Deliverable 4.3 Report:
Functional design of selected tools facilitating the generic EPI-CREM approach

Energy Performance Integration in Corporate Public Real Estate Management

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1.Introduction

The EPI-CREM method aims to improve energy efficiency in corporate real estate management by integrally connecting energy performance to other building management aspects, like maintenance and fire safety. Inspection results from multiple inspections like maintenance, installation, fire safety and energy are made integrally available for decisions with regard to real estate management. Based on the information from inspection results and additional building information, energy efficiency can be embedded in the decision making proces within real estate management. Since energy efficiency measures can often best be linked to maintenance measures/plans (where logical and possible), maintenance information is often necessary as a basis to be able to embed energy efficiency in decision making within corporate real estate management.

In the development of the EPI-CREM method and software tool the available detailed information and advanced inspection method in the Netherlands is used as an 'ideal basis' and starting point for EPI-CREM, since more detailed information ideally leads to qualitative better outcomes and recommendations. However, since this level of detail (on element level) is not always available the method will also be able to work with less detailed building information.
In practice this means that all relevant available building information (detailed and less detailed) is to be stored in the Database Integrated Information System and should be a basis for developing scenario's on more or less detailed level in the Scenario Analyse Module.

This report describes the functional specifications for design of the EPI-CREM tools that support the EPI-CREM approach. In chapter 2 the EPI-CREM tools are described, related to the available data to execute the method. In chapter 3 some detailed requirements for the EPI-CREM tools are elaborated on, after which in chapter 4 a description and visualisation of the EPI-CREM process and software is presented.

2. Selected facilitating tools

Different european countries have different regulations and building inspections (different inspection items and different inspection methods). This means that the available building information that is needed as input for the EPI-CREM method and software may vary between (and possibly even *within*) countries.
For example, in the Netherlands an advanced method for mainenance inspections (NEN 2767) is available and often used within large real estate organisations. This method provides extensive and detailed inspection results on building element level based on a Standard Element List.
In the EPI-CREM partner countries Austria and France no or less detailed information is available concerning mainetance inspections (on element level).
The EPI-CREM method is developed to be (in basic form) applicable in all European Member States, including new Member States. It is to be expected that detailed inspection information is not always available in all member states. This means that the EPI-CREM method must be able to work with both detailed information and with more basic information that is available.

To use the EPI-CREM approach several facilitating tools for generating or collecting data are necessary. A detailed description of the building is needed to evaluate its actual state. Normally a big amount of data and information of the building is available for example from inspection protocols and/or the energy performance certificate but these data are often not collected centrally and usually nobody really works with them within real estate management. So its important to have knowledge of available data and to relate them to specific parts of the building. In doing so it is possible to get an overview of existing data and their quality and also of missing data which are essential to get a detailed description of the actual state of the building.

A variety of resources exists (inspections protocols, etc.) which could facilitate the EPI-CREM approach, but big differences from member state to member state make it essential to create a basis for all countries which covers all topics of the EPI-CREM approach. The EPI-CREM approach provides in a number of tools and a training program to facilitate the method. The following tools will be described more detailed in this report:

1. The Data Acquisition and Quality Protocol
2. The Database Integrated Information System (software tool)
3. The Scenario Analyse Module (software tool)

Furthermore, some underlying available 'supporting tools' can be indicated to support the data acquisition. This tools are not part of the EPI-CREM method, but can be very useful if available.

Description of the EPI-CREM facilitating tools

1. Integrated Data Acquisition and Quality Protocol

With the data acquisition and quality protocol, developed within the EPI-CREM project, it should be possible to collect all data which are required for an energy technical analyse and evaluation of maintenance works and inspections. The data acquisition protocol meets two demands. On the one hand it is the basis for an energy technical analyse and on the other hand it fills the information gap of existing but not adequate or missing data which are needed for the EPI-CREM approach.
The data acquisition protocol has to cover all energy related scopes of operating a building. It contains information and data of the building envelope, the HVACR systems, hours of operation, maintenance information, inspections, applicable law, etc.
It is not intended to be a protocol for making energy audits for buildings but it has to contain a guideline for all information and data which are needed for the specific EPI-CREM software and it is consequently a part of the EPI-CREM approach.

Supporting tool: Energy Performance Certificate according to the EPBD
The energy performance certificate according to the directive of energy performance of buildings (EPBD) is not a specific EPI-CREM tool but contains a lot of relevant information about the building envelope e.g. the u-values, window areas, climate data, etc. and in an ideal case also relevant

information about the HVACR-systems. Because the contents of the energy performance certificates are very different in the member states it cannot be taken as a fully facilitating tool within the EPI-CREM project. But if it is available it can be a valuable support for data collection.

Supporting tool; Inspection Protocols
Any kind of inspection protocols, for example the EPA-NR inspection protocol[1], can be a good support for data collection. Though these inspections (protocols) are not part of the EPI-CREM approach, they can be used as a supporting tool. Protocols of different inspections can contain valuable information about HVACR systems within the building (e.g. emissions of boilers, used refrigerant, year of construction, efficiencies, COP, etc.), maintenance intervals and eventually existing defects. This kind of information is very valuable for the evaluation of the whole or parts of the building. But also in this context it is difficult to define in which kind of inspections those data are collected. Some inspections have to be done regularly because of maintenance reasons; some inspections are required by law. In the most member states there are no legal regulations or standards regarding the harmonisation of inspections for buildings.

