation engines and ecommerce solutions, to produce a smart marketplace for furniture customisation. Customers will be able to select among an extensive furniture catalogue and properties and virtually try the selected pieces in their rooms with three very simple steps: (1) Creating an accurate 3D virtual representation of their place, (2) Trying furniture of different manufacturers in this virtual scenario and get recommendations according to their preferences of a wide range of properties and pieces, and (3) Visualizing the fit of the chosen products in their place using augmented reality.



2 Scope of the document

The purpose of this deliverable is to describe the architectural structure of FurnIT-SAVER platform. This document will be complemented by deliverable *D2.2 In-depth design of the main modules*. Both documents will be defined to such a level that the integration and validation related reports (D3.1, D3.2, D4.1 and D4.2) will follow and will be based on the structure and functionality defined in this deliverable.

The system architecture described follow a modular approach in such a way that allows for additional functionality to be added to the framework as the project evolves. This document is the result of FurnIT-SAVER consortium discussions based on the following referent documents:

- D1.1 User Requirement Document (URD)
- D1.2 Application Scenarios Deliverable (ASD)

3 Technological context

The FurnIT-SAVER platform makes use different technological tools such as portable devices as a room mapping tool, Virtual and Augmented Reality (VR/AR) technologies and recommendation engines to produce a smart marketplace for furniture customisation. The following diagram summarises the process in 3 steps taking into account the different stakeholders involved (buyers and retailers as users and furniture manufacturers):

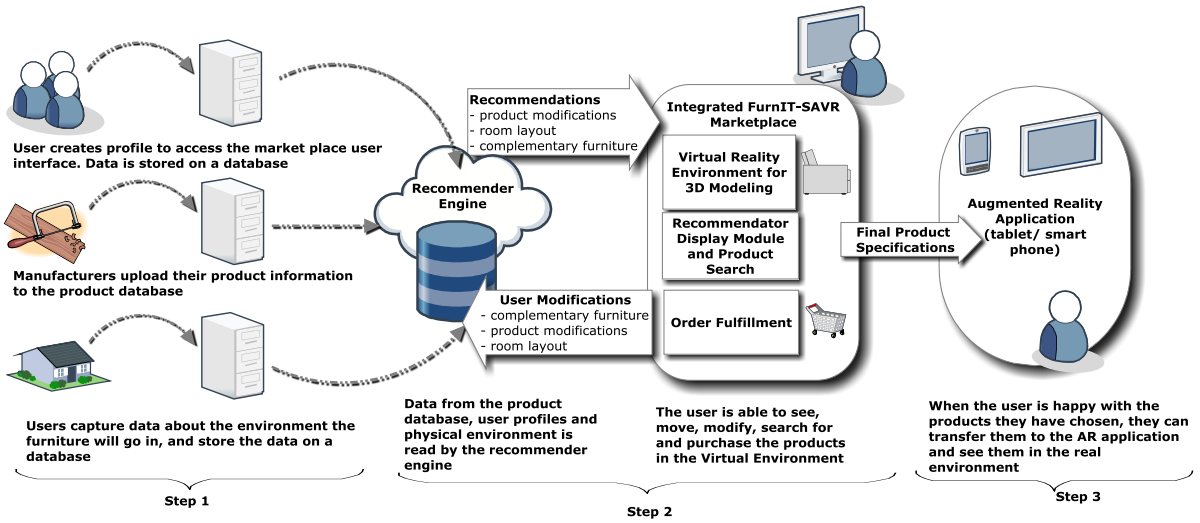


Figure 1 FurnIT-SAVER process

4 FurnIT-SAVER modules decomposition

The FurnIT-SAVER platform is composed by a Front-end providing the user interfaces to log in, visualize and register data into the platform, and a Back-end which is responsible to store and provide access to the needed data by the web services of the defined functionalities and

provides recommendations based on the acquired knowledge about the user preferences providing access to the recommender functionalities and managing the access to the existing data bases. Furthermore, a set of restful interfaces are defined to enable the following defined functionalities in D1.1.

Requirements covered by this module	
FUN-PUR-REG-001	FUN-PUR-REG-004
FUN-PUR-REG-002	FUN-MAN-REG-001
FUN-PUR-REG-003	FUN-MAN-REG-002

The following figure describes the architecture of FurnIT-SAVER platform. The Front-end modules is coloured in blue and the Back-end components and interfaces, in green.

