

# Facility Management (FM) Information Systems, Key Tasks and Implementation Tools

G.G. Malycha & V. N. Kolchin

*Moscow State University of Civil Engineering, Moscow, Russia*

**ABSTRACT:** Facility Management (FM) Information System is designed mainly for the large enterprises and organizations with centralized management that have dozens and hundreds of buildings, many employees and pieces of equipment. FM system permits to create the modern information technology supporting the life cycle of the construction project during its maintenance. The main tasks of FM system are: financial and marketing management of the building; summarizing and presenting the technical and economic information; planning for and decrease of the maintenance costs; presenting the information about the realty status for strategic administrative decision-making; timely servicing, repair and reconstruction; inventory of the movable equipment and furniture; management of the buildings, staff and cleaning; management of the realty and rental.

Presently there are many information systems with various functions and many manufacturing firms in the software market. These systems allow solving at a high level practically any architectural, design, calculation and other tasks. However, availability of separate systems cannot give a certain actual idea about the construction project.

That is why FM system should become the module subsystem of the integrated information system (IIS), which is the assemblage of automated information systems realized on the common information basis and oriented on the optimal management of the construction project maintenance throughout its life-cycle.

The IIS core may become the basis for uniting all the subsystems of the automated information technology into a single whole. It provides for a possibility to integrate the technical, administrative and commercial information into a single system that shall contribute to ordering of the information development and storage, eliminate the losses of the information objects, accelerate their searching and decrease the number of errors in them. As an essential object, the core includes the information channel providing for the information interchange between the modules. The IIS shall include the hardware, software and dataware, and various modules-subsystems for maintaining the life cycle of the building.

## 1 INTRODUCTION

Facility Management (FM) is designed mainly for the large enterprises and organizations with centralized management that have dozens and hundreds of buildings, many employees and pieces of equipment. FM system permits to create the modern information technology supporting the life cycle of the construction project during its maintenance. The main tasks of FM system are: financial and marketing management of the building; summarizing and presenting the technical and economic information; planning for and decrease of the maintenance costs; presenting the information about the realty status for strategic administrative decision-making; timely servicing, repair and reconstruction; inventory of the movable equipment and furniture; management of

the buildings, staff and cleaning; management of the realty and rental.

Presently there are many information systems with various functions and many manufacturing firms in the software market. These systems allow solving at a high level practically any architectural, design, calculation and other tasks. However, availability of separate systems cannot give a certain actual idea about the construction project.

That is why FM system should become the module subsystem of the integrated information system (IIS), which is the assemblage of automated information systems realized on the common information basis and oriented on the optimal management of the construction project maintenance throughout its life-cycle. The IIS diagram is shown in Fig. 1



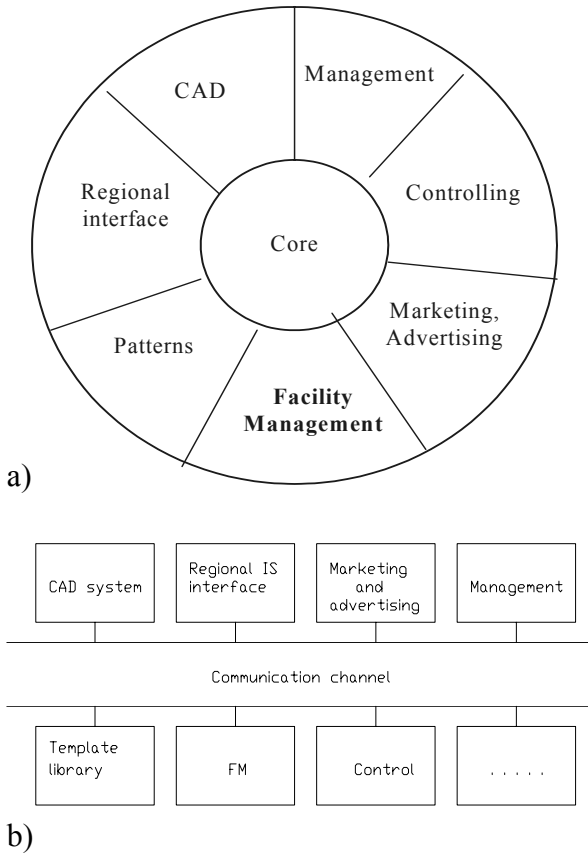


Figure 1. Module structure diagram of an integrated information system with a basis in the form of a: a) kernel; b) communication channel