2. Database Integrated Information System and Scenario Analyse Module (software)

The database integrated information system, developed within the EPI-CREM project, enables the collection of all generated data in one central database. The collected data and information are linked by an expert and used for an energy technical analyse of the building. In this vein energy saving measures can be deduced and a variety of scenarios can be worked out by an expert (advisor) which provide reconstruction plans, maintenance plans and valuable information for decision makers.

Within the EPI-CREM project two specific facilitating tools will be developed: the data acquisition protocol and the EPI-CREM software.

[1] EPA-NR (Energy Performance Assessment in Non-Residential buildings) is a method that has been developed to be able to assess the energy performance of non-residential buildings to be able to provide in an energy performance certificate, for more information see the website www.epa-nr.org.

3. Detailed requirements for facilitating tools

In this chapter some detailed requirements for the two facilitating tools that will be developed in the EPI-CREM project will be described.

Data acquisition and quality protocol

The data acquisition protocol has to contain the minimum information needed for the software. The minimum information needed is the information which is essential to generate the desired output of the software. The protocol should contain compulsory data (the data that is necessary as a minimum to execute the method) as mentioned above and optional data which can provide valuable additional information about the building. It should be a protocol to facilitate the use of the software and should not be an explanation how to make actual inspections and energy audits. Consequently the protocol is to be used by experts (advisors) who are already experienced with energy efficiency and maintenance matters of buildings. To guarantee a basic level of expertise the EPI-CREM project also provides in a training program.
For each required data of the protocol a short explanation (according to standards and regulations if available) is attached. In this vein a minimum level of data quality can be attained.
The protocol will also give advice to where this kind of data could be found (e.g. U-values of windows can be found in the energy performance certificate).
In the data acquisition protocol there is a difference between compulsory and optional data. Because compulsory data are essential to get an output of the software it is necessary to allocate a table with appropriate default-values for each data. This is also necessary in the context of comparability und application in different member states. Default-values can also vary from country to country, so an adaptation of the default-value table will be necessary in each member state. In the most cases default-value tables already exist for calculating energy performance certificates or the like.
The structure of the protocol is according to the input mask of the software, so that a simple data entry in the software is assured. The data acquisition protocol is designed as a help for software users but not for auditors or for inspections of buildings.

Database Integrated Information System and Scenario Analyse Module (software)

In this section some functional specifications for the EPI-CREM software are described.
The EPI-CREM software consists of two parts:

1. The Database Integrated Information System (to save all the assessment data and additional building information)
2. The Scenario Analyse Module (to facilitate negotiations between client and building owner and for integral planning of the energy saving measures in relation with other building modifications).

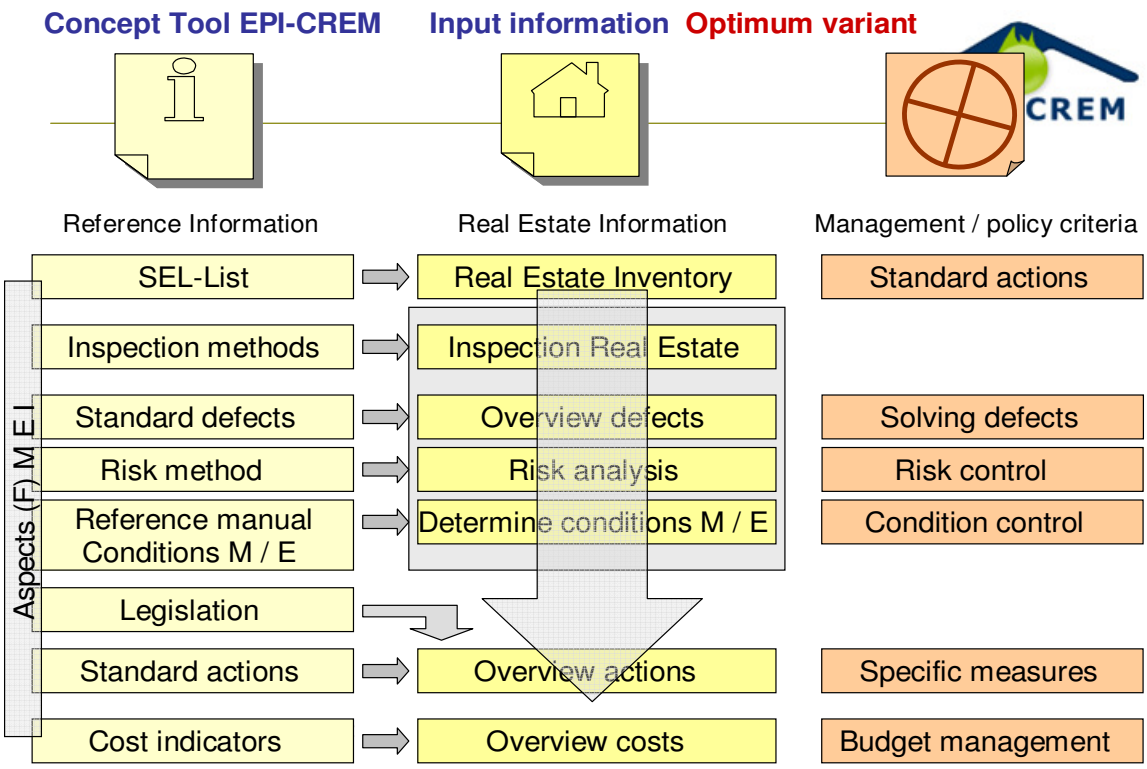
The functional specifications are a basic starting point for the development of the (software) tools and further specifications that become clear along the way can be added. For the development of the EPI-CREM tools input and feedback from relevant market parties is explicitly valued and integrated in the functional specifications for the tools. In order to accomplish this, a series of workshops with NFC members were held in which relevant input and feedback for the EPI-CREM approach and tools was generated.
The functional specifications are based on building construction theory, on the practical experience of building management and on experiences with the development of energy performance assessment software (from EPA-NR, among others). The functional specifications are related to content and form. There are specifications for the input of data in the software, and specifications for the output of the software which is to support management dicisions on different levels within real estate management.