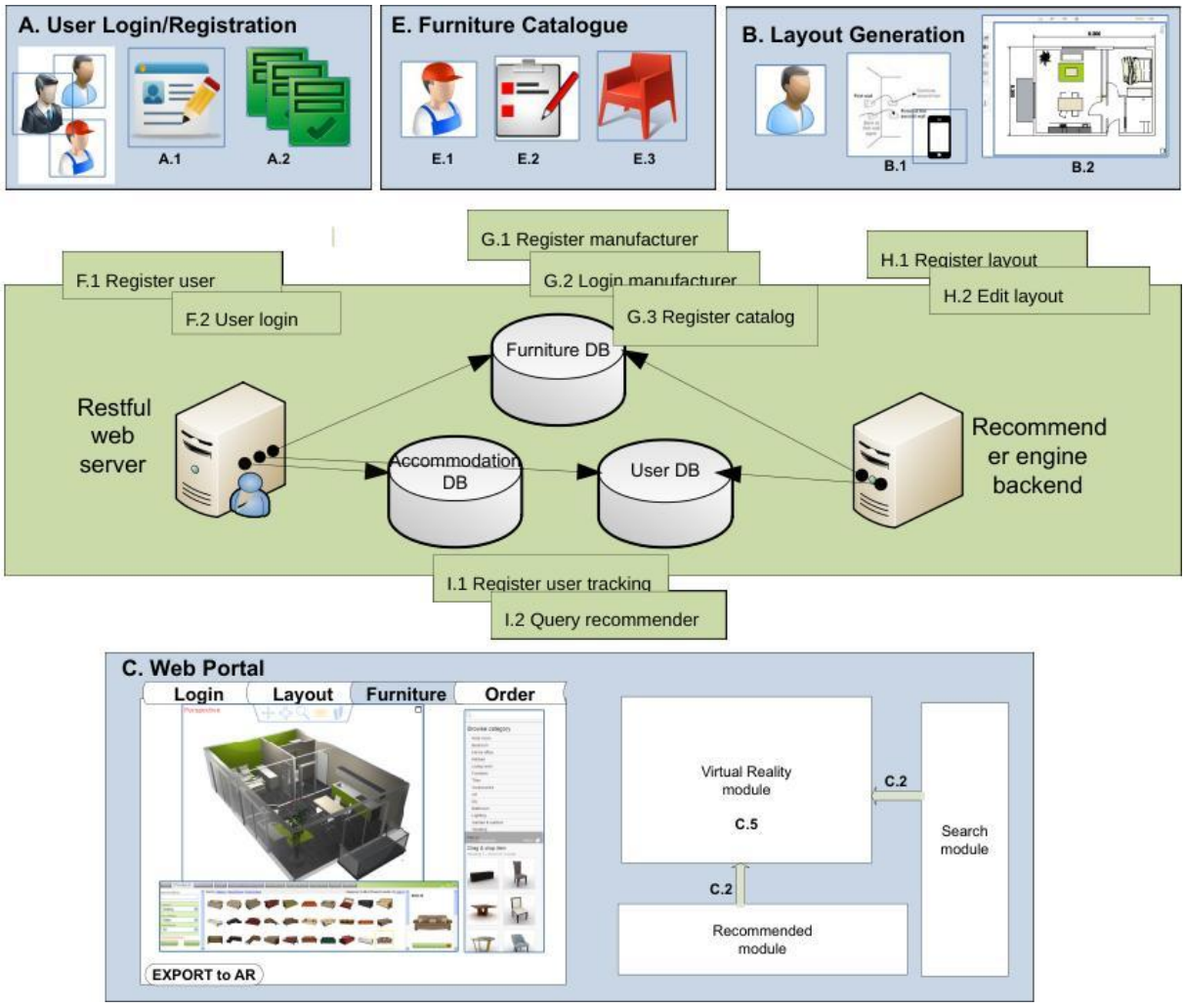


Figure 2 FurnIT-SAVER architecture and draft composition

The following sections describe the main functionalities and tools included in each module. The Deliverable D2.2 complements this document with an in-depth technical description of the defined module.

Application structure model

The following figures define the expected application workflow covered by this module with respect to the registration of the different type of users.