The IIS core may become the basis for uniting all the subsystems of the automated information technology into a single whole. It provides for a possibility to integrate the technical, administrative and commercial information into a single system that shall contribute to ordering of the information development and storage, eliminate the losses of the information objects, accelerate their searching and decrease the number of errors in them. As an essential object, the core includes the information channel providing for the information interchange between the modules (Fig. 1). The IIS shall include the hardware, software and dataware, and various modules-subsystems for maintaining the life cycle of the building. The subsystems may also include the modules of automated designing, of interface with regional information system and the FM system modules.

The IIS core is a model management system and can be presented as a series of subsystems (Fig.2). Let us consider the core subsystems' functions.

*Subsystem of identification and data processing* permits to set and change inside the IIS core the system of identification of the information about the object. The conception of the integrated information system presumes the availability of a single system for identification of the object information model throughout its life cycle.

*Configuration subsystem.* This subsystem sets the configuration of the IIS, namely the task of the ar-

chitectural network, of the hardware and software being used, and provides the system of accesses. It also processes the data and prepares the formats to be used in the next subsystems.

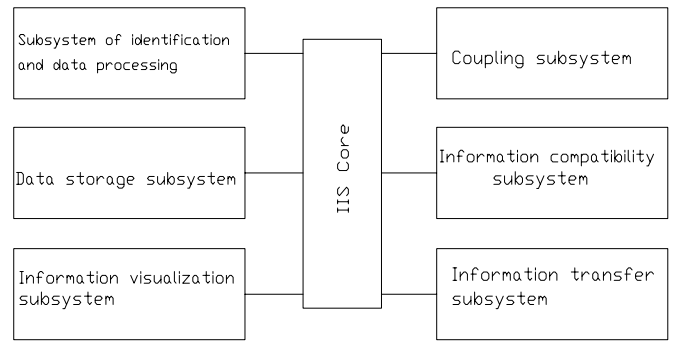


Figure 2. IIS kernel structure

*Data storage subsystem* provides for the archive management, selection of relevant data, effective and fast search, as well as for the communication between the core and the IIS databank.

*Information visualization subsystem* provides the user with user-friendly graphic and alphanumeric interface for reading the information about the object and taking decisions about further use of the information.

*Coupling subsystem* permits to create for all the module subsystem the single system of using CAD based on the object-oriented approach and making it possible to edit, change and save the relevant information model of the object.

*Information compatibility subsystem* processes the information model for use in the other CADs.

*Information transfer subsystem* permits to ensure the convenient servicing of the users working in the net, as well as to select only the relevant information out of the whole information being transferred, to be transmitted in the net.

It is necessary to keep in mind that the core does not have a function of controlling the entire IIS, but it only provides for its operation being to a certain extent the system's server. Each module within the integrated information system performs its own tasks under control of the responsible people in the interests of all simultaneously accomplished projects.

## 2 FACILITY MANAGEMENT SYSTEM IN THE INTEGRATED INFORMATION SYSTEM

The FM system may be presented in the form of a functional model that incorporates its own FM system kernel and FM module sub-systems, whose range depends on a specific list of tasks (Fig. 3).

The construction project model may be presented as files that store the graphic and alphanumeric information about the object (DXF, DWG, TXT, DOC and other formats). Apart from this, the model may