Level of detail in the input for the EPI-CREM software
As indicated in Chapter 2, a lot of difference in the level of detail of available building information can occur between and within countries. Ideally information on the element level is available, which makes it possible to make detailed considearations. But when this is not the case, the EPI-CREM software

tool will provide an alternative, based on the information that is available and default values where necessary. Relevant building information, that may be easily available when detailed information on element level (from quality/condition measurement) is not available, is for example:

- Size of a building
- Age of a building (or specific installations)
- Basic renovation/maintenance information (maintenance schedule, executed major renovations)
- Energy use
- Technical failure information

In the scheme below the input and processing of the EPI-CREM software is visualized. Data collection on building level is executed by means of methods and standards, described in the left part (light yellow) of the scheme. Depending on the information level that is available, several sorts of data are collected as input information. This is visualized in the scheme by the dark yellow (center) part of the scheme. In the right (red) part of the scheme several management/policy criteria are mentioned, which can be used for building management purposes, depending on the availability of real estate information. When some part of the 'idealy' required information is not available, there can be some restrictions in the possibility of use in the management criteria.



Specific functional specifications
Based on the described form and function of the EPI-CREM tool (and the output of the workshop concerning the requested functional specifications from market parties) a number of specific functional specifications for the input and output of the software tool have been defined.

<u>Input specifications</u>
Functional specifications concerning the Database Integrated Information System:

- It should be possible to enter a 'standard planning year'

- The software should be able to work with different detailed levels of in input data
- The software should be able to work with different classification systems (not just the classification based on the Standard Elements List)
- It may be useful when the software can generate information form different software packages ('data plug-in')
- The input of variables should be easy to accomplish for inspectors (user friendlyness)
- Mutations in the database should be logged

<u>Output specifications</u>
Functional specifications concerning the Scenario Analyse Module:

- The software tool should facilitate the process of generating relevant information for all four management levels in real estate management (PM, FM, PPM, AM)
- It should be possible to add weighing factors in terms of SHEEQ aspects in the analyse module
- It should be possible to use example scenario's as a lead
- It should be possible to create and compare different scenario's based on *input* variables (weighing factors, policy, financial possibilities etc) and on *output* variables (criteria based on targets that we want to realise, like energy targets, financial targets related to pay-back-time which can in practice be linked to the SHEEQ-aspects)
- Scenario's should be able to be generated based on one or more of the following criteria:
    1. available budget for measures
    2. development of mainatance costs (combined with different measure options)
    3. pay-back time of measures
    4. policy objectives
    5. profitable investments (and % of total investments)
    6. building quality targets and measuere relevant for other sheeq-aspects that can logically be combined with building quality measures
    7. legally binding measures that are obligated to be executed
- It should be possible to add a time dimension in the creation of the scenario's so the output can provide in scenario's that are optimised in time.

4. Functional design of the Database Integrated Information System and Scenario Analyse Module

Because the software tool is the central tool for the EPI-CREM method, this chapter discusses the basic design of the tool.

The EPI-CREM software is a tool for experienced experts who are working as advisors for CREM organisations. The main task of the advisor is to acquire all information concerning inspections and maintenance works within the building and to make an energy technical analysis on which scenario analyses can be based. Therefore the advisor needs data and information that is collected through the data acquisition protocol and other supporting tools like the energy performance certificate and protocols of multidisciplinary inspections that can be entered into the software.

The software consists of three main phases (see figure 1):

Phase I: All generated data of a building is collected here. The outcome of this is a database with all available information of a single building (and not from a whole building stock). All existing data from multidisciplinary inspections, energy performance certificates etc. (gathered by means of the data acquisition and quality protocol) are needed for this phase.

Phase II: In this phase the advisor has to classify every single element of the building. By means of the through phase I generated element list of the building and the within this project developed classification method the actual state of every single element can be described. A risk analysis of the exposures resulting from the actual state of every single element follows. By this means an analysis of the whole building is possible and possibilities for improvement are located.

Phase I and phase II are the statically parts of the tool. This means that the process of these two phases is similar for every building. The data collection and also the classification as well as the risk analyse are defined methods which are in principle applicable for every building. The advisor therefore gets a manual and a guidance book how to make the classification and the risk analyse.

Phase III: According to the results of phase II the advisor defines a variety of measures for improvement. He links this measures and risk management results in a variety of scenarios, annual maintenance plans, reconstruction plans and important information for decision makers.

