EPIQR – A NEW SURVEYING TOOL FOR MAINTENANCE AND REFURBISHMENT

Epiqr – A new surveying tool

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Abstract

Consultants and maintenance managers are often requested to inspect buildings in order to assess the conditions and to make proposals for maintenance and refurbishment actions including investment budgets. In a European project a computer-based methodology has been developed including tools for diagnosis of the building, analysis, decision making and reporting. The systematic procedure in the methodology helps to identify all major parameters affecting the performance of the building. The methodology is based on collection of available general information, a standardized visit to the building and a questionnaire. The available general information, i.e. drawings, addresses, dimensions, energy consumption etc., is collected from the owner or the manager of the building during the preparation of the visit. The visit itself is done in a systematic way assessing the building element by element using a template on a personal computer as support. During the visit also energy performance of the elements are evaluated and potential energy saving measures are noted. The indoor environment quality is evaluated on basis of questionnaires given to the residents prior to the visit. During the visit at least three flats are assessed which gives an opportunity to investigate indoor environmental problems further by interviewing the residents. Based on the findings and a comprehensive price database, the computer program gives reports on the current conditions, alternative scenarios regarding refurbishment, energy saving measures and costs for each scenario.

Keywords: Building conditions, building diagnosis, building investigations, energy performance, indoor environment quality, refurbishment, surveying.

1 Introduction - The refurbishment demand

In Europe, building maintenance and refurbishment have become of increasing importance to the building sector. According to a study by the institute Euroconstruct covering all EU member countries and Switzerland, the total construction sector represented, in 1990, 670 billion ECU (about 750 billion US$) (EUROCONSTRUCT,1990). Refurbishment and related activities represented 39% of this figure, with a growing tendency.

The demand for maintenance and refurbishment is based on the fact that a major part of the building stock was constructed in the first half of the century and now needs action in order to prolong its service life and to bring the performance up to current standards as regards insulation, wiring, sanitary installations etc. Furthermore in the sixties and seventies a large number of dwellings was constructed in big haste during the building boom in Europe. They are often of an insufficient quality and, as they were constructed before the oil crisis, often with insufficient insulation and outdated heat production systems. Rehabilitation activities in these buildings often constitute an excellent opportunity for reducing the energy consumption and often with an improvement of the indoor environment quality as well. Building refurbishment is normally considered mainly to concern the physical state of building materials and components but should also take into account related subjects such as energy consumption, function of building services, waste management, indoor environment quality and spatial comfort.

2 New tool required

Taking into account the huge amount of money required for maintenance and refurbishment, it is obviously of great economical interest to ensure an efficient assessment and handling of the works to be done. First of all it must be ensured that all information of importance to the decision process is taken into account and that this is done as objectively as possible. Next the information should be utilized thoroughly to ensure the best possible basis for decisions. For example the information should serve as a basis for an analysis of potential problems and for the planning of an intervention strategy.

Many tools and methods already exist for aid in maintenance and refurbishment problems. However, they have not been found suitable to solve the problems in the current situation. A new tool was set up which approaches projects in a pragmatic way and responds to the new requirements of the market. The target was that it should allow rapid (and therefore low-cost) collection of all data relevant to a sufficient precision of the diagnosis and it should be able to respond to market fluctuations in the building sector. Furthermore, the developed tool should be accessible to a wide range of people working in the building sector, e.g. architects, engineers, surveyors and technicians, who are not necessarily specialists in building investigation, or building pathology.

To meet these requirements the tool should be easy to use, guide the surveyor through the data collection, help to reveal the possibilities of energy saving and indoor environment improvements and, last but not least, calculate the costs for all proposed actions and report the findings in a standardized way.

