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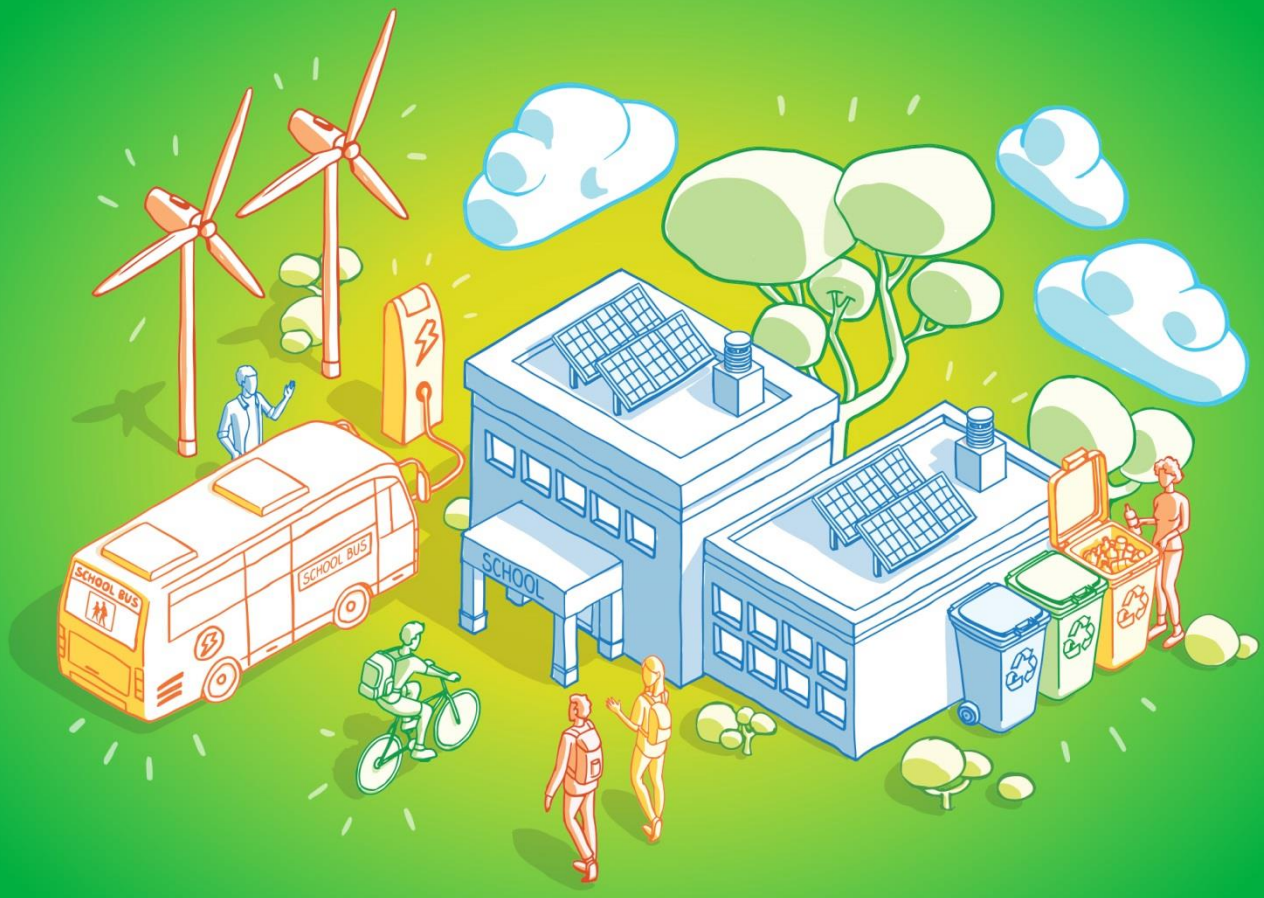

