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## **Guidelines for a Handbook on the Service Life of Buildings**

**Directives pour un manuel de conservation des bâtiments**

**Richtlinien für ein Handbuch für die laufende Instandhaltung von Gebäuden**

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### **SUMMARY**

The goal of the research is the identification of the contents and aims of a handbook on the building life in service. The research puts forward a mode of building card, defines, in particular, concepts such as "maintenance pools" and consequent "inspective paths" on which the building inspection is based for the purpose of programmed maintenance. An indispensable tool for the proper management program of conservation, the building handbook is a document which undergoes continuous updates during the life span of the building.

### **RÉSUMÉ**

Cette recherche a pour but la préparation d'un manuel pour la conservation des bâtiments en service. Elle propose un modèle de mise en fiche du bâtiment, règle spécialement les principes d'entretien et les parcours d'inspection. Pour une programmation correcte de la conservation, il est indispensable de posséder un manuel pour la conservation du bâtiment. Ce document sera sujet à des mises à jour continues au cours de la vie du bâtiment.

### **ZUSAMMENFASSUNG**

Ziel unserer Studie ist die Bestimmung von Inhalten und Zielsetzungen eines Handbuchs zur laufenden Instandhaltung von Gebäuden. Vorgeschlagen wird ein Modell zur karteikartenmässigen Erfassung des Gebäudes, insbesondere Konzepte wie die Gesamtheit aller Massnahmen zur Instandhaltung und die Kontrollgänge, die zur Inspektion des Gebäudes im Zusammenhang mit einer gezielten Planung der Instandhaltung notwendig sind. Unabdingbares Instrument einer korrekten Planung der Instandhaltung ist ein Nutzungshandbuch des Gebäudes, ein Dokument, das im Laufe der Lebenszeit des Gebäudes ständig aktualisiert wird. Dieses Handbuch setzt sich aus drei Teilen zusammen: der Gebäudekarte, dem Instandhaltungsbuch und dem Betriebsprogramm.



## 1. INTRODUCTION

"L'architetto non dee, tosto che e' finito qualunque edificio, abbandonarlo ma bisogna che gli stia intorno con diligente cura per conservarlo". "The architect, soon after any building is completed, must not forget it but must get around it with great care to preserve it (...)" ; this is the opinion of the sieneze physician T. Gallacini, 1564-1641, in his 'Treatise about architects mistakes'. This exhortation is again very much actual in Italy at present time. In the last years, especially in the so called building boom period (1950 - 1960) buildings have been realized without any attention to basic requirements of project and construction qualities which were at odds with the profit rules; in this period construction made in a hurry and based on superficial planning allowed substantial savings on working force wages and on professional payments, but has yielded buildings which have deeply degraded within 15-20 years. Not only construction quality has been left out but also maintenance activity which has indeed allowed, during past centuries, the preservation of a huge and precious historical patrimony. Understanding the high value, both historical and economic, of the real estate has stirred up the awareness of careful planning and execution, also in view of management costs decrease.

The main reason which led the research group to elaborate a handbook for the building life in service stands in the persuasion that each stage of the building process yields pieces of information (documents and data) which must be systematically collected in order to have, once the building is completed, a knowledge and maintenance guide tool of the predetermined planning quality; a tool which allows to collect continuously the functional and technological history of the building subsequently to its first use. Such a tool has been called the Building Informative System (B.I.S.) and is a complex of structured and systemized information concerning the building. Information can be aggregated in specific functional modules which are cards with different aims: historical and cultural goals (catalog of buildings and architectural masterpieces, etc.); fiscal goals (cadastral enrollment, real estate taxes, solid waste disposal taxes, etc.); public administrative goals (rescue plans, construction authorizations, adjustment to safety codes, etc.) and, particularly, maintenance goals (maintenance booklet, calculation of millesimal portions, organization of inspection and maintenance activity, etc.); moreover, such cards can be targeted for different uses (cadastral card, maintenance booklet card, catalogation of architectural patrimony card, etc.).