2.1 EPIQR - a new tool

In a European project sponsored partly by the EU and partly by a number of national bodies, a new tool was developed on the basis of the demands mentioned above. The project EPIQR (Energy Performance Indoor environment Quality Retrofit) was launched in 1995 and finished at the end of 1998. It was carried out in collaboration between:

- Building Research Establishment (BRE, United Kingdom) Project coordinator
- Centre Scientifique et Technique du Bâtiment (CSTB, France)
- Danish Building Research Institute (SBI, Denmark)
- Fraunhofer Institut für Bauphysik (IBP, Germany)
- National Observatory of Athens (NOA, Greece)
- Building and Construction Research (TNO, The Netherlands)
- Ecole Polytechnique Fédérale de Lausanne (EPFL, Switzerland)
- G.A. Meylan (Lausanne, Switzerland)
- GS Arkiteckten AG (Münchenstein, Switzerland)

EPIQR is a computer-based methodology including tools for diagnosis, analysis, decision-making and reporting. It is based on previous methodologies used in Switzerland (Genre, J.-L.et al., 1992). The target audiences are building surveyors, architects, engineers, owners and managers. It concerns the first phase of refurbishment projects, figure 1, and encompasses every step from the first decision to assess the building is taken to the providing of different refurbishment scenarios as an aid in the decision process of whether and how maintenance and refurbishment should be done.

EPIQR uses a systematic diagnosis formalism in order to determine the current state of deterioration of each element and its impact on energy consumption and indoor environment quality. Interacting with a large database of costs, energy consumption, indoor environment quality and upgrading possibilities, the EPIQR user can review different refurbishment scenarios. For each scenario the method calculates the global refurbishment cost and the energy requirement of the new situation. A cost analysis is possible using the EPIQR cost database with more than 900 detailed refurbishment reference costs set up for each of the participating countries.

Recent developments in the IT technology enabled the integration of different software modules. The user-friendly EPIQR software uses database technology to organize information and multimedia possibilities to illustrate it. The open structure of the software package offers the possibility to each country to adapt the method to local particularities and construction modes.

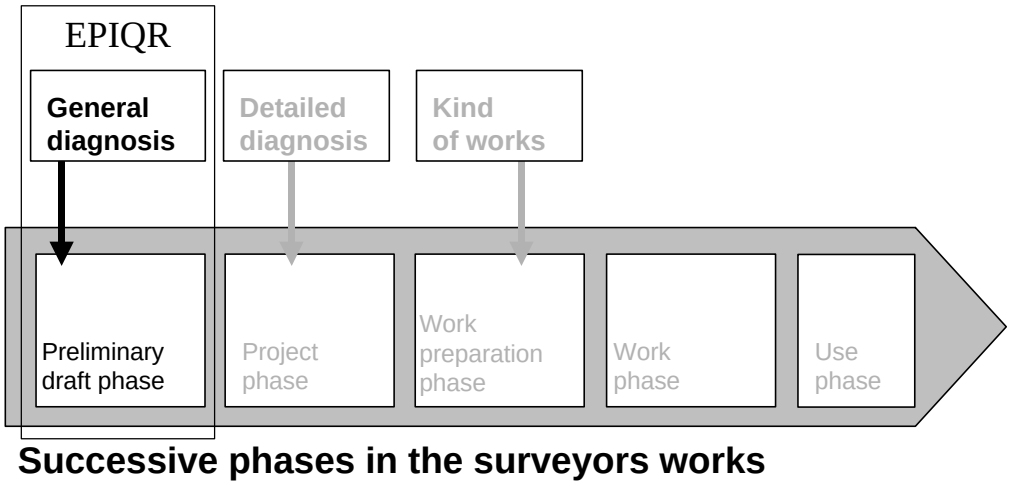

Fig. 1: EPIQR in the general renovation process has its place in the preliminary phase

3 EPIQR diagnosis

The basis for the EPIQR methodology is a systematic inventory of the current building condition based on objective assessment of critical parameters, achieved by:

- A visit according to a standardized procedure to determine the current state of the building materials and components
- Information from the management about the current energy consumption and an assessment of potential energy saving measures.
- Information about indoor environment quality gathered from a questionnaire.