CLIMACT - ACTING FOR THE TRANSITION TO A LOW CARBON ECONOMY IN SCHOOLS – DEVELOPMENT OF SUPPORT TOOLS

ClimACT Decision Support Tool Operational Platform Structure

October 2016

WWW.CLIMACT.NET

Executive Summary

This is an internal document of the ClimACT project, which defines the requirements structure of the modules that will be integrated into the Operational Platform (OP). This document is delivered in the context of WP2 – Development of tools to support the transition to a low-carbon economy in schools. One of the objectives of WP2 is to develop an integrated tool able to support decision-making with respect to the transition to a Low Carbon Economy (LCE) in schools. This tool will incorporate 5 modules that will be developed in the framework of Actions 2.2-2.6 while providing a user-friendly interface suitable for schools managers and other stakeholders.

The present documentation will explain the OP structure to all ClimACT project beneficiaries, stakeholders and External Advisory Board members in order to receive feedback. Therefore, the Architecture and Flux Diagram of the Decision Support Tool (DST) were described, and properly explained.

1 Introduction

1.1 Introduction

The Operational Platform (OP) Structure document is produced in the context of WP2 and defines the structure of the modules that will be integrated into the Operational Platform.

The objective of WP2 is to develop an integrated tool able to support decision-making with respect to the transition to a Low Carbon Economy (LCE) in schools. This tool will incorporate 5 modules that will be developed in the framework of Actions 2.2-2.6 while providing a user-friendly interface suitable for schools managers and other stakeholders.

The OP Structure document aims to crystallize the information gathered from project members necessary to define the guidelines to the OP development. This document stands as a starting point and is intended to be a solid basis for the development process. Note that, this is not a closed document, the present structure can evolve according to the challenges found along the working path.

The present documentation will explain the OP structure to all ClimACT project beneficiaries, stakeholders and advisory board members in order to receive feedback. Therefore, the Architecture and Flux Diagram of the Decision Support Tool (DST) were described, and properly explained.

This document will be available to the project members on the ClimACT storage platform (provided by IST) in the relevant folder, and will be updated iteratively throughout the entire duration of the project.

2 Decision Support Tool - DST

2.1 Information Flow

The DST is a tool that incorporates 5 modules:

- Core Module;
- *Key Performance Indicator* (KPI) Generator;
- Building Scenario (BS);
- Life Cycle Assessment (LCA);
- Cost-Benefit Assessment (CBA).

Figure 1 presents a simplified scheme of the tool information flow. Firstly, the database is fed with information acquired from the users (through questionnaires, feedbacks, direct insertion in the database, others) and buildings (measurements of indoor parameters - meters and sensors - and others). Then, when requested, this information is processed by the different modules (KPI, BS, LCA and CBA) and displayed to the user through the DST interface or to any other module via the API.