The management stage is made up of the building life in service and the administration phases (Fig. 1). The building life in service must be properly set in the planning phase and defined as precisely as possible at test time and when the building starts being used.

## 2. BUILDING LIFE IN SERVICE AND MAINTENANCE

The two words building life in service and maintenance are often considered synonymous in the technical language. On the contrary the "building life in service" configures a process <sup>1</sup> whose aim is to maintain predetermined reliability characteristics of the building, or one of its parts, to adequate, if necessary, building characteristics to new requirements and to optimize functioning costs; on the other hand, maintenance is the operational phase <sup>2</sup> of the building life in service, i.e. execution of programmed interventions.

The building life in service process entails subphases as follows:

a - *Building knowledge phase* <sup>3</sup>, already undertaken in the planning and execution phases, allows to gather and elaborate, based upon the B.I.S., the Building Computerized Card finalized to the maintenance handbook.

b - *Maintenance strategy selection phase* is indispensable for the preparation of the maintenance program; in fact, possible maintenance strategies may be diverse: either a posteriori maintenance, a priori maintenance (programmed or at the limit state), or opportunity maintenance <sup>4</sup>.

c1 - *Inspective control phase*: during operation, inspections are carried out in order to check, at given times, the fulfillment of the maintenance program, to survey situations of degradation or beginning damage, and/or to accomplish the opportunity maintenance. Specifically trained personnel should be available to carry out inspection activities for the technological system, as it already happens in mechanical and manufacturing industries and management of great public works (dams, railways, nuclear or electrical power plants).

c2 - *Control phase with calculation*, allows checks on the reliability of the technological system or some of its parts during operation, both with laboratory and in situ checks.

d - *Diagnostic phase*, has the goal to judge the state "of health" and of consistency (diagnosis) of the building or of some of its parts, referred to different technological units and to specific technical elements. The diagnosis is the support for subsequent planning and estimates of expenditures for the intervention: possibly, it appraises the causes (etiology) <sup>5</sup>