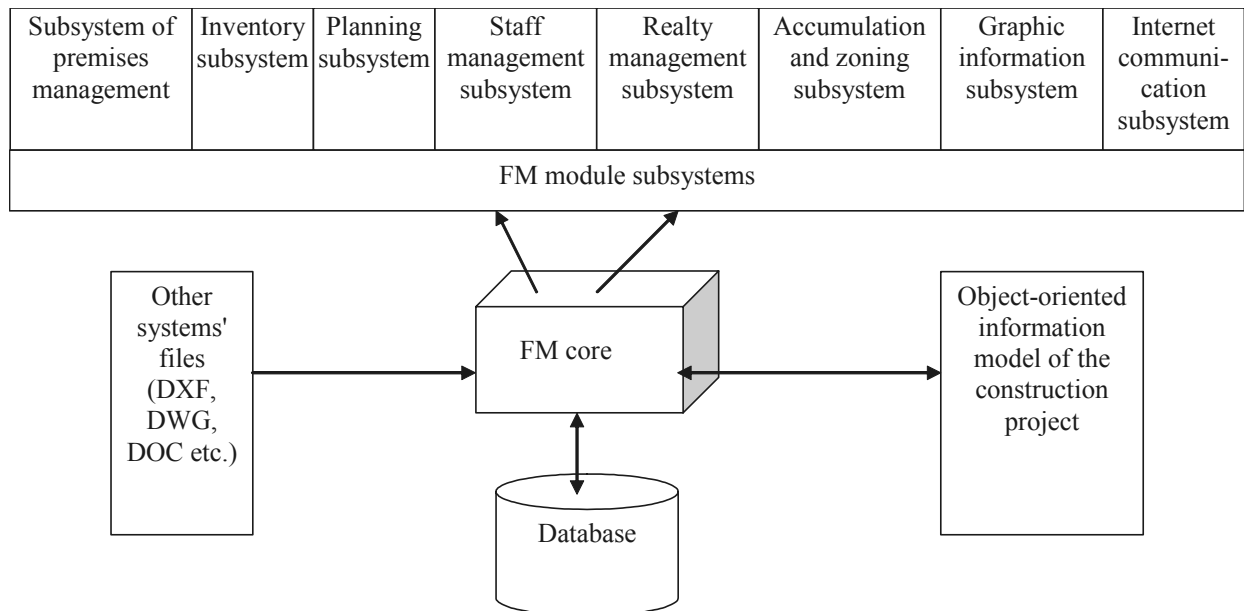


Figure 4. Architecture module of the Facility Management

be created using the object-oriented approach, which allows describing the graphic and alphanumeric information about the object as a class library.

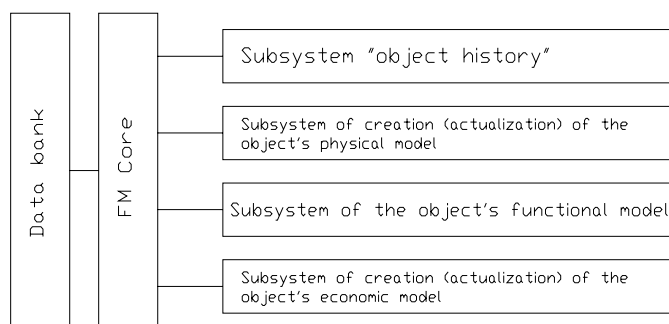


Figure 3. A functional model of a FM system

*Subsystem "object history"* permits to systemize all the information about the object as applies to the stages preceding the maintenance. The user is enabled to read the information.

*Subsystem of creation (actualization) of the object's physical model* permits to create, using the core subsystem, the new or edited model that stores the data on geometry, material, equipment, articles, technology, color of the object, and can present the decision in the user-friendly form: plans, sections, elevations, specifications, parts etc.

*Subsystem of the object's functional model* permits to determine and identify, based on the physical model, the premises, staff, communication system, inventory and equipment, to edit (change) the parameters in the graphic and alphanumeric mode, using the system core, and to store the actual model.

*Subsystem of creation (actualization) of the object's economic model* permits to solve, based on the physical and functional models, the economic tasks of the managing company and maintenance service, associated with the bookkeeping, calculation of costs and profit, managing the finances, planning for the

expenses (budget), statics and assessment of the construction project effectiveness factors.

The architecture of the FM system is shown in the diagram (Fig. 4).