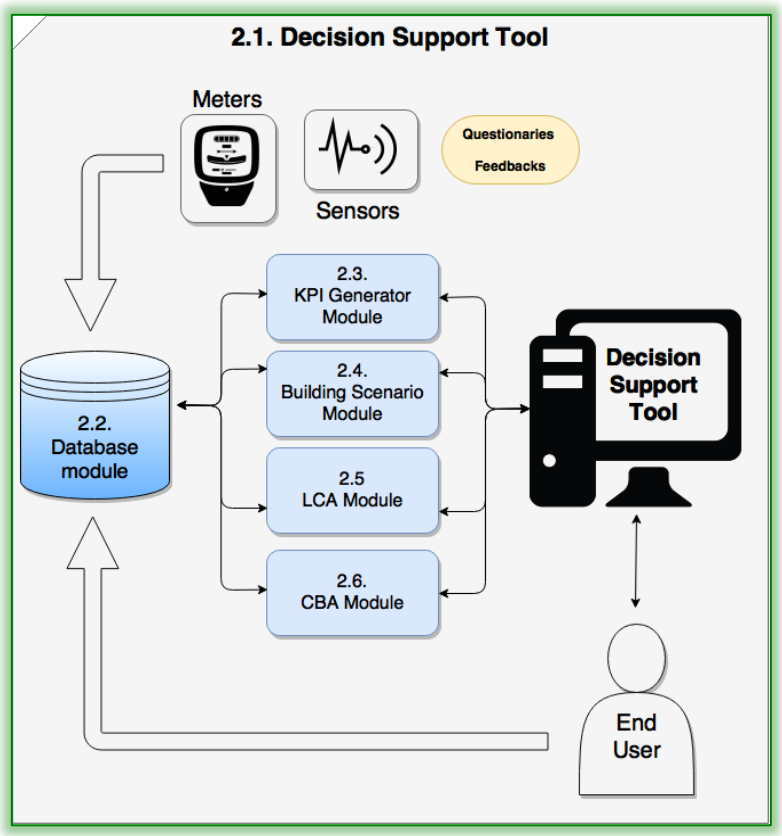

Figure 1 - DST Simplified Scheme

Each project beneficiary will contribute for the tool with his expertise; therefore, the modules will have different coordinators depending on their experience (table 1).

Table 1 - Modules coordinators

Module	Developers	Action Coordinator	Deadline
Main Database	EDIGREEN (EDGR)	EDGR	31/12/2016
KPI Generator	EDGR	EDGR	28/02/2017
BS	USE EDGR	EDGR	31/03/2017
LCA	CIEMAT ISQ	CIEMAT	31/03/2017
CBA	CIEMAT ISQ	CIEMAT	30/04/2017
Core Module	EDGR	EDGR	31/05/2017

Table 2 resumes all the work involved and clearly identifies the role of each partner in the tool development.

Table 2 - Work resume

	Main DB	Auth	KPI	BS	LCA	CBA
Develop Database	EDGR	NA	EDGR	EDGR	EDGR	EDGR
Identify Necessary Input Variables	All	NA	EDGR	EDGR USE	CIEMA ISQ	CIEMA ISQ
Develop Data Access Layer	EDGR	NA	EDGR	EDGR	EDGR	EDGR
Develop the algorithm [a]	EDGR	EDGR	EDGR	EDGR USE	CIEMAT ISQ	CIEMA ISQ
Implement the algorithm	EDGR	EDGR	EDGR	EDGR	EDGR	EDGR
Develop the API	EDGR	EDGR	EDGR	EDGR	EDGR	EDGR
Develop the front-end	EDGR	EDGR	EDGR	EDGR	EDGR	EDGR

[a] The assessment models for each sector will be required from all sector leaders and participants to develop the algorithms.
Label: All – CIEMAT, ISQ, Edigreen and USE; NA - Not applicable

The sector leader and participants of each environmental sector (table 3 - energy, water, waste, IAQ, transport, green spaces and green procurement) are responsible to define the assessment models for each proposed variable. It will be used and implemented in the Main Module, KPI Module and Building Scenario Module. It would allow determining the best low-carbon energy solutions to improve the environmental performance of schools.

Table 3 - Sector leader and participants

Sector	Leader	Participants
Energy	ISQ	EDGR, USE
Water	ISQ	IST
Waste	ISQ	IST

Sector	Leader	Participants
Mobility	IST	UniGib
IAQ	ULR	IST
Green Space	IST	VLR
Green Procurement	IST	UniGib

3 Architecture Diagram

The architecture diagram (figure 2) of the DST is divided into 5 different modules (that will be presented in section 2.2), each one is structured in 6 different layers, namely:

1. **Application Layer** - Cross-browser compatible user interface written in *HTML5*, *CSS3* and *Javascript*;

2. **API Layer** - RESTful API's all directly communicating with the Core API to get the main information related to buildings (energy, water, waste, CO_2, transport, IAQ, number of students and school staff, other relevant information). All the modules will make authentication requests to the Authentication API. The API's should respond to *http* requests with JSON formatted data. CBA and LCA modules will analyse either real building data and scenarios built with BS Module;

