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Building Museum Information Systems: A Knowledge Management Approach

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***Abstract* – Approaches to Museum Information Systems development focus mainly on the form of the product (collections metadata standards, digitisation standards for digitising visual or audio material, etc.), rather than on information systems analysis and design issues. Consequently, true understanding of the information development process is still missing. This paper advocates an enterprise knowledge management approach towards the development of museum information systems. It provides a structured framework, which incorporates different viewpoints that provide insights into the purpose of the system, its operational characteristics and its implication on the roles of the different actors inside and outside the organisation. We argue that such an approach can lead to a closer alignment between the organisational and informational aspects of a museum.**

***Index terms* – museum information systems, knowledge management, knowledge modelling**

I. INTRODUCTION

Museums as cultural organisations, generate and hold vast amounts of information. This falls into three types of categories: *collections*, *museological* and *business* information [1]. Collections information refers to all of the documentation about museum objects. Examples include accession, catalogue, donor records and image files. Museological information concerns the documentation about the activities that have some relationship to the objects such as conservation, exhibition, scholarly research and education materials. Finally, business information is all of the documentation about the institution housing the object and its administration, including financial and human resource records, names and addresses of donors, members, consultants and the museum's communications with all these entities.

In most museums these records and documents are viewed as a discrete set of material stored in separate 'containers' including databases, web sites, reports, libraries and archives, usually controlled and maintained by those who created them.

Commercial museum software applications (referred to as collections management systems), focus on collections information [2, 3]. As such they provide the means for documenting, indexing, retrieving and displaying data about museum objects. Less attention is paid in the need for managing museological information, or in the need to record and trace business information about museum public events and programs, or statistical information such as audience research, in relation to objects of the museum collections.

Museum web sites on the other hand, are often built from a "web emergency" perspective with the short-term goal of responding to an outside demand for putting content on the web [4]. These efforts focus on external information provision rather than internal information management. As a result, a lot of

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resources go into generating information, but no policies exist for retaining and re-using it [5].

There is an increased awareness among museum information management professionals about the need to create, deliver and store museum information on an institutional rather than departmental or even individual level [1, 6, 7]. In this sense, the fragmented view of information scattered throughout the museum will give its place to *knowledge* gained from navigating the information.

Current approaches to Museum Information Systems development have focused mainly, on technical issues for integrated access to different categories of museum information (e.g., mda's international museum standard for describing objects called "SPECTRUM", and CIMI's Museum Initiative for Digital Information Interchange Standards project). They focus on the form of the product (collections metadata standards, digitisation standards for digitising visual or audio material, etc.), rather than on analysis and design issues. Consequently, true understanding of the information development process is still missing.

This paper advocates an enterprise knowledge management approach towards the development of museum information systems. Enterprise knowledge management refers to the collection of *conceptual tools and techniques* that enable the communication and sharing of enterprise knowledge between different people. We argue that such an approach can lead to a closer alignment between the organisational and informational aspects of a museum. By bridging these two domains one can begin to incorporate measurement parameters, justification criteria and explanations about the information system 'product' and the 'process' by which it was developed, in terms of 'real-world' objectives, needs and phenomena. The approach is exemplified through the use of an arts museum case study.

II. KNOWLEDGE MANAGEMENT

Knowledge management is more about enabling than managing [8]. Its main objective is the communication and sharing of enterprise knowledge between different people. An issue of concern therefore, is how to describe enterprise knowledge so that this sharing can be effective. In practice this question has been answered in terms of two possible alternatives: using *natural language* (for example consultants' reports) or using *conceptual modelling*.

The advantages of conceptual modelling over informal, natural language descriptions are well documented [9, 10]. The goal in developing conceptual models is to gain insights into the problem and through this to arrive at an agreed set of requirements. This needs to be achieved in the context of an organisational setting that has the usual facets of time constraints, interpersonal conflicts, organisational politics, and ambiguities about goals and requirements.

Within the context of conceptual modelling, the term *enterprise knowledge modelling* refers to a collection of techniques for describing different facets of the organisation [11-16]. It provides a structured framework, which incorporates different viewpoints that provide insights into the purpose of the system, its operational characteristics and its implication on the roles of the different actors inside and outside the organisation. It is a natural extension to information modelling whereby the models target not just the information system requirements but also the enterprise objectives, the work processes, the customer needs and processes that create value for customers.

In summary, enterprise knowledge can be logically grouped in terms of three views:

- The *intentional* view. This provides a definition of the organisations' goals and objectives that describe the enterprise purpose.
- The *operational* view. This provides a definition of how objectives are realised through the co-operation of enterprise actors.
- The *informational* view. This provides a definition of the information, its structure and allowable operations that ultimately support enterprise actors in carrying out their roles.