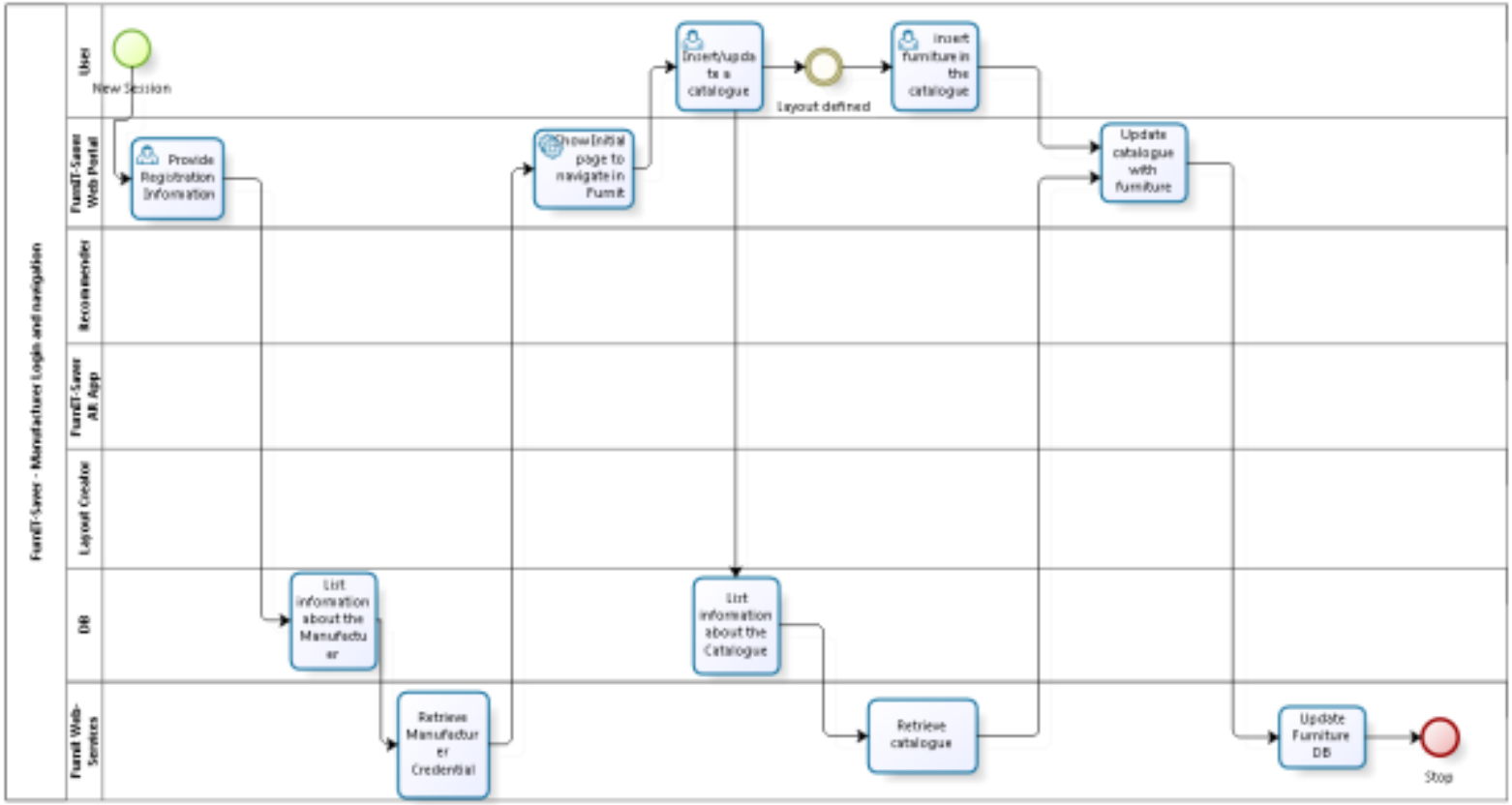


Figure 3 User log in and navigation workflow

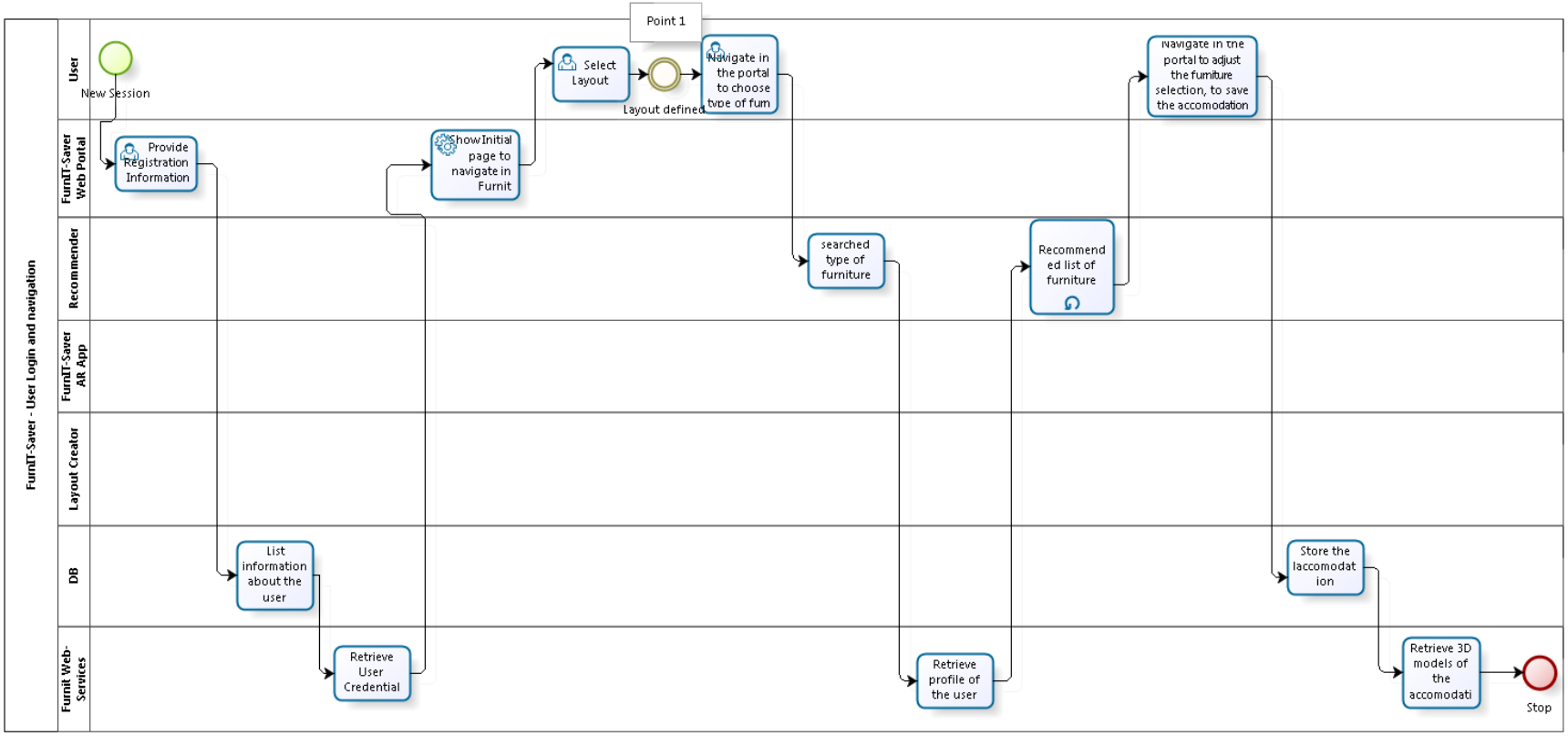


Figure 4 Manufacturer log in and navigation workflow

4.1 User registration and profiling

The user registration and profiling module allows users to create and modify their user profile as well as to gather basic users' preferences during the registration process. The user will register and log in by introducing name, surname, email and password (only the two latest when log in) or alternatively using their most common applications accounts such as gmail, facebook or twitter.

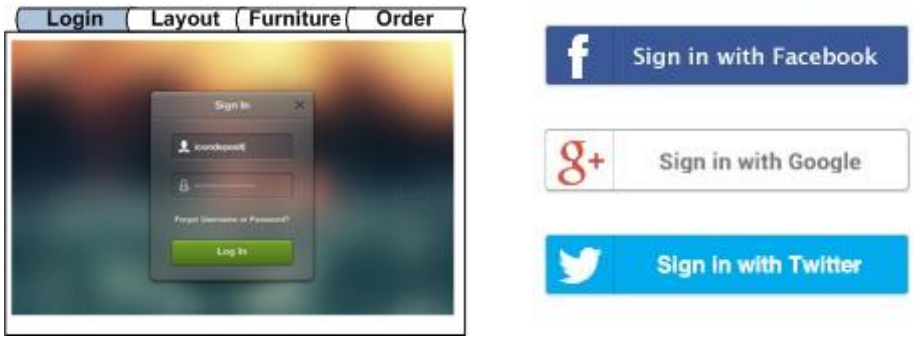


Figure 5 User Registration and Login Interface

The information gathered will be securely stored in the Users Database (see Section 5). The types of users that will be able to register according to the application scenarios defined in D1.2 are:

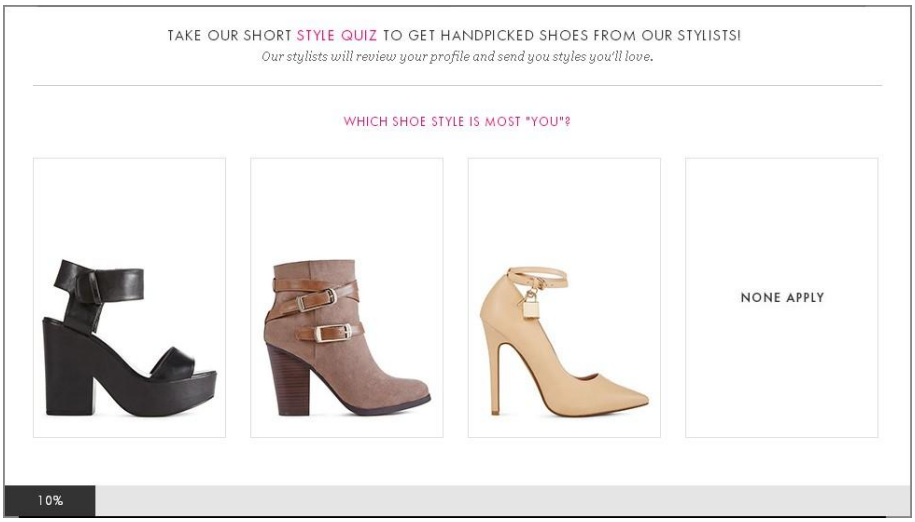
- *Domestic user*: These users, also called *buyers*, aim at using FurnIT-SAVER platform to create personal accommodations composed by a configuration of furniture pieces and decoration accessories to be acquired for personal use.
- *Professional user*: This type of user includes designers, architects, furniture salespersons or other professional from the furniture sector offering furnishing related services. These are users with specific skills to suggest, promote or sell furniture and will typically advice and support domestic users or contract channel customers.
- *Manufacturer user*: This type of users populates the furniture catalogue with their products in order to sell them through or thanks to the FurnIT-SAVER platform.

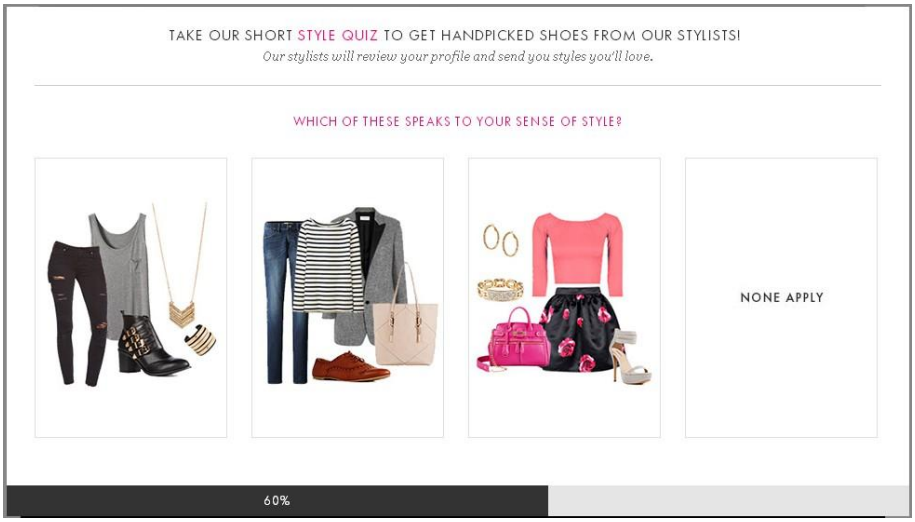
The information gathered from domestic and professional users is of two types: personal information and profiling information or *preferences*. The first one includes name, surname, age, email and other personal data. While basic information will be gathered during registration, other personal data may be introduced by the user upon suggestion during the usage of the platform. The second type of information will aim at building a style and preferences-based profile of the user. Part of this information such as type of room and style will be gathered after registered or log in, whereas other information will be inferred by the usage of the platform, that is, selected furniture, chosen colours and materials, preferred

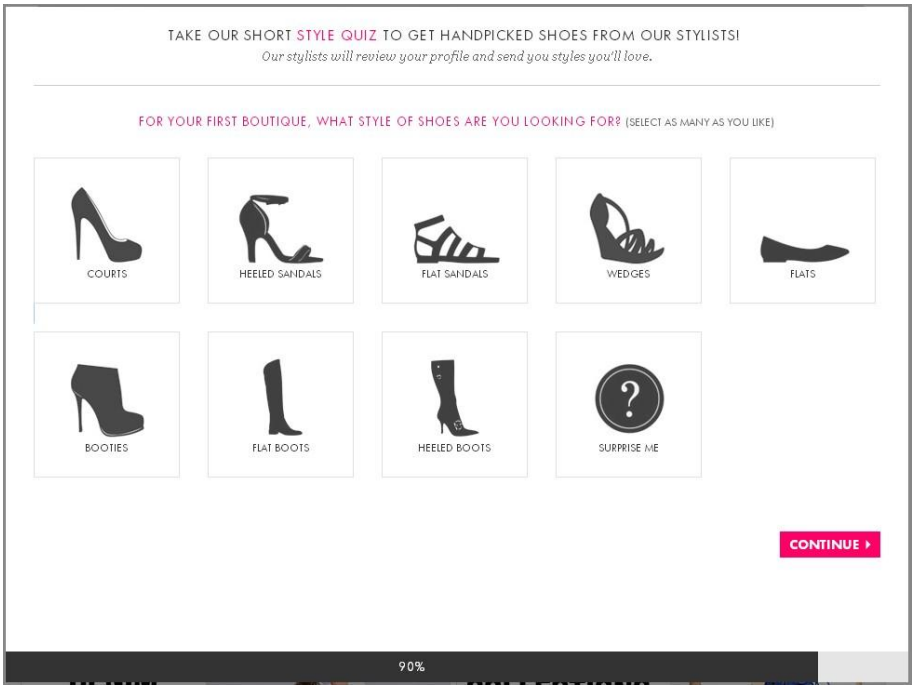
manufacturers, etc. although it may also be requested at some point according to specific commercial purposes.

On the other hand, information gathered by the manufacturers includes company information and furniture information. The first one includes company name, list of collections catalogue, business lines (contract channel, personal furniture, decoration accessories, etc.), and the second one includes the items to be registered on the catalogue and their attributes.