Phase III is the dynamic part of the tool. Here the advisor needs his experience to define measures for improvement in terms of energy efficiency as well as for maintenance and inspections. According to the results of the classification and the risk analyse of phase II the advisor has to define a range of measures for every single element. Furthermore he has to communicate with the decision makers (asset manager, portfolio manager, etc.) to check the company's strategy in terms of SHEEQ aspects. The decision makers have to fix their priorities and according to these priorities the advisor has to link single measures for improvement to scenarios. Those scenarios have to be considered by the advisor and the decision makers.

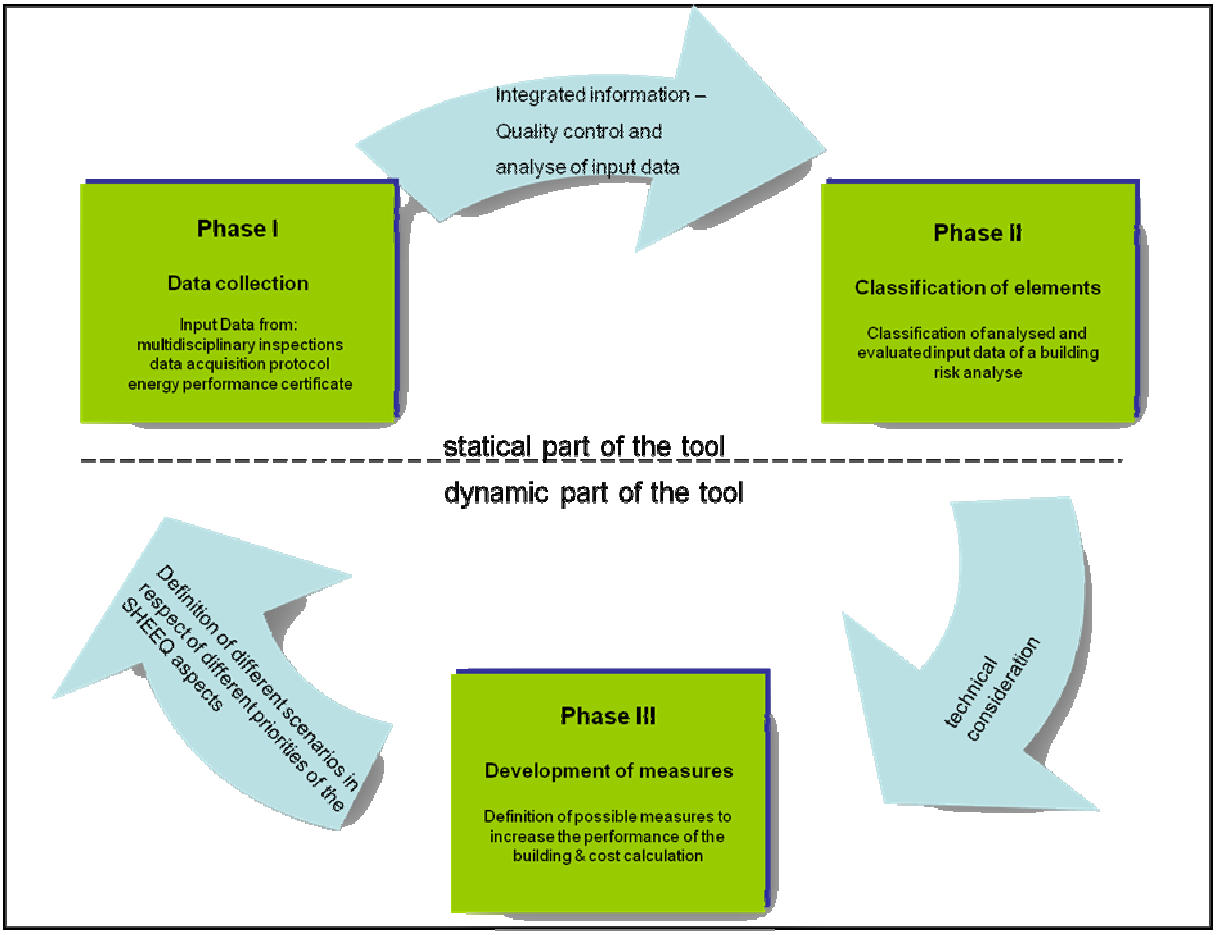


Figure 1: functional principle of the software

Phase I: Data collection and Database
With assistance of the data acquisition protocol the expert starts working with the software and enters all data in the first step of the first phase. When the data entry is finished the software is able to generate an in hierarchies structured *picture of the building* in step 2 of the first phase (see figure 2). This picture contains all information of the building.