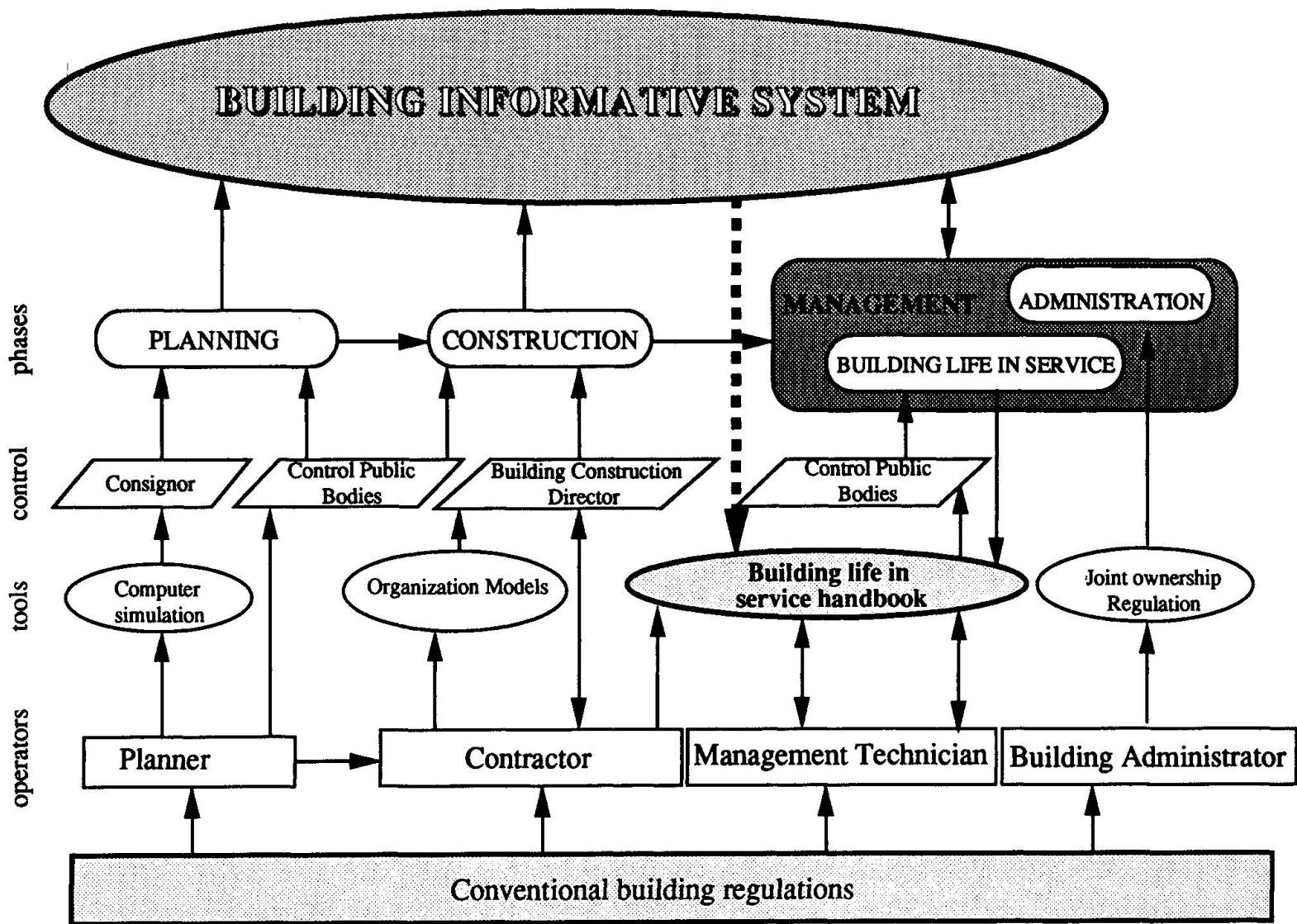


Fig. 1 The Management phase within the Building Process



that have provoked the degraded state (pathological state).

e - *Estimation of expenditures and work planning phase*. It is possible to prepare estimates of expenditures and a program of works to be done on the basis of the data obtained in the preceding phases on the consistency state, and of the diagnosis of the state of degradation.

f - *Maintenance phase*, is the building activity which has the goal to counteract aging and degradation phenomena, to repair unexpected and sudden damages, to adequate the building or some of its parts to new regulations or to different destination uses (in such case it is an improvement activity which is in between maintenance and rescue<sup>6</sup>).

### 3. THE BUILDING LIFE IN SERVICE HANDBOOK

Useful guidelines for handbook preparation are derived from the methodology based on the principle that only the exact building knowledge in its historical, technological and functional specificity (constructive technics, materials, systems, construction age, use destination, urbanistic bonds, etc.) allows to intervene in a timely and aimed manner and to adopt appropriate measurements for building life in service. Thus, an authentic anamnesis<sup>7</sup> of the building must be applied both as a methodological principle and an analysis tool.

#### 3.1 The scanning of the building in maintenance pools

The building once completed requires a reading modality different from that used in the project and in the construction phase. The constituent elements are so deeply interrelated to constitute new entities which we propose to define "maintenance pools". For "maintenance pool" we intend an aggregation of elements and works which may have different functions but, insisting in the same space, interact one upon another; so that they determine the level of reliability of the aggregation. The limits of the maintenance pools are specific for each building and depend upon its physical configuration, on its use organization and on its ownership. An inspective path corresponds to each maintenance pool; various are the parameters which may guide to limit and define the pools (use omogeneity, belonging to the same technological units class); it has been deemed appropriate to consider as the leading aggregation criterion the straight sequence of what appears to the inspective personnel along the entire inspective path.