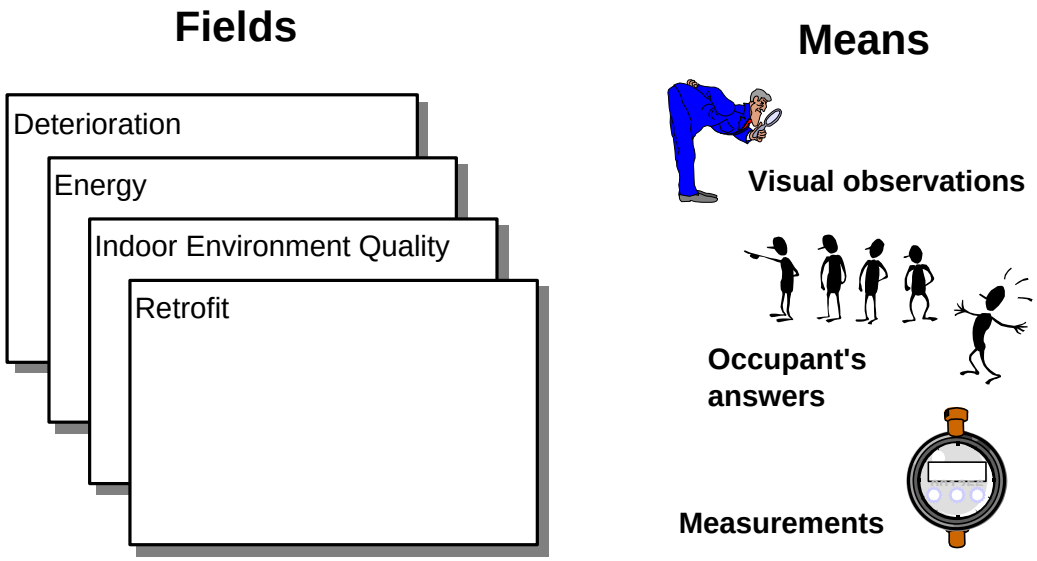

Fig. 2: The EPIQR database contains different subjects. Data are gathered through visual observation and occupant interviews

In order to facilitate the investigator's assessment and to ensure a correct judgement of the situation, the advantages of multimedia are used thoroughly, both through text and images, in the inventory. All information is entered into databases on the different subjects. The databases related to the various subjects, i.e. deterioration, energy, indoor environment quality, etc. can be adapted to local particularities and evolve as a function of more precise and complete knowledge of the domain.

3.1 The visit

Before the visit all available information about the building(s) is collected from the owner or the manager of the building and entered into the database, i.e. location, use, types of materials, age, management and current energy consumption. Energy consumption is used in the EPIQR software to situate the building relative to the national average. Likewise information from previous surveys may be relevant.

The visit itself is done in a systematic way. In the methodology the building is sub-divided into 50 elements which are assessed element by element using a template on a portable computer as support. The condition of each element is classified in one of four degradation classes designated “a”, “b”, “c” and “d”, where “a” signifies elements in a good state whereas “d” signifies a very deteriorated element which should be replaced. The classification criteria are explained as text and illustrated by photos from a national database, giving examples of building elements belonging to each type and class, see figure 3. All findings/classifications are entered directly into the template. During the visit energy performance of the elements are also evaluated and potential energy saving measures can be noted.

The visit will normally take a few hours (2 to 6 hours) dependent on the size and complexity of the building. The methodology used for the visit also exists in the form of a booklet, which contains all building elements and criteria.

3.2 The questionnaires

Before the visit questionnaires about indoor environment problems are distributed to the occupants. The answers help the auditor to identify indoor environment problems and other problems, which may not be visible at the time of the visit. For example it is not possible to see if there is a problem with insufficient heating under winter conditions, during a visit in the summer. The results of the questionnaire can be supplemented by interviewing some of the residents during the visit.