The FM module subsystems are usually divided into the following ones:

*Subsystem of premises management* ensures the optimal use of premises and working area;

*Inventory subsystem* unites the data distributed among various divisions and systems of the enterprise and controls the change of the information about the location and cost of the equipment and inventory;

*Planning subsystem* works out the strategic plans based on the scripts and current data;

*Staff management subsystem* plans and monitors the staff movement and ensures the integrity of the database under various changes;

*Realty management subsystem* monitors and analyses the property and rental relations; it also presents the financial, historical and market information that reflects the expenses on the purchase of the land, buildings, constructions and rental relationships;

*Accumulation and zoning subsystem* allocates the projects, organizations, individuals and equipment (in the cities, buildings, floors, zones and working areas);

*Graphic information subsystem* coordinates the graphic information in the wide spectrum of management functions. The data of the CAD systems are used for the information input. It is possible to use one's own or borrowed graphic expression system in the interactive mode;

*Internet communication subsystem* ensures the interaction of the distant management system elements.



### 3 IMPLEMENTATION OF A FACILITY MANAGEMENT SYSTEM

This concept describes how to use computerized facility management information technologies or, shortly, “Facility Management”– FM.

Key objectives and characteristics of Facilities Management

The primary goal of the FM implementation project is to create a multi-functional facility management system with the use of modern information technology.

The key objectives of such management systems are the following:

- Provision of data for strategic decision making
- Examination of the characteristics of premises and of other components of a building
- Financial management and marketing of a building
- Real estate and leasing relationship management
- Inventory of movable equipment and furniture
- Personnel management.

The FM system is intended, primarily, for large companies and organizations with centralized administration and dozens and hundreds of premises, a large labor force, and a substantial body of equipment. It does not matter whether the premises are located in one building, one city or in different cities. The system is managed and updated on an on-going basis in accordance with the actual changes that take place in the organization. FM should be distinguished from automatic process control systems (APCS); the purpose of an FM is to provide information to the company’s management and to assist it in strategic decision-making, and not to directly interfere in technological processes.

The employment of modern information technologies makes it possible to transform graphics and related documents into electronic form; timely introduce changes and corrections; timely link accounting information with databases of other information systems of the company; and set up a required amount of automated workstations providing simultaneous access to current operational information. If needed, hard copies of graphic materials may be printed for operations.

Since graphic data is presented in electronic form, there are no longer any limitation on drawing dimensions. The user is able to move around the sheet in any direction thanks to the so-called “seamless” display of graphic data. The mechanism that scales and controls the content of displayed data allows to solve the problem of data limitation typical of hard copies. By selecting a facility on the diagram, the user gains access to all currently available data on this facility by switching from the diagram to data. Reverse action is also possible by switching from tabular data to diagrams with selected facilities.

#### 3.1 Task definition

Design a system for managing premises and an inventory. For this purpose the following should be developed:

- Graphic user interface
- Sub-system and key principles of data storage and retrieval (including backup storage)
- Sub-system for displaying data in graphic and electronic form
- Sub-system for managing the units of the system and the key principles of these units interaction

#### 3.2 Main development phases

In the course of the first phase, all the main attributes of the system were studied and identified, as well as its capabilities in terms of the defined task.

The basic principles and classes of graphic user interface were also developed during this phase and included the following:

- Graphic interface classes responsible for command buttons, menu, display field, and information panel
- Graphic interface classes responsible for the drawing of lines, nodes and cells
- Graphic interface classes responsible for text drawing
- Graphic interface classes responsible for equipment drawing
- A class responsible for data storage and retrieval
- Principles of object creation, interaction and deletion, as well as their storage during system operation

In the course of the second phase, both the graphic user interface and the general structure of the system were changed. In particular, the graphic user interface was completely modified, becoming much more attractive and, most importantly, more convenient for the user. New capabilities were added in the process of altering the graphic interface. They include:

- Scaling
- Employment of user units of measurement and automatic conversion of in-system measurement units (pixels) to millimeters
- A possibility to scroll the display field vertically and horizontally
- Grid parameter setting by the user and changing these parameters in the process of working with the program
- Returning to initial grid parameters

In the course of further alteration, the general structure of the system was changed to become as flexible and convenient as possible. This new structure allows to quite promptly and with minimal changes of the structure to install new upgraded functions and capabilities.



This made it possible to include in the system a new class required for the smooth operation of the system. This new class is responsible for “Editors” which allow changing such attributes of graphic objects as lines, nodes, text, etc. This class is universal and may be applied to any object of the system, including those that are currently under development.