For example, once a global description of the building is given (Typology classification: 1 - Massing, Building type, Plan type; 2 - Structure: Foundation system, Floor systems, Wall systems, Roof system; 3 - Interior: Interior division and use, Mechanical and electrical systems), the analysis of the building, based on maintenance pools, must be done: each specific maintenance pool is examined in subsequent studios. Let us examine the maintenance pool "Facade". First, it must be localized with respect to the building as a whole and to the other constituent annexes (how many facades, blocks, wings), pointing out their orientation. Second, a global description of the principal characters is given: Walls (visually height: basement, raised basement, stories, attic, belt course), Finishes, Decorative elements, Additions (terraces, etc.), Doors, Windows. Third, each element or component is described analitically (e.g., Facade elements: joints, chimney and flues, gutters and downspouts, damp-proofing courses, lattices, flagholders, signs, sunshades, solar control device, vent outlets, lightning rods, lightning fixtures, branch circuits, communication).

The various tecnological plants require additional and specific inspection and must have peculiar control modalities.

#### 3.2 The handbook contents

The building life in service handbook is an essential tool to plan the preservation. The handbook is a document which must be always kept up to date during the building life. It is prepared for each specific building by a management expert.

The handbook consists of three parts: the Building Card, the Maintenance Booklet, the Practice Program.

- The Building Card is the essential document which allows the complete identification of the building and records all the events important for the building life in service.

The Building Card must contain:

- the data deduced from the following documents: certificate of property, historical and new cadastral maps, approved project (when it exists), and any other document (technical and contractual) pertinent to technological and environmental systems, to location of technical systems inside the building and of their connections to public input and output canalizations, to a thorough building diagnosis including critical spots and full appreciation of the building consistency.

Such a diagnosis requires specific technical knowledge (historical-architectural, statical and constructive, chemical, etc.). By comparison to what happens in the medical field, the diagnostic <sup>8</sup> activity articulates in a series of logical-analytical subphases, i.e., informative (the observation of an objective sign or of the complex of several signs, carried out in the control phase) and synthetic, the judgement.

- the building executive project, or in its absence, the dimensional survey that includes the preparation of adequate technical papers (plans and sections), detailing the components lifespan and their capability to be inspected.

- The Maintenance Booklet articulates in three parts: a) the maintenance pools; b) the inspection program; c) the maintenance program.

The first part lists and describes the maintenance pools; the second part describes inspection paths, the inspection calendar, agents and tools for adequate control, i.e., observations, chemical and physical laboratory tests, in situ tests with portable instruments and non-destructive tests, etc. The third part is the maintenance program derived from the maintenance strategy chosen in relation to both the quality levels to maintain and attain, and the financial resources available in the short and long run. In the maintenance program are listed the interventions, their periodicity and executive modalities, and operators qualified to carry them out.

- The Practice Program specifically indicates the use modalities of the building in order to decrease degradation caused by improper use (ventilation of premises, rules to favour or limit insulation, etc.).

Such a program should be useful for the final user and the building administrator, in order to avoid requests which are either unexpected and/or contrary to established planning criteria (Fig. 2).