Special care will be taken when requesting personal information and preferences to the users. User-friendly and non-intruded strategies will be used so that users get easily familiar and do not feel interrogated by the process. The following is an example of the style quiz by Justfab.co.uk, a fashion products e-commerce, to gather users' preferences and data:







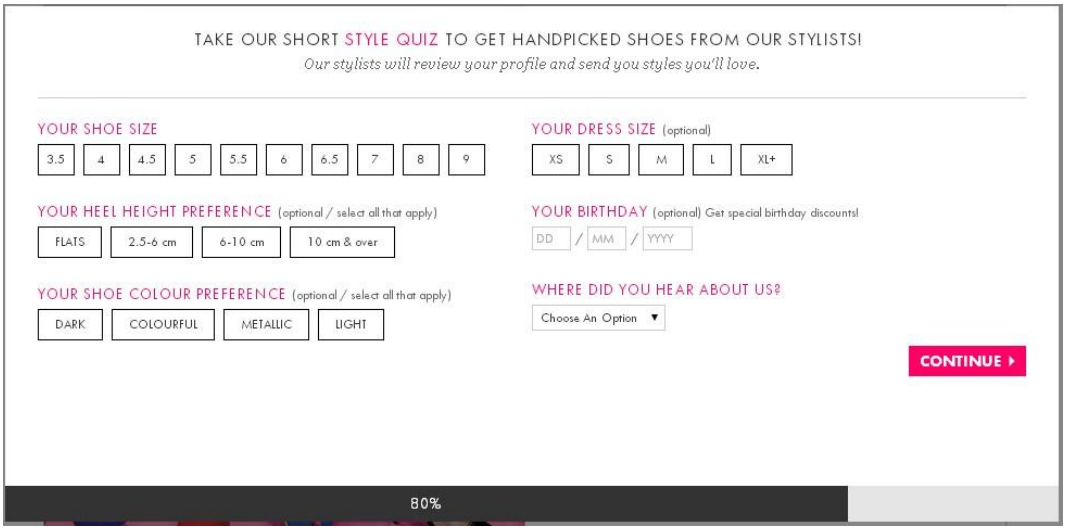


Figure 6 Screenshots of Justfab.co.uk style quiz as example

4.2 Layout Generation

The functionalities included in this module aim at providing the user with the necessary tools to obtain and reproduce the layout of the targeted space. The user will be able to generate the layout using three different mechanisms:

- *A room scan mobile application*: using this option the user will be able to scan the perimeter of the real room. This tool will be based on existing applications (see examples in Figure **7**) integrated into the platform.
- 2D Drawing tool: this option will be similar but a simplified version of existing home planners (see examples in Figure **7**) that will allow the user to define a room layout,

edit the dimensions of the perimeter and insert existing items such as doors or windows (the possibility to insert existing furniture is under technical discussion).

- Default layouts (e.g. square, T or L shaped): the user will be offered the option to choose among 2/3 simplified default layouts that may be edited with the exact measures.

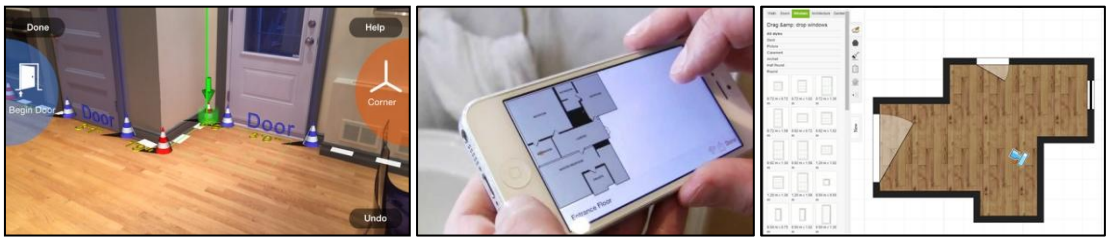


Figure 7 Examples of layout generation mobile and web-based applications: (1) MagicPlan app by Sensopia Inc. (2) Roomscan app by Locometric (2) Home planner by Roomsketcher

This module cover the following corresponding requirements as defined in D1.1:

Requirements covered by this module
FUN-PUR-LAY-001
FUN-PUR-LAY-002
FUN-PUR-LAY-003

The expected **application structure model** is defined according to the following workflow.

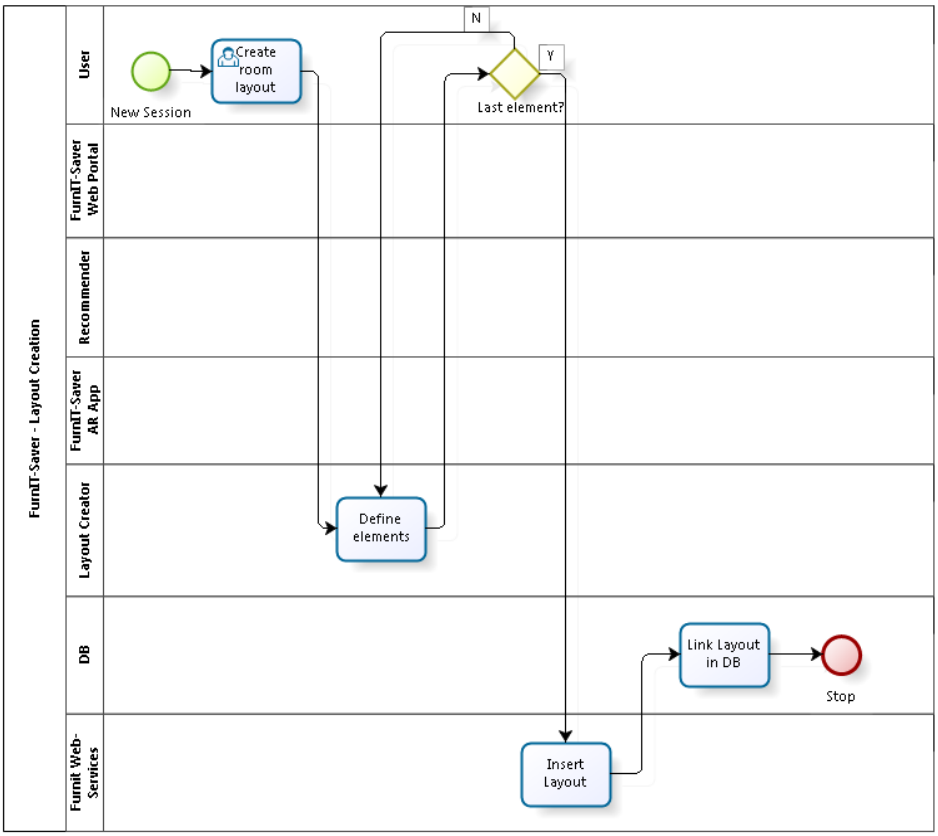


Figure 8 Layout generation workflow

4.3 Furniture Catalogue management module

This module will be accessible to registered manufacturers and will allow them to create collections and insert new furniture pieces for every collection. The module will offer a user interface similar to the figure below where the manufacturers will have to upload the furniture file (2D and 3D formats should be supported, e.g. 3ds, dwg...) and texture files (png, jpeg, etc. formats should be supported) and fill the defined attributes such as material, colour, collection, price, season, style, etc.