3. **Business Logic Layer** - Layer containing all relevant business logic and operations relative to the modules. Also contains the authentication module, responsible to transform a password and username into an access token, and the authorization module, responsible to filter user access to information according to his privileges;

4. **Data Access Layer** - Server-side modules that communicate with the corresponding database, linking it to the logic layer;

5. **Data Layer** - Databases containing information relative to the respective module. The data consistency of secondary databases can only be assured through communication with the main database;

6. **Physical Layer** - Sensors and meters connected to an active gateway that periodically sends information to the main database through the Core API. The information should be sent via *http* or *ftp* protocols.

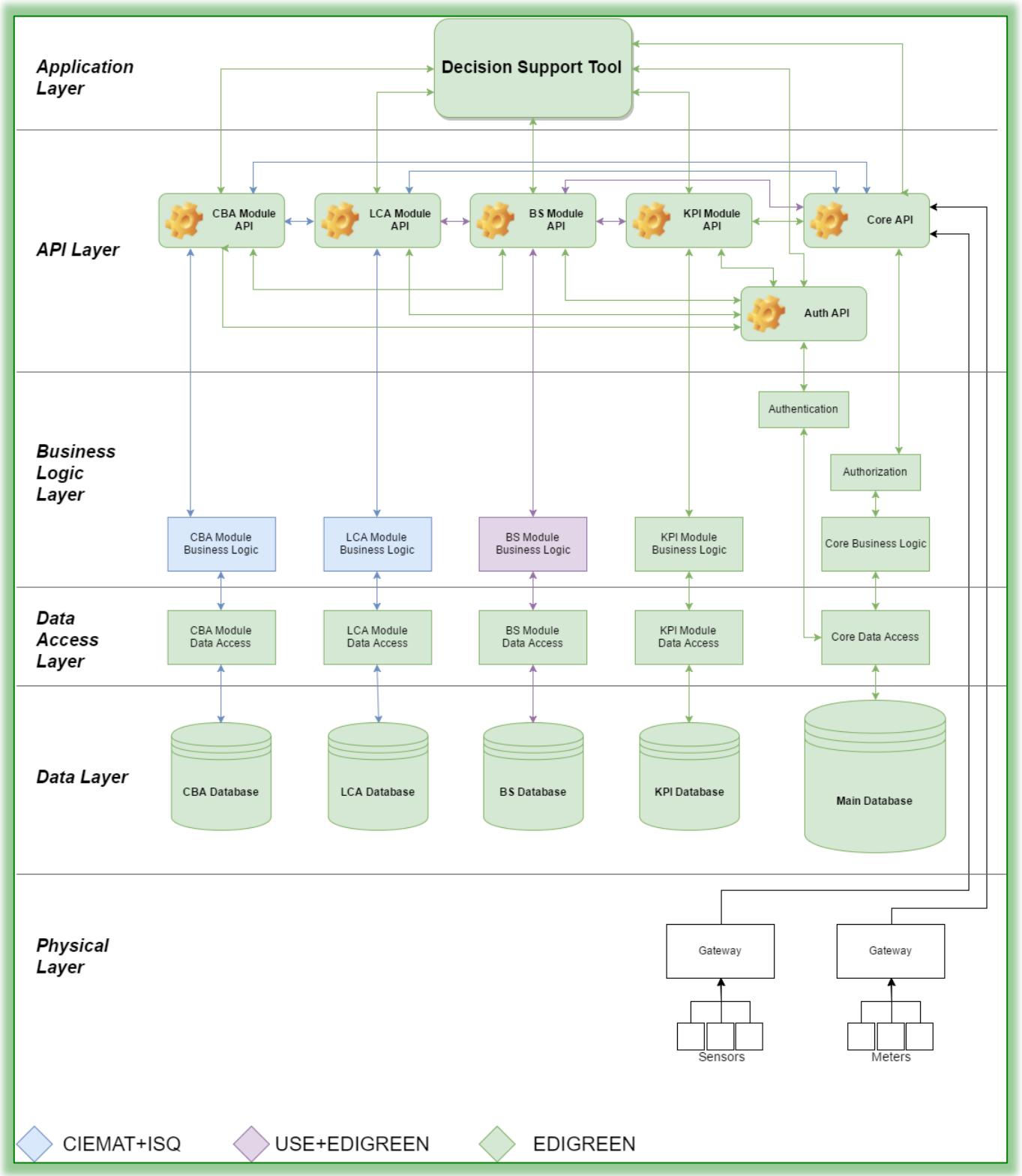

Figure 2 - DST Architecture Diagram

3.1 Decision Support Tool User Interface – DST UI

The DST User Interface will enable the end-users to communicate with the tool via a user-friendly web interface and will be developed by EDIGREEN. Through this interface the user can add/change information in the Main Database, follow the school benchmark as well as assess the progress and success of the measures implementation over time. The user is also allowed to evaluate both school or previously created scenarios Cost-Benefit and Life Cycle Impact.

This information will be presented in a graphical and intuitive way, focusing on the user needs and suiting their technical knowledge.

3.2 Modules

3.2.1 Core Module

The Core Module (figure 3) contains the Main Database as well as all authentication and authorization features.