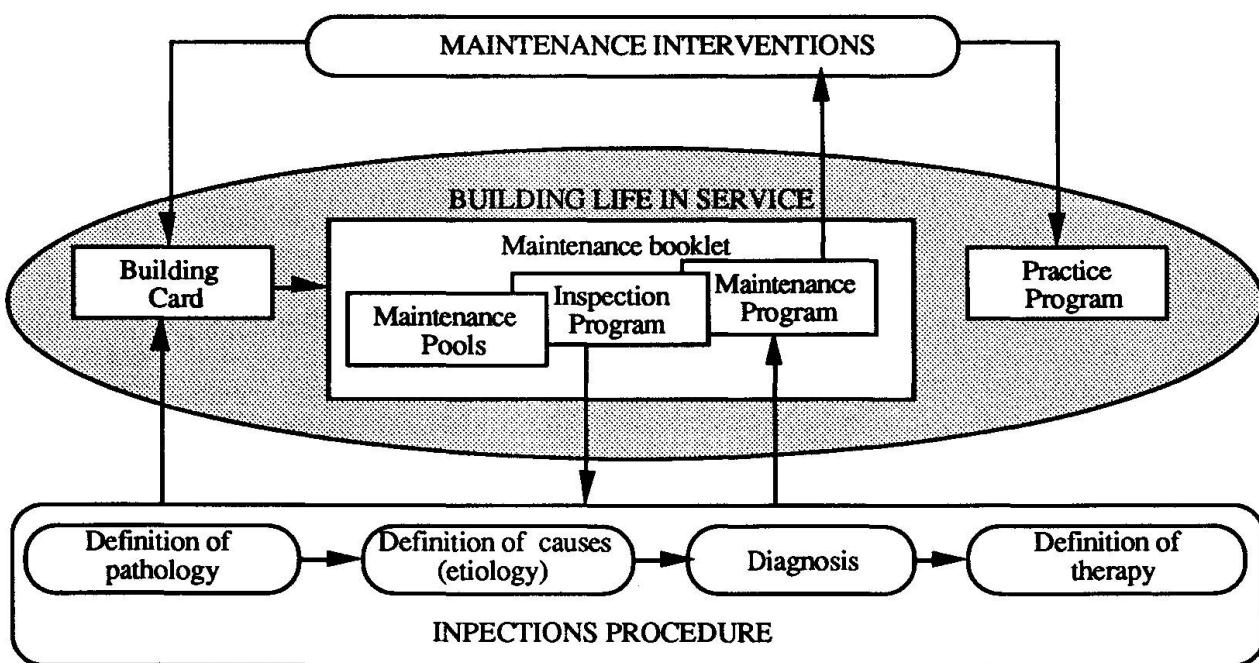


Fig. 2 Relationships between constituent parts of buildings life in service handbook, inspections procedures and execution of maintenance interventions

#### 4. CONCLUSIONS

In the present communication, we have explained the reasons which led to the elaboration of the maintenance handbook, and have outlined methodological guidelines for its preparation.

Moreover, we have underlined the importance of the link between the knowledge phase and the management phase, indispensable link for the preparation and constant update of the building life in service handbook.



Quite often the building process remains incomplete with respect to the management phase because its social and economical importance has not been understood yet, and also because it is not mandatory the preparation of tools necessary for proper unfolding of the management phase.

In Italy, maintenance is shaping up, as time goes on, as the leading activity in the building field. Thus, there are immediate needs for new organization models of building contractors, for new specializations and professional expertise, now centered in the building administrator, for new contract models, and for new technological proposals.

#### NOTES

- 1 For process we intend a structural whole of entity linked up each with another by relative conditions.
- 2 For phase we intend each of characteristical and different moments of a continous development.
- 3 The definition of knowledge process is given in: E. Dal Zio, V. Dal Piaz, R. Paparella, E. Rinaldi and F. Vergine, *S.M.I.R.N.E. Il sistema metodologico intelligente al recupero nell'edilizia*, University of Padua, 1994
- 4 Branch of knowledge dealing with causes of a disease or abnormal condition
- 5 Definitions relative to mentioned concepts are given in:
- 6 Rescue refers to the global process, whereas maintenance, restoration, recovery and restructuration refer to different types of the rescue.
- 7 Anamnesis: reminiscence. In medicine, a preliminary case history of medical patient, referable both to the investigation of the specific pathological condition and to general and foundamental stages of the patient's life, i.e., physiology, remote and recent pathology.
- 8 Diagnosis: the act of identifying a disease from its signs and symptoms; an investigation or analysis of the cause or nature of a condition, situation or problem.

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