Figure 9 Graphical mock up of the Furniture catalogue management interface

The functionalities of this module should meet the following requirements defined in D1.1:

Requirements covered by this module
FUN-MAN-UPL-001
FUN-MAN-UPL-002
FUN-MEN-UPL-003

The application structure of this model is defined as part of the manufacturers log in in Figure 4.

4.4 Configuration of furniture and recommendation module

The main FurnIT-SAVER platform user interface is a web-based interface providing access to the virtual reality environment, to the furniture catalogue and to the recommender system. The design overview of this interface is as showed in Figure 10. The information handled by the system is exchanged between the web-interface and the databases using a set of storage services provided to access the Databases (restful web services).

It is considered the possibility to integrate a Context Management System (e.g. Joomla) to allow publishing, editing and modifying content, organizing, deleting as well as maintenance from a central interface.

Figure 10 Graphical sketch representing the frames of the main platform user interfaces

The user will be able to insert and remove furniture pieces and accessories from the 3D room layout as many times as desired by accessing to the furniture catalogue (right side frame of figure hereunder) or by including the furniture items recommended (bottom frame in figure below).

Figure 11 Graphical mock up of the main FurnIT-SAVER platform user interface

The functionalities related to the configuration of the furniture pieces in the layout are provided by the virtual reality environment according to the following requirements defined in D1.1 and following the application structure model of Figure 12:

Requirements covered by this module	
FUN-PUR-VRE-001	FUN-PUR-VRE-006
FUN-PUR-VRE-002	FUN-PUR-VRE-007
FUN-PUR-VRE-003	FUN-PUR-VRE-008
FUN-PUR-VRE-004	FUN-PUR-ORD-001
FUN-PUR-VRE-005	FUN-MAN-ORD-001

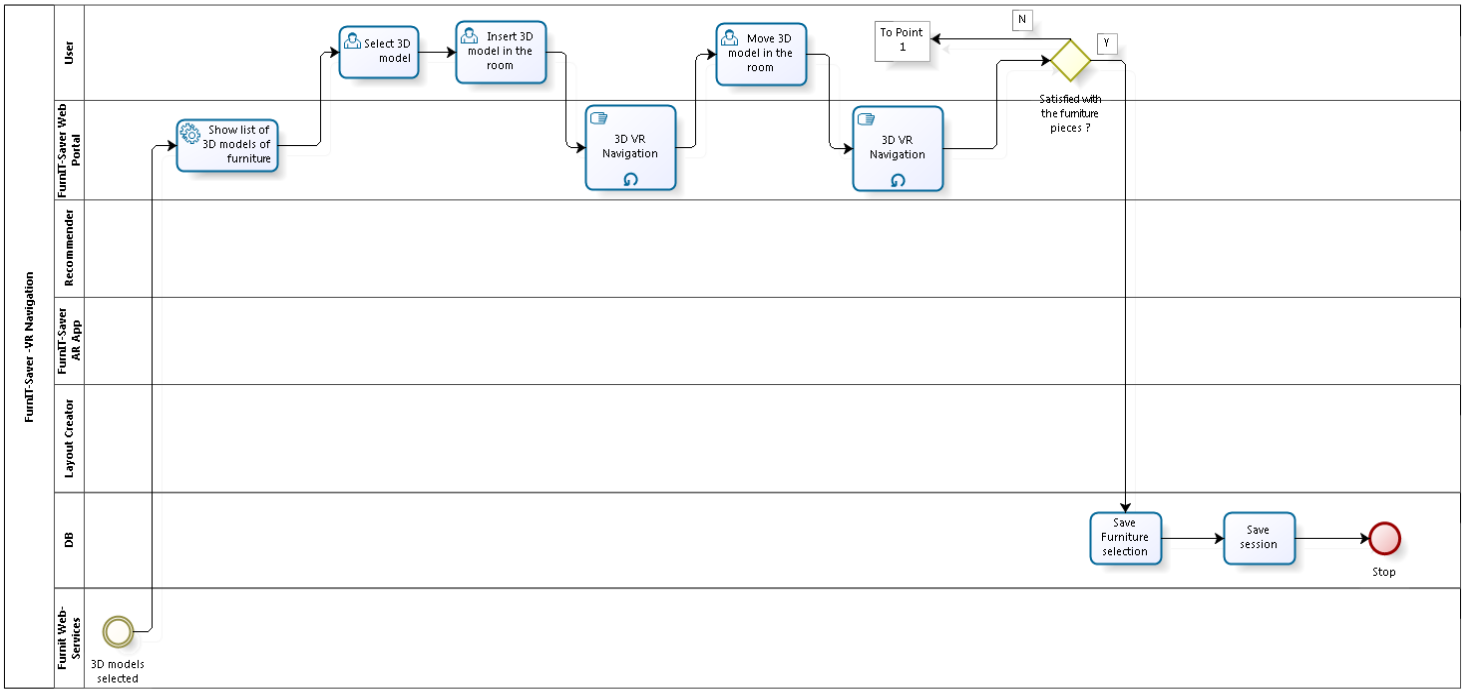


Figure 12 Virtual Reality environment workflow for the configuration of furniture pieces in the layout

4.4.1 Recommendation system

The recommendations will be offered for similar or complementary/supplementary products. The recommendations will be obtained by combining different parameters that provide information of the user preferences. On the one hand, the user will introduce some parameters during the registration phase such as type of room and preferred style. Additionally, the user could be offered the possibility to introduce new parameters such as the civil status, number of children, budget limitation or range and others during the usage of the platform in order to provide more accurate recommendations. On the other hand, a tracking system will be implemented as part of this module to monitor user actions within the platform in order to infer his/her preferences such as most frequent selected materials and colours, previously similar selected furniture, etc.