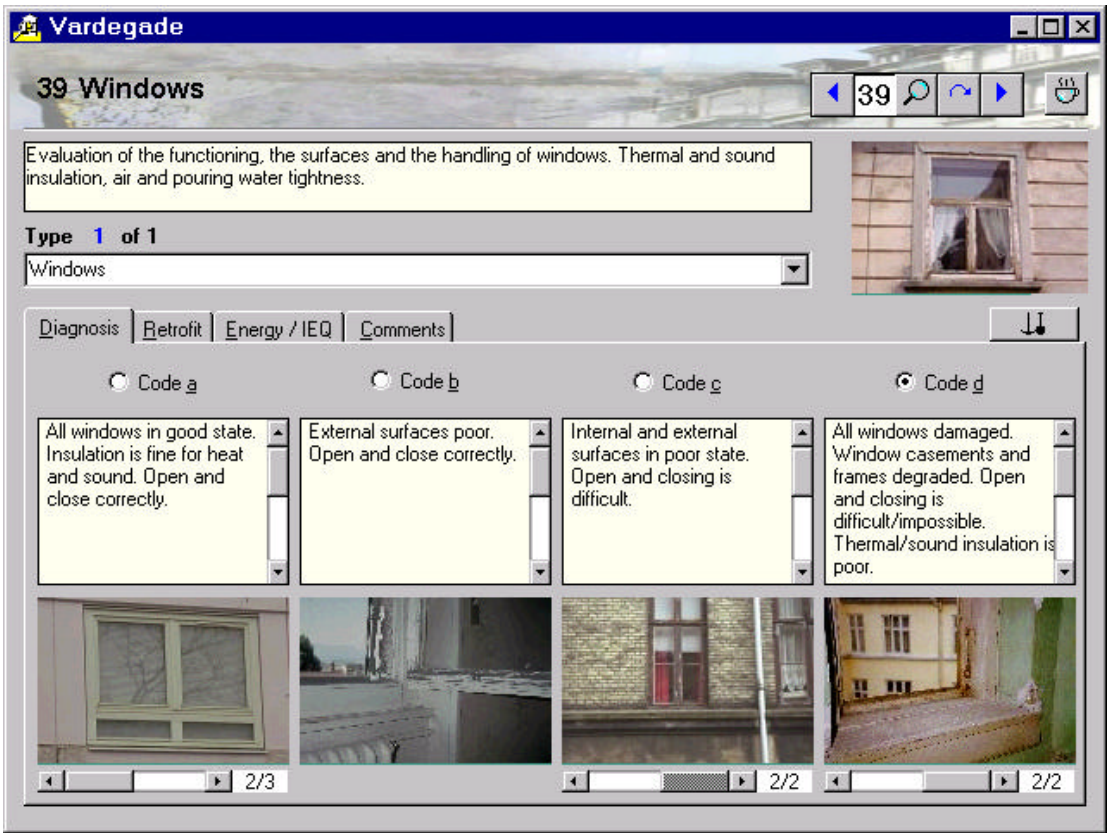

Fig. 3: The degree of deterioration of the 50 EPIQR elements is described and coded ”a” to ”d”. The text is illustrated with typical examples

4 Refurbishment scenarios

In a special interface, all information collected in the diagnosis phase is summarized. Additional information for any specific building element is available concerning national standards and guidelines, indoor environment quality and energy savings. Energy calculations give information on the energy saving potential of each action as it is possible to calculate the potential energy savings by improving a building element and compare to the current conditions. For each action there is feedback on the refurbishment costs sub-divided into the detailed works. Further, the costs obtained from the EPIQR database can, if necessary, be adjusted by the surveyor to fit the particular project better. All costs can be changed and new works added.

This information can help the surveyor decide what maintenance and refurbishment actions to suggest. The proposals are given as refurbishment scenarios and it is possible to make scenarios with emphasis on different themes, i.e. energy savings, indoor environment and low investments. Each scenario lists the required/-proposed actions with an associated budget.