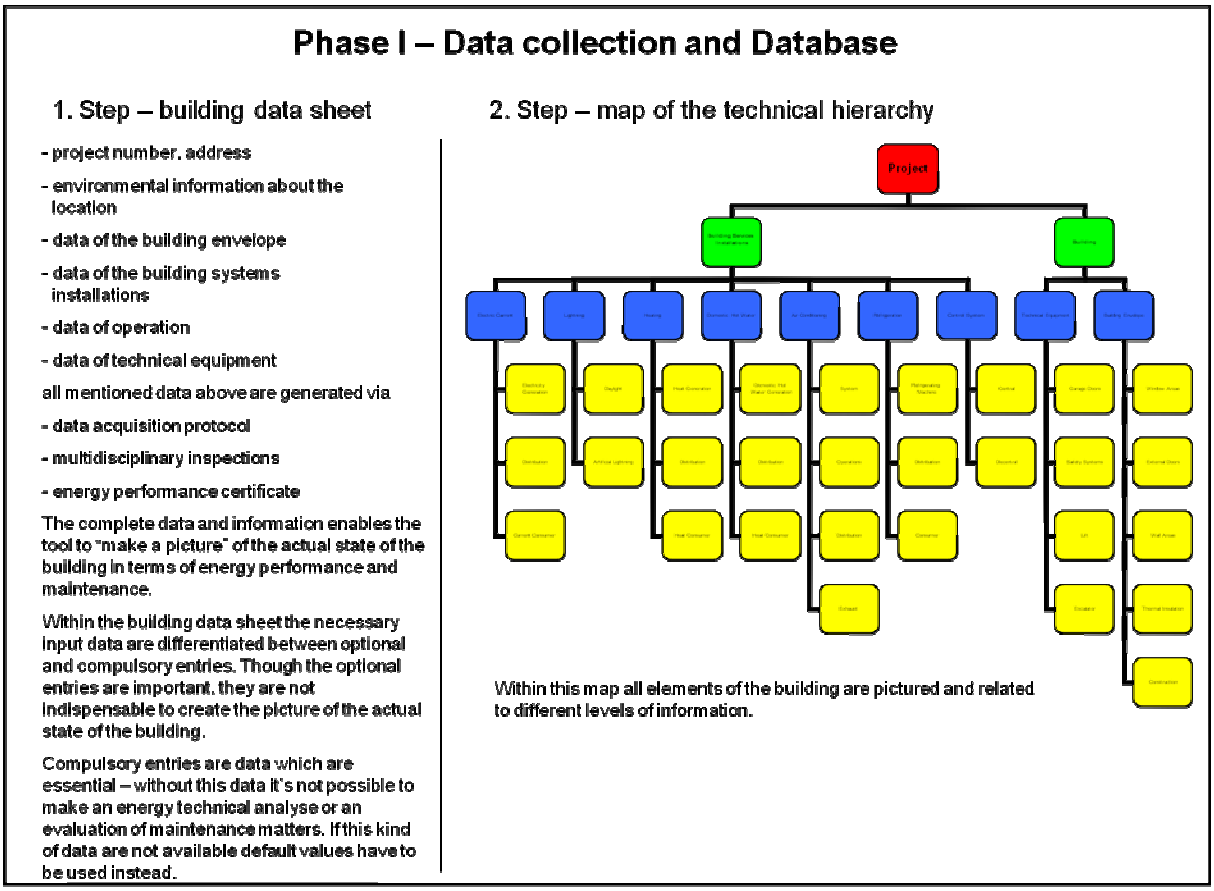


Figure 2: Description of Phase I of the software – the data acquisition and database

To keep this structure as simple as possible the picture does not show the whole information entered in phase I but behind every element-field of the picture (yellow fields in figure 2) the information is available based on performance indicators (see figure 3).

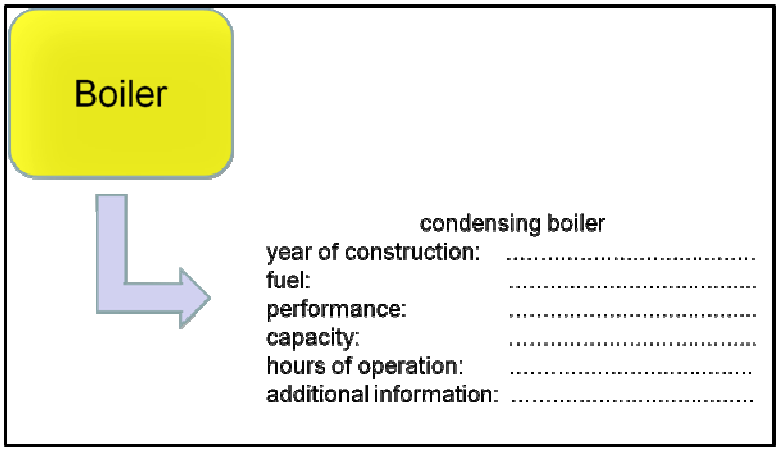


Figure 3: Detail of the last level of description within phase I of the software

Phase II: Classification and risk analysis
With all the information and data of phase I the software is able to generate a picture of the building. Within the EPI-CREM approach the building is parted in a hierarchy of 4 levels. The first level is the whole building. The second level is parted into the building envelope and the technical equipment (escalators, lifts, doors, etc.) as one part and the building system and installations as the other part. On the third level the systems are located. This means heating system, cooling system, building envelope, etc. The fourth level is the single element level. In this level every single element of the building, e.g. boiler, windows, etc. is described. It is also the last level of the hierarchy described within the EPI-CREM approach.
The advisor has to make a classification by means of the developed classification method described below in figure 4. When the advisor has classified all elements on level 4 the software sums up the classification for level 3, 2 and 1. As a result the building is classified on every level of the hierarchy and the advisor as well as the manager gets valuable information of the actual state of the building.

