MONDIS: KNOWLEDGE-BASED SYSTEM OF FAILURE OF HISTORICAL CONSTRUCTIONS

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Abstract: *Preservation of built cultural heritage, although constituting a well-documented branch in the field of conservation, presents a considerable knowledge gap in the systematic understanding of its common failures, physical, chemical or other mechanism of their occurrence and corresponding mitigation measures. The lack of available data coupled with the complex heterogeneity of their sources raises issues concerning the establishment of a framework able to process the information sensibly. The main aim of introducing and developing a knowledge-based system of failure of historical constructions called MONDIS is to address this demand. MONDIS proposes a methodology capable of reproducing the logical relationship between the manifestation of damage, its diagnosis and the possible interventions. Based on novel information sciences tools, like semantic technologies, the system will be able to assist users in finding similar failures cases, in analyzing the causes of damage and also suggesting suitable restoration techniques accordingly to conservation principles of intervention.*

Keywords: *Historical structures, knowledge-based systems, defects of cultural heritage objects, risk assessment.*

1. Introduction

With certain delay information technologies are entering the field of protection of cultural heritage. This delay can be partially explained by the multi-disciplinary nature of the subject. Currently there exist databases which serve primarily as archives for storage of general data but that unfortunately provide little scientific insight and technical support to users in understanding the actual cause-effect relationship in the evolution of damages. MONDIS proposes a comprehensive knowledge-based system with innovative perspective to decision-making processes. This system is the result of an evolution of previous efforts spanning more than ten years (e.g. Strufail see Drdácký et al., 2011).

2. Historical immovable objects

Historical objects present valuable peculiarities of technical and cultural interest. It is indubitable that remarkable efforts should be made to preserve for future generations historical objects as witnesses of a prolonged experience in building adaptation and optimization. The accessibility to exact information relevant for the assessment of such value is however often limited or impossible. The lengthy sequence of events suffered in the course of time by the object, the absence of original designs and constructive details makes difficult for individuals to clearly distinguish the context in which artifacts developed. Further the complexity of the agents impacting the objects´ fabric generates multiple unknowns in the determination of causes of degradation.

3. System description

Understanding cultural heritage pathologies requires exploring basic methodological phases: the identification of the object and its damage (presentation of the problem), the diagnosis (its understanding of decay mechanism involved) and finally the selection of adequate intervention (its solution). In order to match such sequence of phases MONDIS system introduces a structured

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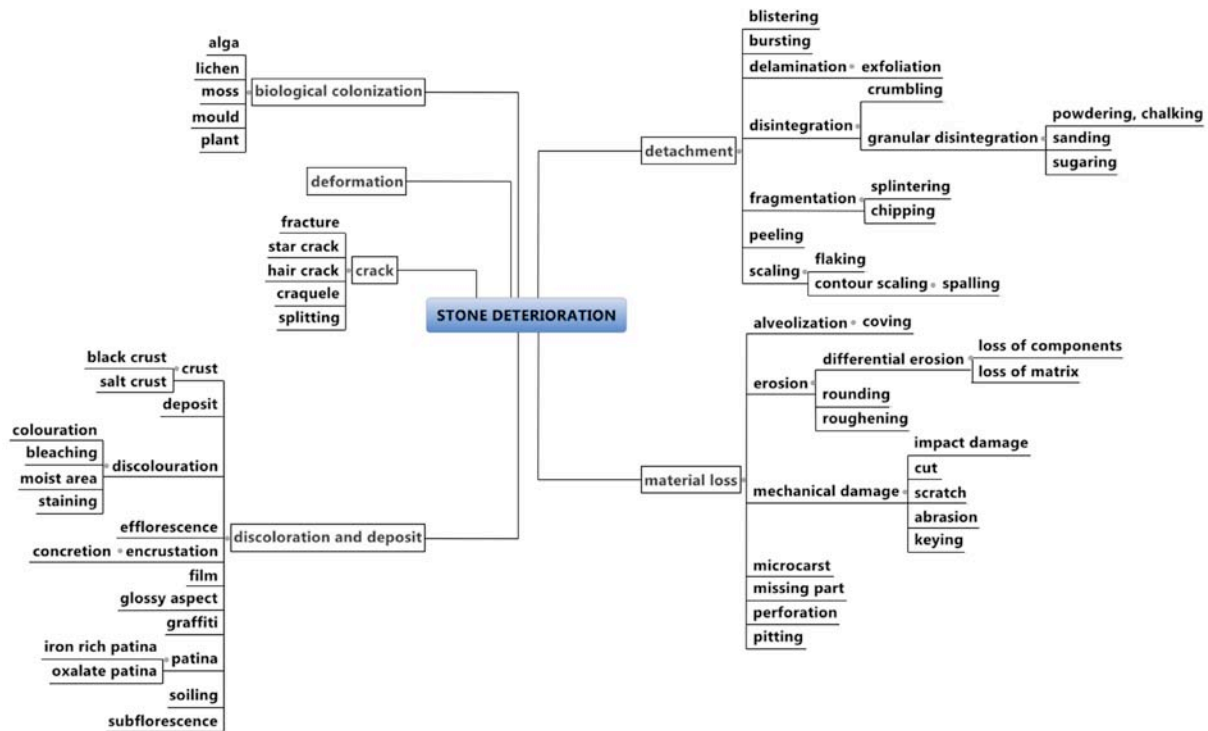
Fig.1 Example of knowledge map for stone damage

framework able to logically relate different concepts (component, material, damage, cause and intervention) and allowing for integration of users' knowledge by the implementation and improvement of built-in mapping of factors (fig.1).

MONDIS serves two main functions: input of knowledge (complete analysis and diagnosis of failures) and searching of stored solutions. Each entry can include a full description of a damage manifestation to which acting damaging mechanisms, primary and secondary causes can be assigned. For this purpose the system presents a layering in the modeling of cases´ entry dependent on the depth of information provided by the user. The option to either qualitatively or quantitatively assess damages, risk and a component condition is supported. The user interface is backed by a pictographic vocabulary for improved precision in entering or retrieving records.

MONDIS is composed of several parts: dedicated server for storing data, semantic web engine, user interface for entering/retrieving data, and a tool for in situ damage surveying. It is designed to accommodate a diverse community of users, being able to adapt to their different perspectives: experts in the field of restoration and conservation, owners and property managers, researchers, students and general public. It can be accessed on-line on the Internet: http://www.mondis.cz.

4. Conclusions

The paper presents a project aiming to develop a knowledge-based system for documentation and analysis of defects of cultural heritage objects. The MONDIS information system covers mainly damage of immovable structures due to various causes, and preventive/remedial actions. Its main goal is to create an artificial intelligence able to reproduce the interplay between relevant factors which govern damaging mechanisms in historical constructions.

Acknowledgement

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