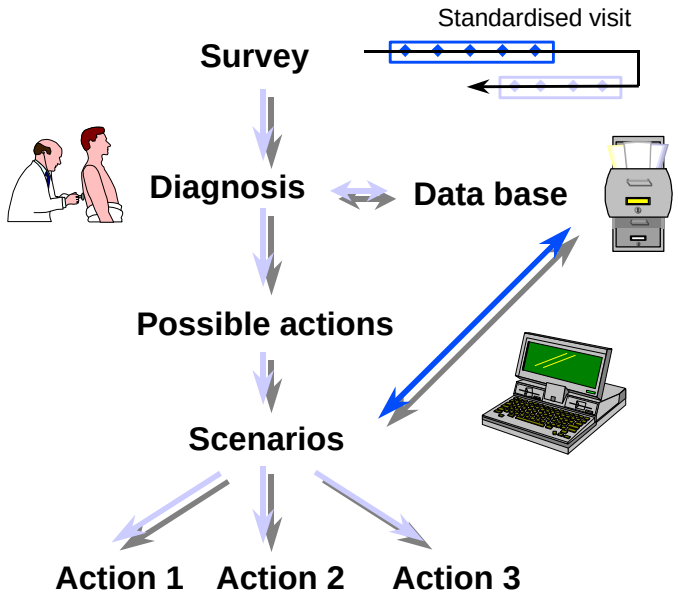

Fig. 4: The EPIQR concept - The complete catalogue of possible actions allows different refurbishment scenarios

The scenarios can be used by the building owner and/or manager as a basis for decisions on which actions should be taken, dependent on the maintenance policy, priorities and/or budget limitations.

5 Reports

EPIQR offers the possibility of producing different reports automatically dependent on the results of the diagnosis and the chosen scenario. The surveyor is therefore able to present a complete report to the building owner/manager including not only the building diagnosis but also a presentation of different scenarios for the future maintenance and refurbishment.

The indication of the global cost is accompanied by a detailed description of related work with associated costs, classified according to building elements or professions (masonry work, carpentry etc.). A probabilistic model simulates the evolution of the global maintenance and refurbishment cost for the next 15 years (figure 6). This will be a really useful tool for the financial planning of building refurbishment and the choice between possible scenarios.