### 3.3 Graphic interface description

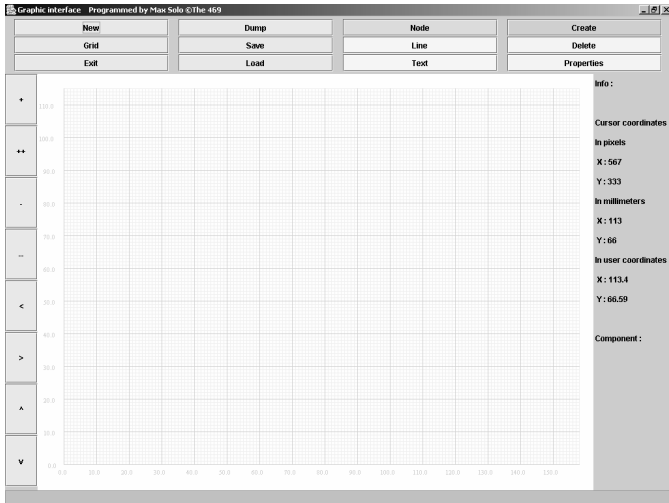


Figure 5. General view

The basic program modes menu is located in the upper part of the interface (cf. figure 5 and figure 6).



Figure 6. Basic Program Menu

- Basic modes: Create, Delete, and Properties. These three basic modes allow creating, deleting and changing or viewing the properties of graphic objects.
- Modes of graphic objects: Node, Line, and Text. These command buttons allow switching among graphic objects and working with each of them separately.
- The remaining buttons are responsible for creating a new display field, setting grid parameters, storing and retrieving entered data, etc.

Command buttons for controlling the display field and changing the scale and position of the display field are located in the left part of the interface (s. figure 7).



Figure 7. Command Buttons

The display field is presented as a graphic field with a grid (graph paper) and number marking for identifying the distance between the lines of the grid (s. figure 8). On this field the user can draw and edit a floor plan. This graphic interface allows to create plans of practically any level of complexity.

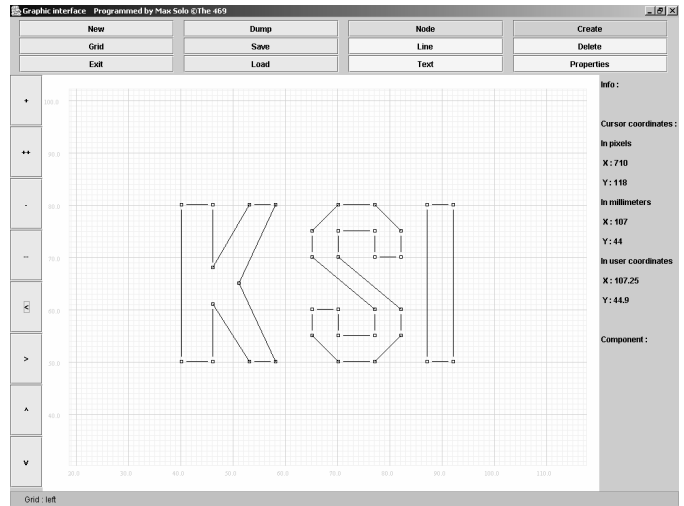


Figure 8. Display Field

The information panel is located in the right part of the interface. This panel shows information about the object, with which the user is currently working, the cursor position, and the coordinates in pixels (in-system measurement unit), millimeters and in user coordinates. This panel also shows information about the type of the object, its title and exact coordinates of its location (this data is stored in the object).

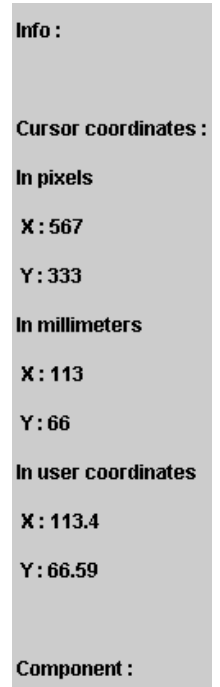


Figure 8. Information Panel

### 3.4 Current development phase:

At the current phase the following classes are being developed:

- Cell drawing class
- Equipment drawing class
- Class for displaying objects of the system in text form (as tables).