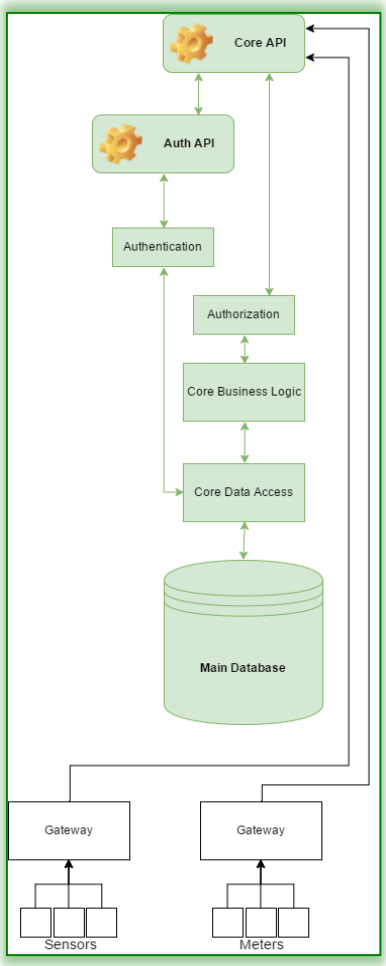

Figure 3- Database Module Scheme

The Main Database contains all the information related to the buildings. The data acquisition is done through administrative sources, such as governments and other organisations, surveying (e.g. online questionnaires) and measurements.

The stored information, after processed, is the answer to the 2W2H questions:

WHAT?							
energy	water	waste	IAQ	transport	mobility	carbon footprint	others

HOW?					
lighting	cooling	heating	cooking	school activities	others

WHEN?					
morning	weekends	holidays	night	monday	others

HOW MUCH?				
€	CO_2	costs	savings	others

Note that some of the answers can only be known after the completion of the Decision Support Tool (i.e. the tool working with all five modules).

All the information is processed by the *Core API*, which works as a bridge between the modules and treated by the *Core Business Logic*. The *Authentication API* serves as an endpoint to make login requests. The *Authorization* sub-module is responsible to associate each user to the information he is allowed to access.

All the layers will be developed by EDIGREEN with the project member contributions, in order to define the database information.

3.2.2 KPI Module

The *KPI Module API* (figure 4) will communicate with the in order to get the information needed to determine the KPI's (previously established – E2.3.1). The information from the main database (e.g. number of student, amount of consumed water – m^3, others) is requested to the Core API and processed by the Business Logic before being displayed to the user (e.g. m3/student).