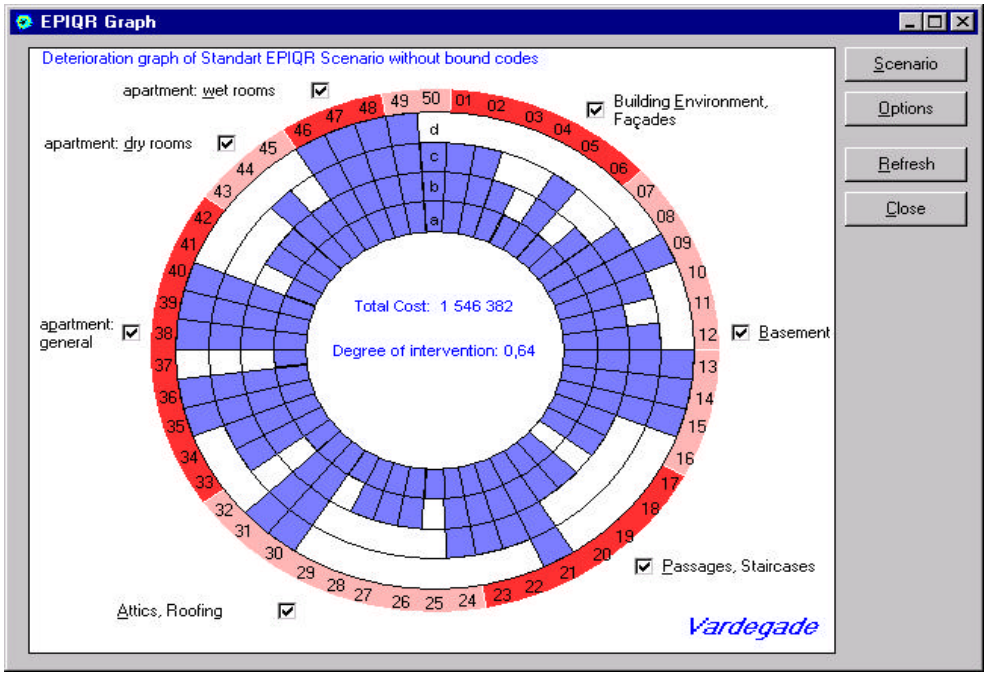

Fig. 5: An interactive graph visualizes the deterioration codes or costs of the 50 building elements. Choosing different scenarios immediately results in an illustration of the consequences

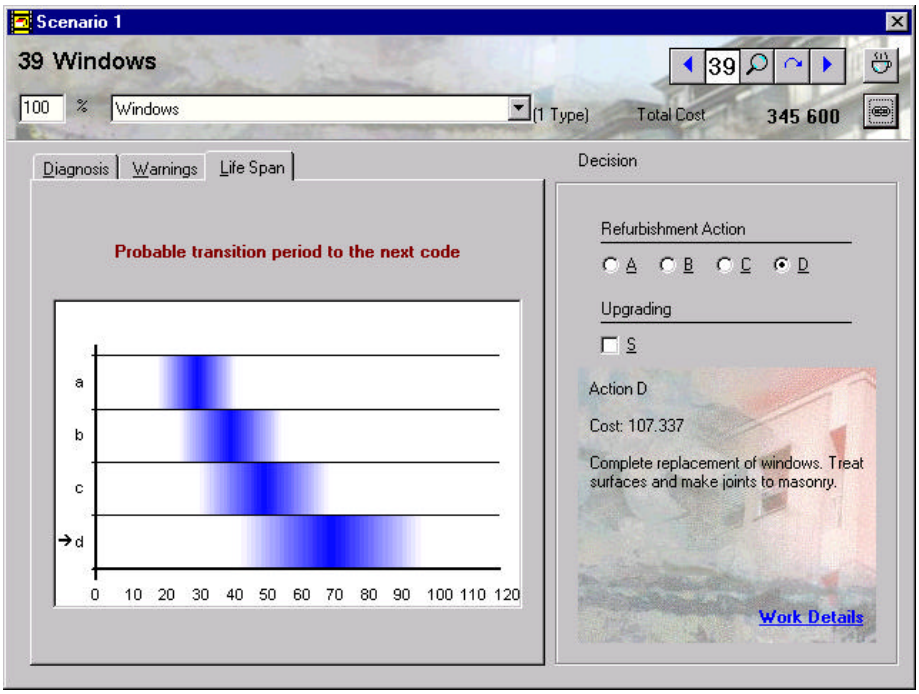

Fig. 6: Simulation of the development in degradation code, based on the current code and age of the building element and statistical information on the degradation of such building elements (Flourentzou F. et al., 1998)

6 Extension of the methodology

The EPIQR tool has been developed solely for use in residential buildings. The EPIQR databases were set up for 7 countries each in their national language. The open structure of the software allows adaptation to new ones.

However, it is believed that it can relatively easy be adapted to other building types such as schools, hotels and office buildings which might contain somewhat different elements and where focus is on problems slightly different from those found in residential buildings. A similar project, TOBUS (A decision making Tool for selecting Office Building Upgrading Solutions), concerning office buildings was started in September 1998.

7 Conclusion

It has been shown during the project that EPIQR allows a rapid and comprehensive inventory including reporting. The software makes it possible to utilize the information acquired through visual observation and interviews with the occupants comprehensively. Different refurbishment scenarios can easily be elaborated as a basis for choosing the one that best fits the specific situation i.e. the financial possibilities and the need of reducing the energy consumption and improving indoor environment quality.

Finally EPIQR could easily be adapted to other countries, and even other building categories or other sectors.

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