The functionalities provided by the recommender should meet the following requirements defined in D1.1:

Requirements covered by this module
FUN-PUR-REC-001
FUN-PUR-REC-002
FUN-RET-REC-001
FUN-RET-REC-002

4.5 Augmented Reality

The user will be able to save different configurations and export them to the Augmented Reality App. In order to do that the platform will suggest the location of several physical markers (depending on the size of the room) so that the user can easily visualize the 3D model of the furniture in the room.

Then, the user will have to print these markers and place them according to the guidelines provided by the platform (see an illustrative example on the figure below).

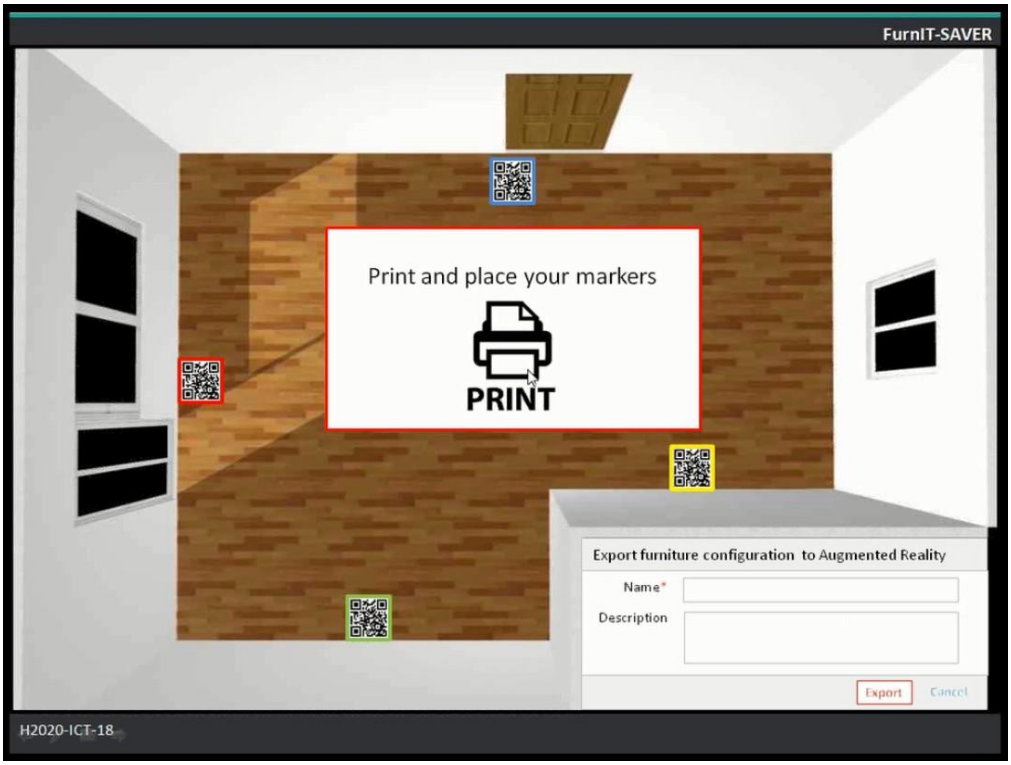


Figure 13 Graphical mock up of the user interface suggesting the location of the AR markers

The configuration or configurations will then be exported to the Augmented Reality module which means that they will be accessible through the AR application. The user will have to download the app and log in, after which he/she will be able to select a room and a configuration in the user area. The furniture will be then represented in the user's mobile phone

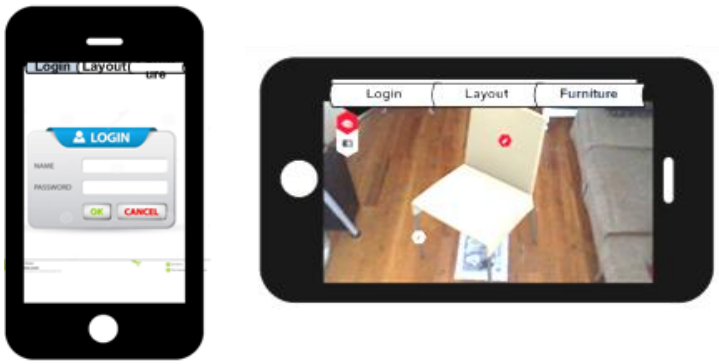


Figure 14 Graphical mock up of an augmented reality application applied to the furniture sector

This module should provide the necessary functionalities to cover the following requirements defined in D1.1 according to the expected application structure model of Figure 12:

Requirements covered by this module	
FUN-PUR-ARE-001	FUN-PUR-ARE-004
FUN-PUR-ARE-002	FUN-PUR-ARE-005
FUN-PUR-ARE-003	FUN-PUR-ARE-006