The knowledge management process can be described as a systematic process consisting four general tasks: conceptualise, reflect, act and review [17].

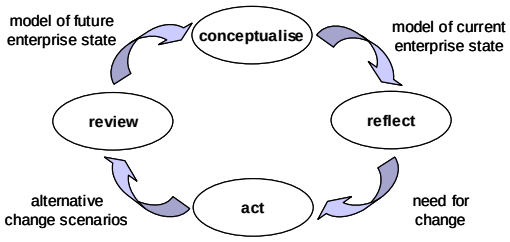

Figure 1: Knowledge management process

The conceptualisation phase concerns the elicitation of knowledge from different organisational actors (stakeholders) and its representation using appropriate modelling tools. The reflect phase refers to the analysis of current strong and weak points and about opportunities for improvement of the current organisational state. Based on this analysis enterprise stakeholders can identify new goals and devise *alternative* operationalisation plans (scenarios) that will bring the new goals into fruition (act phase). Finally, the review phase requires criteria for assessing the appropriateness of alternative scenarios. A summary of the knowledge management process is shown in Figure 1

III. Applying EKM – a Greek arts museum case

To illustrate the application of knowledge management approach we use examples from a Greek arts museum case study. The museum is organised in three divisions namely: collections management, public programmes and administration. The collections management division is responsible for the registration, documentation and preservation of museum's art objects. The public programmes division is responsible for the organisation of events and the production of museum publications aiming to disseminate information about the collections to the public. Finally, the administrative division is responsible for internal personnel and financial administration as well as for providing visitors services. Since it is a small museum more than one of the responsibilities within the three divisions are assigned to the same individual.

The functional organisation of the museum is depicted in the following Figure 2.

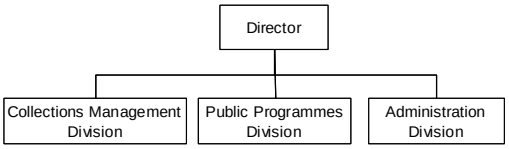

Figure 2: Functional description of the museum organisation

Currently, information about the museum's collection is kept only in paper-based form. In order to provide better access to the information held about its art collection, the museum has taken the decision to transform its existing documentation and information provision processes.

According to the knowledge management approach this involves the following tasks:

- describe current museum processes using appropriate process models (*conceptualisation*),
- identify strengths and weaknesses of current processes in relation to the

objective of improving public access to the museum information (*reflect*),
- deliberate on identified issues and identify the required changes and develop alternative change plans (*act*), and
- assess the appropriateness of proposed plans against a number of criteria (*review*).

The modelling techniques chosen to support knowledge representation in our example, are Role Activity Diagrams [18] and simple goal hierarchies [19]. Role activity diagrams show the set of activities carried out by individual or groups in the context of their role. In addition they show how different roles interact in the context of different museum processes. Goal hierarchies illustrate organisational goals and how they are operationalised in terms of organisation processes.

A. *Conceptualise*

The aim of the conceptualisation phase is to document knowledge concerning the current museum structure and operation.

Such knowledge can be found in existing organisational charts (similar to the one shown in Figure 2) and accompanying descriptions of the role of the different divisions.

These documents provide a clear view of the functional organisation of the museum according to the individual types of work performed within each museum division. However, they fail to describe the collaboration between different actors within and/or across different divisions. Relevant knowledge is distributed among museum staff and therefore, the conceptualisation phase requires their active involvement.
Modelling of the current museum processes is facilitated by the use of Role Activity diagrams. Rather than focusing on museum activities within the boundaries of different functions, Role Activity diagrams describe the current museum behaviour in terms of the roles involved in each process, the responsible agents and their collaboration. A model of the 'art object documentation' process is presented in Figure 3.