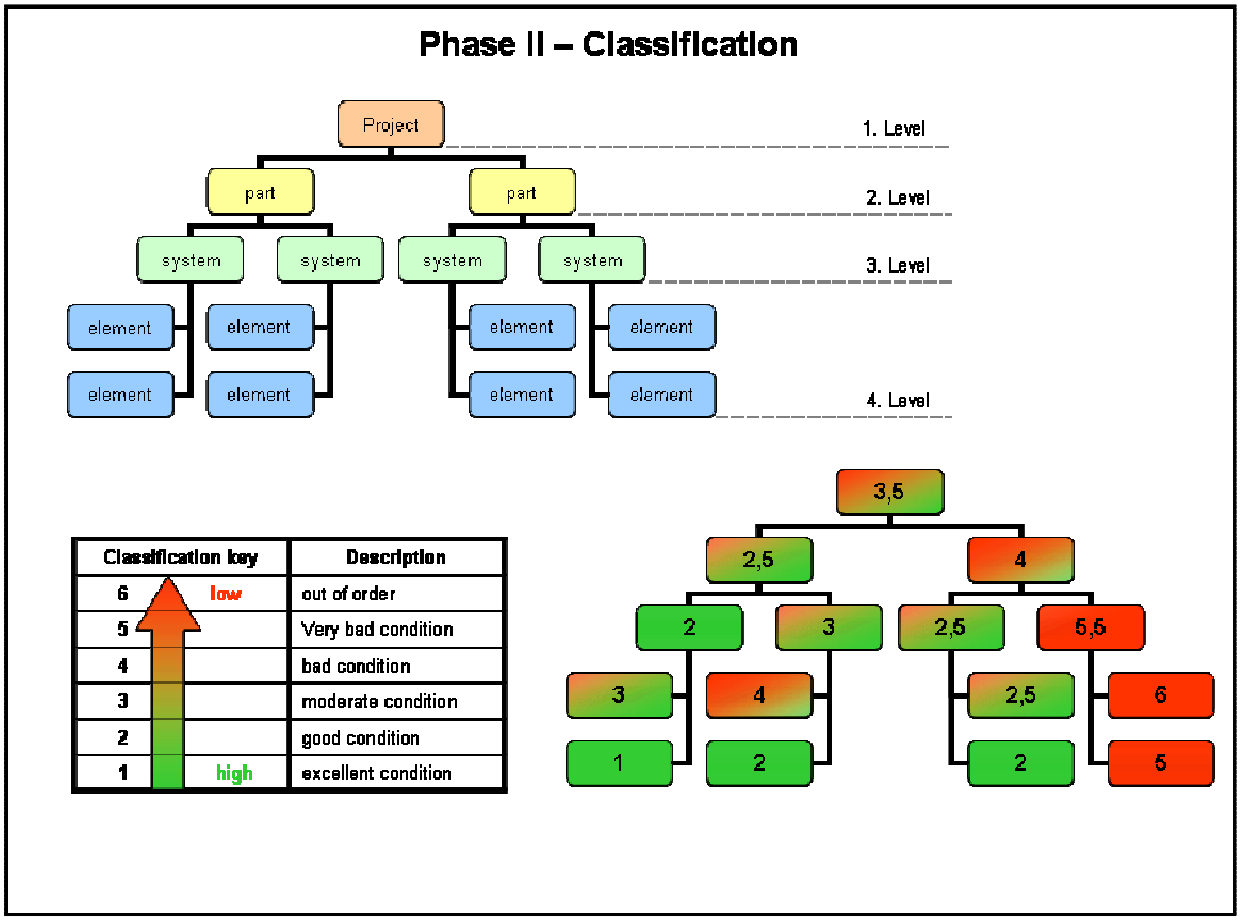


Figure 4: Description of phase II of the software – the classification system

After the classification the advisor has to make a risk analysis of the exposures resulting from the actual state of the building/elements.

Phase III: Development of measures
According to the results of phase II the advisor has to make a technical consideration and define measures for improvement for every element. Therefore he uses the classification figure of phase II. Here he enters a number of measures for every single element (see figure 5). For every element the advisor defines a number of measures, calculates the costs and the benefits of every measure.