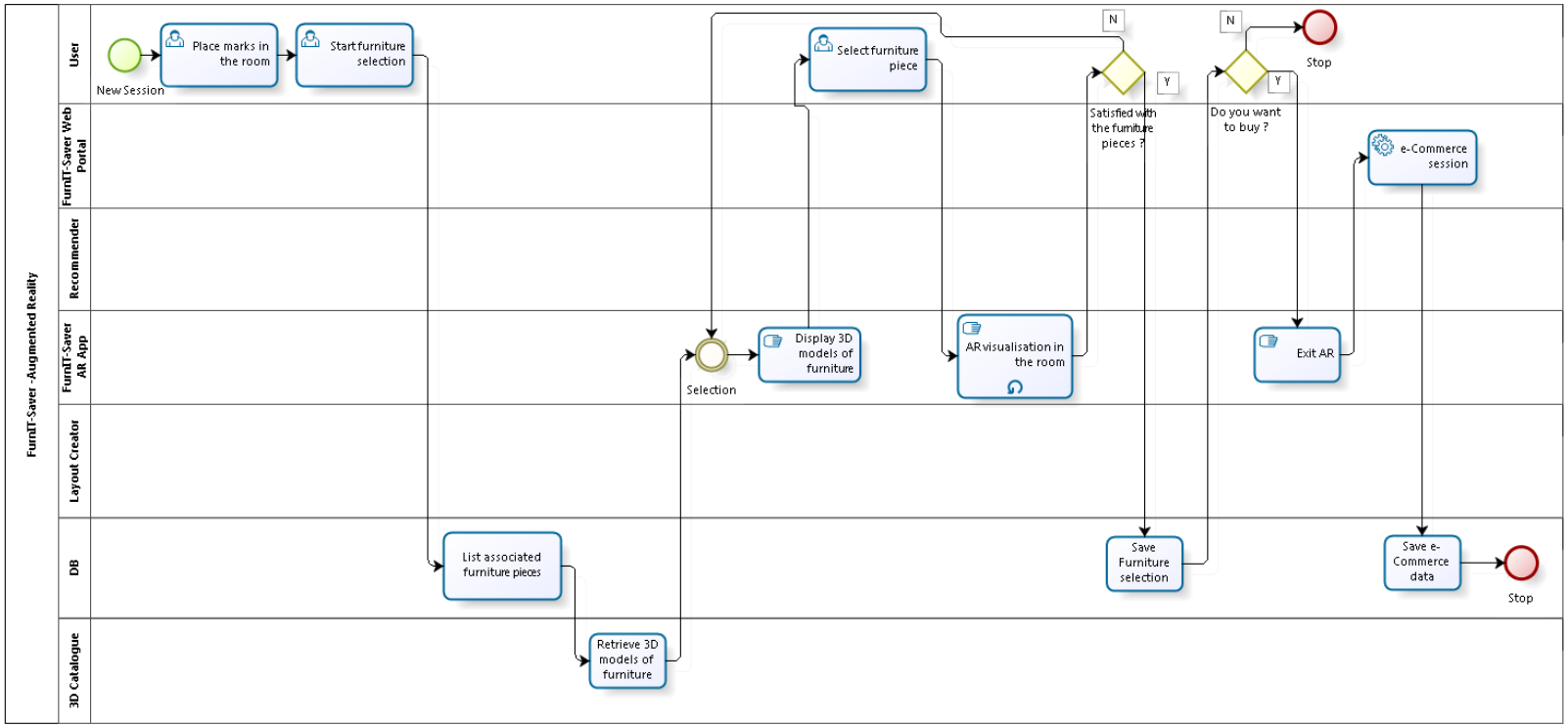


Figure 15 Graphical mock up of an augmented reality application applied to the furniture sector

5 Databases

The following figure describes the main structural data, attributes and relations that form the FurnIT-SAVER platform. This structure is likely to suffer modifications until the final implementation is reached. The definitive data structure will be included in D3.1. Three logical areas of data sets have been defined: user data, accommodation data and furniture data as described in the figure.

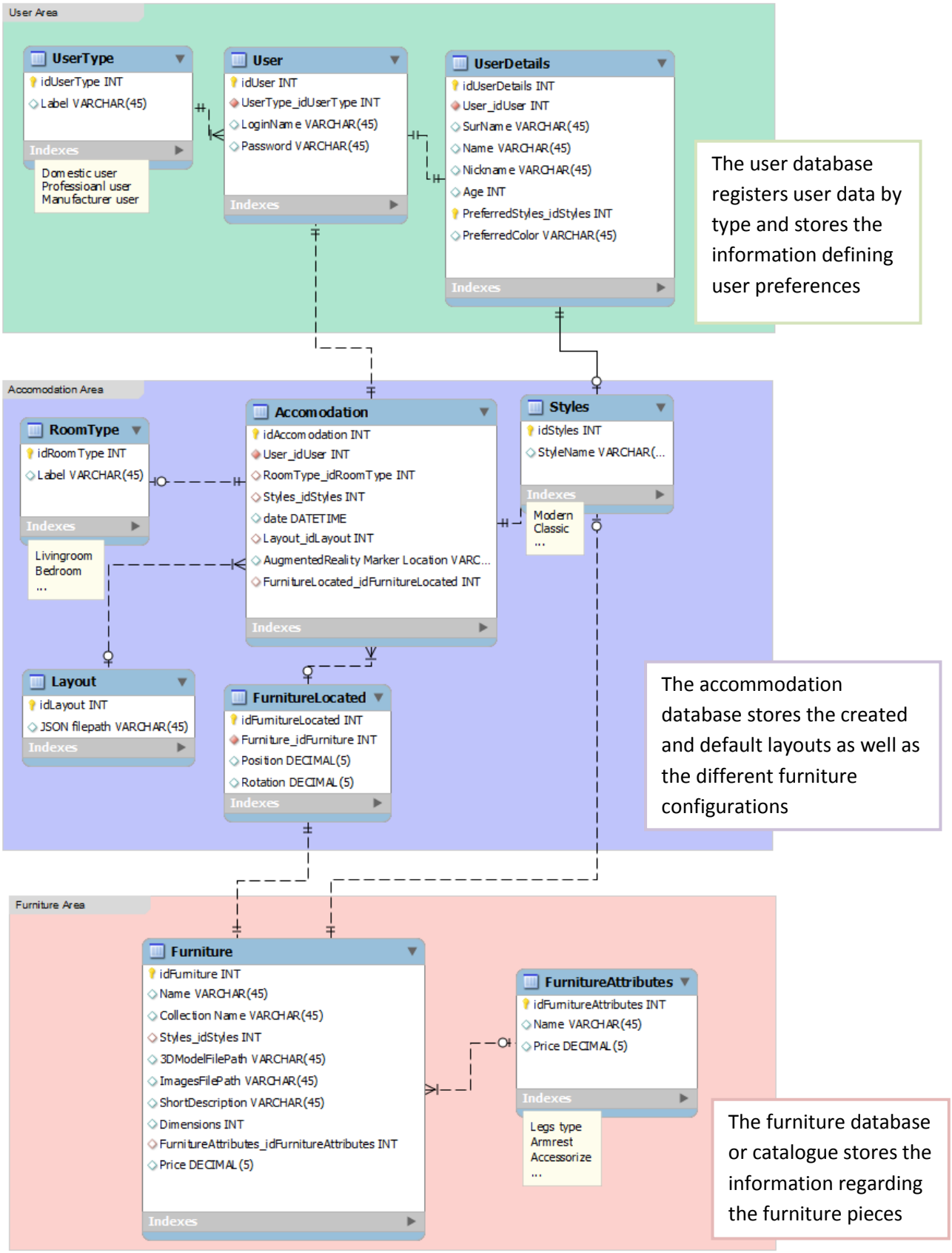


Figure 16 Database schema