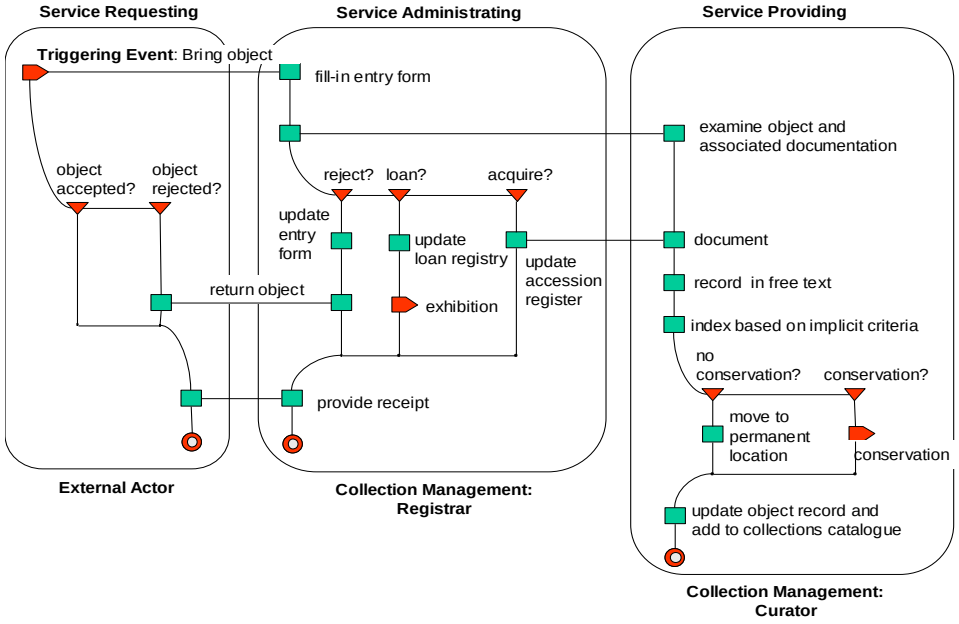

Figure 3: Role-Activity diagram of the 'art object documentation' process

As illustrated in Figure 3, the process is triggered when a new object is brought to the museum through a donation, a purchase, a field collection, or a loan. New objects are brought to the registrar of the Collections Management Division who is responsible for registering all objects entering or leaving the museum. In case of a loan, the registrar fills-in the loan registry and then forwards the object to the Public Programs Division who is responsible for the exhibition that the object is intended. In all other cases, the registrar in co-operation with the curator, decide whether the specific object should be acquired for the collection of the museum or not. If the object is acquired the curator based on his/her knowledge and skills assigns an authoritative name to the object, establishes its use, identifies the materials from which it is composed, decides on the authenticity, or otherwise, of its professed provenance, and generally documents the object. This information is being recorded in free text. In addition the object is classified, again using an implicit indexing scheme. Finally, the curator decides whether the object should be sent for conservation or it can be moved to its permanent location and the associated information is input to the object record (card) which is then added to the paper-based collections catalogue.

B. Reflect

Conceptualisation of the existing museum processes provides the background knowledge for discussing current strengths and weaknesses. This results in the following observations:

Strong points

- Cataloguing and indexing is performed for all art objects based on many years of experience.

Weaknesses

- Documentation is mostly performed in a free-text form. This has two drawbacks (a) free text is often too general lacking the necessary detail to distinguish one object from another; (b) no standard vocabulary is used which makes difficult the exchange of information with other museums.
- No standard mechanism for classifying and indexing art objects is used. Rather information searching and retrieval is based on implicit knowledge of museum staff. This implies the risk of losing knowledge through staff retiring or changing jobs.
- The information of art-objects exists only in paper-based form, therefore it cannot be accessed by more than one person at a time, nor is it possible for people to access the information at a distance, e.g., over a network.
- Collections catalogue is only accessible to museum staff, which implies that visitors enquiries can be time-consuming on the part of the museum staff, especially when these cannot be answered by specially prepared information sheets.

C. Act

The next phase in the knowledge management process concerns reflection about the required changes in the museum processes on the basis of the strong and weak points identified and in relation to the objective of 'improving access to the information held about the museum's art collection' and planning the realisation of the intended changes, i.e. identifying the changes that should be made on current processes in order to address current problems and achieve new museum goals.

The transition from intentions to processes is a gradual process that encompasses the 'causal transformation' of general goals into one or more (often alternative) subgoals. For

example, 'improving access to the information held about the museum's art collection' can be refined in the complementary subgoals 'use standard way to describe and classify art objects' and 'improve access to the museum catalogue'. The former can be consequently refined into two alternative subgoals 'develop standard vocabulary from existing documentation' or 'use an art thesaurus'[1]. In a similar way using an art thesaurus may be refined into the alternative subgoals 'construct a thesaurus' or 'customise existing thesaurus'. This is graphically represented in Figure 4.

The result of this activity is the construction of a goal graph containing alternative ways of acting towards realising the desired change.

D. Review

This final step, refers to the evaluation of the 'competing' change options previously identified. The evaluation task is facilitated by the identification of criteria which can be both qualitative or quantitative in nature, such as implementation costs, efficacy of proposed transformations, feasibility to deliver the proposed transformation in a given time frame, etc.