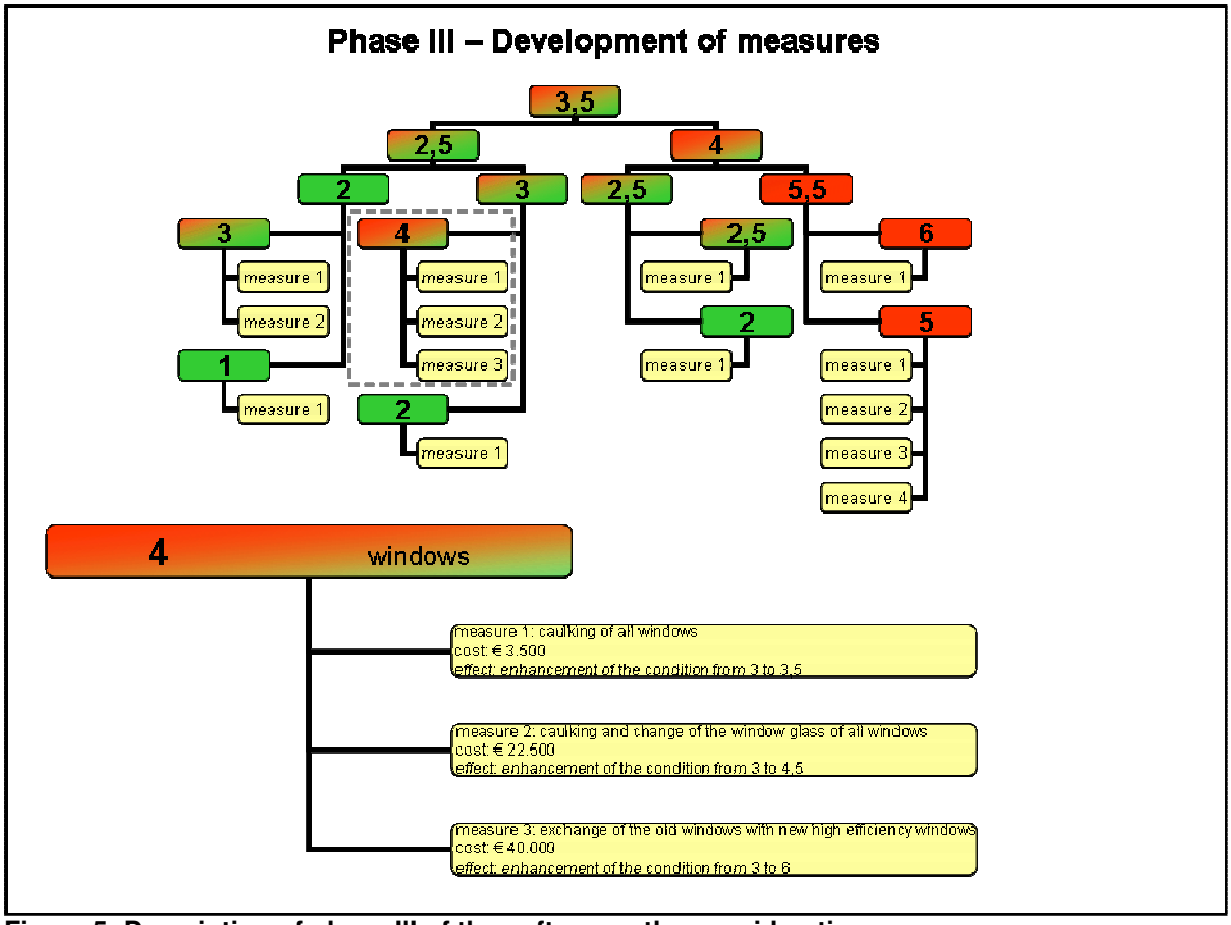


Figure 5: Description of phase III of the software – the consideration process

After phase III the advisor has to coordinate the results with the managers. Therefore he has to assembly single measures to scenarios, based on risk analysis (consideration). According to the strategy of the building owner in terms of SHEEQ aspects they choose one scenario. That means that the advisor fixes the measures which he has assembled to this scenario in the software. The software automatically adopts the new data of the elements and updates the classification and risk analyse in phase II according to the defined benefits of phase III. The advisor updates the data of the elements in phase I. Therefore the software attaches a new project. In this vein a comparison is possible between the building in its actual state and the building in its state after execution of the defined measures of the chosen scenario. The picture of the actual state before the execution of the scenario will be documented and archived and the picture of the updated and improved building will be the actual state. Additionally the totally investment costs of the scenario can be shown by the software. The complete process chain of the software is pictured in figure 6.