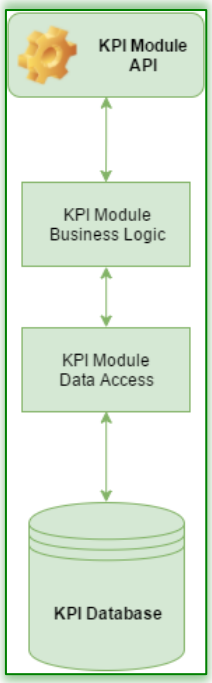

Figure 4 - KPI Module Scheme

This database will contain the KPI associated with each school, as well as each building scenario.

All the layers in this module will be developed by Edigreen.

3.2.3 Building Scenario Module

As the previous module, the Building Scenario Module API (figure 5) will communicate with the Core API to obtain the building information. This information and the data stored in the BS Database will be processed by the Business Logic Layer and returned to the user.

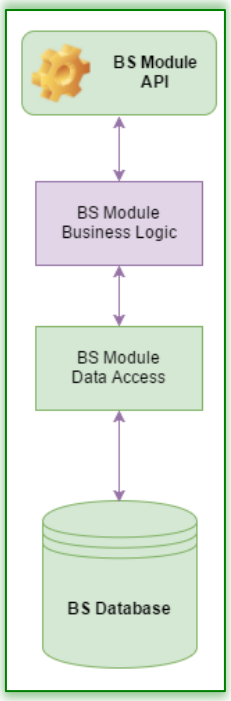

Figure 5 - BS Module Scheme

With the gathered information from de Main Database, the user can define new building scenarios through the DST interface. The scenario impact and costs will be assessed through the LCA and CBA modules, as well as new KPI's will be determined for the created scenarios.

This module results from a joint effort between EDIGREEN and USE. USE and EDIGREEN will work together to build the algorithm integrated in the Business Logic Layer. EDIGREEN will raise the module around the algorithm, being responsible for all the software development.

3.2.4 CBA and LCA Module

The CBA and LCA Modules (figure 6) are coordinated by CIEMAT with ISQ strong collaboration. EDIGREEN will contribute in the software development of the Data Access, Business Logic and API Modules.

As the other modules, the API Layer will connect with the Core and BS Module API in order to exchange information. All data will be processed by the Business Logic Layer, and it will be saved in the related database.

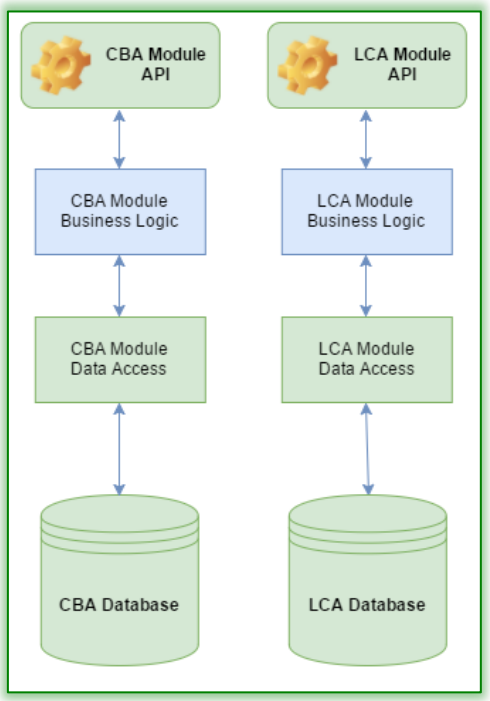

Figure 6 - CBA and LCA Module Scheme

4 Future Work

In order to organize the future work, two more documents will be created:

- **Software Architecture Document** – that will include the use cases, logical and physical diagrams and establish the detailed schema of the OP as well as the data structure to be used.
- **Software Requirement Specification** – taking the use cases in the previous document as a base, defines all the functional and non-functional requirements. This document will be used further ahead to build a product backlog and develop test sets and quality standards.

It is important to reaffirm that this document can be changed during the next phases if needed and agreed by all stakeholders.