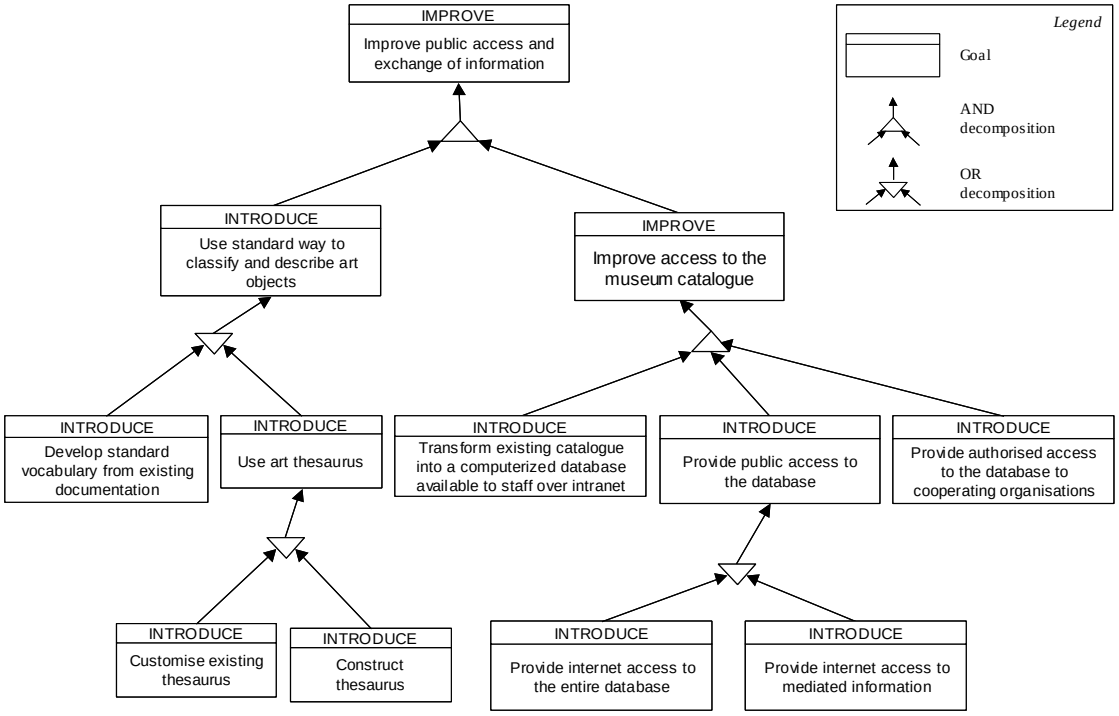

Figure 4: Alternative ways of improving the current museum situation

For example, let us consider the two alternatives 'construct a thesaurus' or 'customise existing thesaurus'. A thesaurus is a tool, which helps indexers and searchers to choose words consistently to describe things or concepts and

[1] *Thesauri*. Controlled vocabularies of semantically related terms usually covering one field of knowledge.

to improve the consistency and retrieval information and forward communication across organisations and public. However, the construction of a thesaurus is time-consuming and requires both a financial and a staff resource. Furthermore, the creation of a thesaurus, may not be possible at all, if there are no information and subject professionals in the museum.

Alternatively, the museum could use an already created thesaurus. For example, the Getty Information Institute has produced an *Art and Architecture Thesaurus [20]*. Unfortunately, there is no availability of this thesaurus in Greek, thus once again both the financial and staff resources may be required in order to translate the AAT terminology into the local language. In addition, it could be possible that certain terms specifically relevant for Greece may not be included in the AAT.

Thus, it can be seen that selecting among alternative plans is not straightforward and in many cases it could lead to the identification of new alternatives, such as 'to use the AAT as a guide in order to develop a thesauri specific to the museum needs'.

IV. Conclusion

The development of information systems is not simply about designing software components but also about understanding the needs of individuals and other stakeholders within the enterprise and ensuring that the system meets user requirements and business strategy.

The approach presented in this paper is based on the premise that the key to successful development of museum information systems is *knowledge* shared by multiple stakeholders about:

- *where* the museum *is* currently
- *where* the museum *wishes to be* in the future and
- *alternative designs* to effectively bringing about transformations about the desired future state.

This knowledge management process concerns the modelling of knowledge distributed among different museum actors. The models themselves serve as transitional objects – their value is derived from their usefulness in the process of learning that the actors undergo.

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