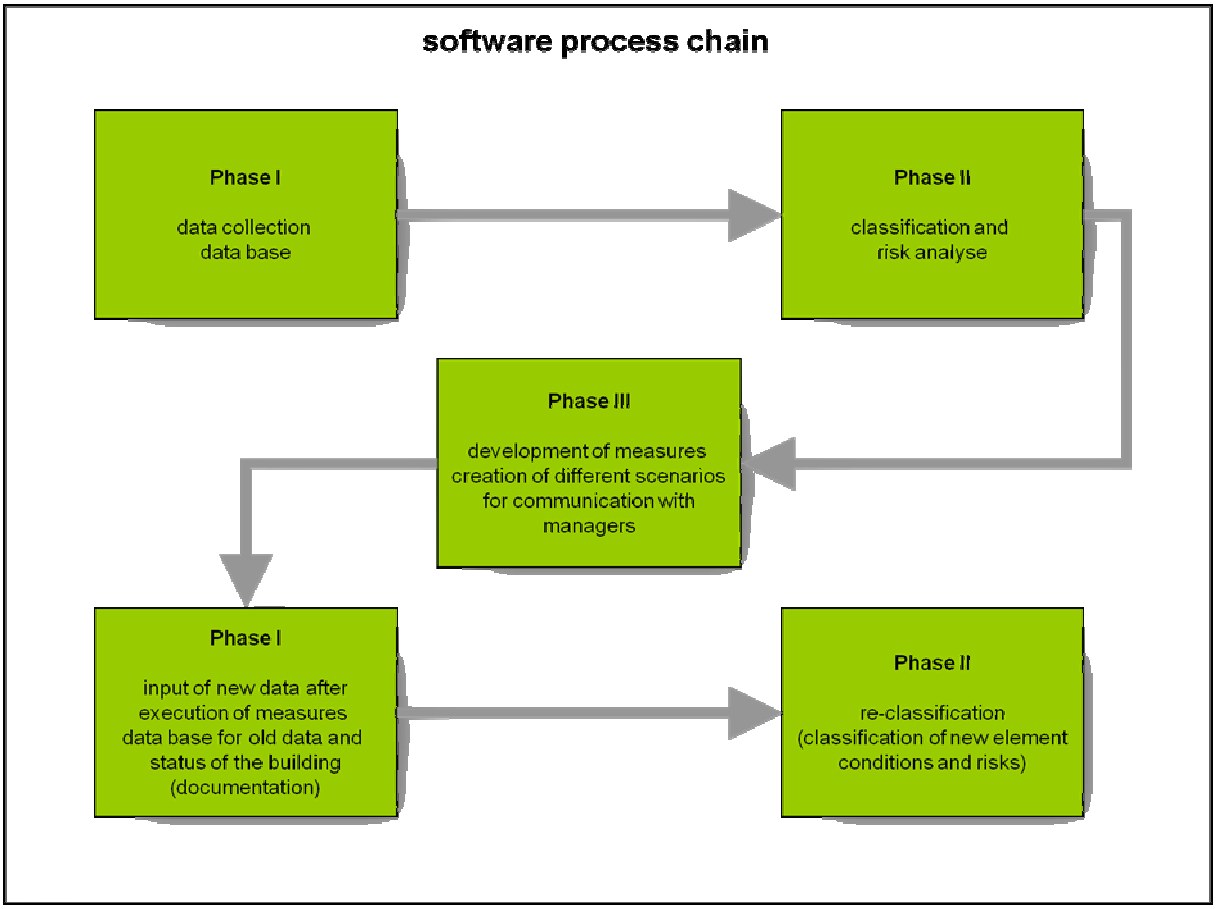


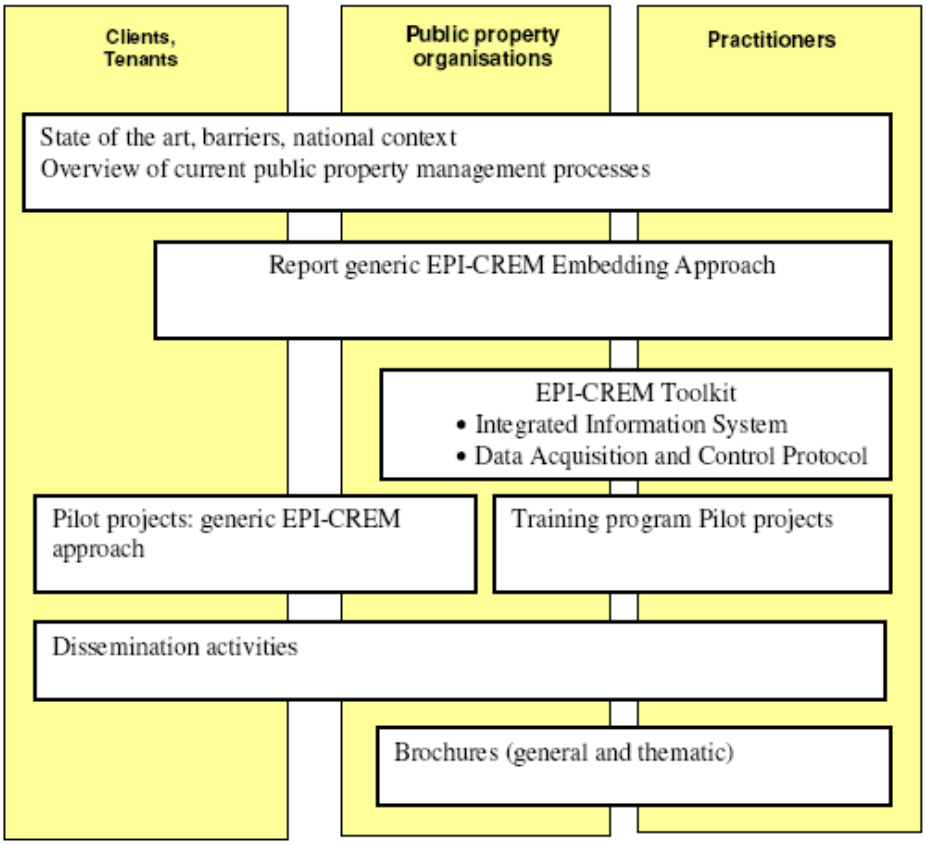
Figure 6: software process chain inclusive a re-classification and re-consideration

Conclusion

Based on the functional design of the selected tools that is described in this report the development of the tools starts. This development process, however, is a cyclical process. This means that there is some room for reconsideration of the design based on advancing insight during the development process of the tools.

Project Description

EPI-CREM aims to improve energy efficiency and rational use of energy across public building stock in Europe by embedding energy issues in decision making processes within Corporate Real Estate Management (CREM) at a strategical level, and translating those decisions into tactical and operational levels of building management. This way the decision making process surrounding energy saving measures is embedded in the CREM-process, and is made structural and more cost effective. To reach these goals EPI-CREM provides a strategy and a set of tools enabling building owners and users to make the energy aspect an integral aspect of Corporate Real Estate Management.



The expected project results are:

1. **The EPI-CREM embedding approach**, where energy efficiency and rational use of energy issues are embedded into public property management processes;
2. **The EPI-CREM toolkit**, which contains an Integrated Data acquisition and Quality Protocol, a Database Integrated Information System, a Scenario Analysis Module, a Training program for assessors and the EPI-CREM Reference Manual;
3. **20 EPI-CREM Pilot Projects**, testing the embedding approach and the developed tools;
4. **Dissemination of the EPI-CREM results** in relevant networks and sectors like the public building real estate sector, consultancies, architects, tenants, umbrella organisations, knowledge providers and national authorities, with special attention to the new European Member States.
5. **A concise overview of current public property management processes**, highlighting institutional barriers for energy saving and sustainable energy strategies. This overview serves as the basis for developing the EPI-CREM embedding approach and the tools.

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