Museum Space – Model-driven Web-based Platform for Digitalisation and Preservation of Cultural Heritage

Maria Todorova, Teodor Martev
Sirma Solutions, Tzarigradsko shose 135, Sofia, Bulgaria
maria.todorova@sirma.bg, teodor.martev@sirma.bg

Abstract. Museum Space is an end-to-end Museum Management Software Suite developed to help Galleries, Libraries, Archives, and Museums (GLAM) make the World’s Cultural Treasure accessible to and meaningful for all. Museum Space utilizes Sirma Enterprise Platform (SEP), a comprehensive open-source platform with a service orientated model-driven architecture (SOA, MDA) for high performance and reliability in the cloud. SEP incorporates open source components and semantic technologies which are used to implement enterprise content management (ECM) applications covering document and collaboration management, business process management, semantic search, optical character recognition (OCR), image annotation, managing email correspondence, security and permission management, integrations with legacy systems, etc. The semantic technology allows representing highly interlinked data and application of data scheme updates without increasing implementation and maintenance complexity.

Keywords: museum, GLAM, model-driven application, open-source, semantic

1 Introduction

The idea for the development of Museum Space (https://museumspace.com/), solution for full museum management, including collections, exhibitions, loans, acquisitions, conservation activities started from Conservation Space – a web-based, open-source, digital document management system, developed specifically for conservators by Sirma.

More than 8 years ago, in 2010, in a workshop organized by The Andrew W. Mellon Foundation (https://mellon.org), was identified a need of a system for the conservation community. A group of 26 conservators and IT professionals participating in the workshop, came up with functional requirements for ConservationSpace (http://conspace.wixsite.com/conservationspace/copy-of-overview-1) - a well-designed open-source software system that would facilitate the work of conservation professionals by supporting customizable templates to make report writing easy, providing ability to upload and store documents in all popular formats, powerful search tools to find documents, configurable to address all types of cultural objects, image annotation, etc. The request for proposals was released in October 2012 and our company Sirma
Solutions, a member of Sirma Group Holding, was selected as the developer in February 2013.

After we achieved the functional scope of ConservationSpace, and deployed it as a cloud multi-tenant application ready to be used by partner museums (Courtauld Institute of Art, The Denver Art Museum, Indianapolis Museum of Art, Statens Museum for Kunst, Yale University, and the National Gallery of Art, Washington), we upgraded the solution with two more modules – Exhibition Space (with exhibition management functionalities) and Collection Space (with collection and curation management functionalities).

2 Sirma Enterprise Platform - the Basis for Museum Space

2.1 SEP Architecture overview

Sirma Enterprise Platform (SEP) is a combination between semantic technologies, modelling tools and methods, as well as utilization of leading open-source servers and components. It is designed applying service-oriented architecture (SOA) for high performance and reliability. Applications built with the platform solve various business problems and comprise of specific models and customizations on top of a rich functional foundation. More information about the architecture and technologies used can be found on the Sirma Enterprise Platform web site (https://www.sirmaplatform.com/)

2.2 SEP Functional overview

SEP establishes a solid functional foundation for enterprise data integration, content creation and organization, collaboration, knowledge management and business processes. The platform incorporates the following basic functionalities:

- **Content management** - Ability to upload, store and preview any kind of existing electronic document formats – MS Office, PDF, txt, scanned documents, images, audio and video files, OCR of scanned documents, version control (preview historical versions, compare versions), full text search in document content, records management, etc. Ability to create and edit documents directly in system, that can combine static text with dynamic content like a result of a real-time reports and content from other business objects and images.

- **Image management** - Integration with Mirador tool, an open-source, web-based tool for image annotation, deep zoom and image manipulations (brightness, contrast, flip, rotate, adjust saturation, support grayscale, image comparison and image overlay).

- **Manage business objects** – Ability to create business objects based on organization-specific semantic domain model, create libraries of business
objects, link documents and other business objects, manage behaviour based on state transitions.

- **Tasks and Business process management** - Integrated BPMN 2.0 based Camunda workflow automation platform, ability for automated execution of custom workflows, configured based on organization needs, support of single, pool and multi-instance tasks, log time on tasks, assign tasks in the context of documents and business objects, send notifications on new tasks.

- **Dashboards** - Provide personalized view of the system through custom dashboards, provide personal dashboards, as centralized high-level view of key information associated with the user.

- **Integrated e-mail** – Integrated Zimbra mail server and client, allowing support of email addresses for different business objects, thus providing unified space for communication and collaboration by sending email messages and addressing to internal and external recipients from the business object itself.

- **Contextual comments** - Ability to comment and create discussions on every document and business object, search and filter comments, send e-mail notifications when user is addressed in a comment.

- **Search** – Keyword search in the content of any document and business object, advanced search queries, providing ability to combine different business object criteria with AND and OR operands, saved searches.

- **Business reports** – provide ability to create custom static and dynamic business reports, support table view format of the reports, export to MS Excel, MS Word and PDF.

- **User management and access control** – manage user login credentials, manage personal profile, support role-based system for access control, support system audit log, single sign-on.

- **System configurations** – template management, vocabulary management, organization/tenant specific configurations – default language, time zone, date format, etc.

3 Museum Space

Museum Space is a web-based, open-source museum management solution, built on top of SEP for the needs of Galleries, Libraries, Archives and Museums (GLAM). As the solution is model-driven, it allows rapid application development (RAD) and could easily be customized for any institution based on its specific requirements – data model, cultural objects tombstone data, business objects (e.g. loans, exhibitions, acquisitions, movements, etc.), types of documents and document templates, business workflows.

3.1 Features and capabilities

The museum management functionality is organized in 3 integrated modules – Collection Space, Exhibition Space, Conservation space:
• **Collection Space** - The module maintains an electronic dossier for every cultural object, that includes the scientific passport of cultural value and all documents related to acquisition and restoration, certificates, scientific publications, surveys, condition assessments, photos, audio and video files, etc. The module facilitates the movements and inventory of cultural objects by keeping register of all the buildings and premises of the museum, with history information for all the movements and relocations.

• **Exhibition Space** enables collaboration between people from different departments during their daily activities for preparing an exhibition - planning, documentation, sending requests for outgoing loans to other museums and private collectors, tracking requests for movements from one premises to another, etc. All materials, prepared for the purpose of an exhibition are stored in one place in a digital format - printed texts, drawings, diagrams, posters, diagrams, etc.

• **Conservation Space** is designed especially for the needs of conservation experts and conservation departments at galleries and museums. The main advantages of the module are related to the opportunities for creating documents, based on templates specific to the institution, running automated workflows for restoration and of cultural objects, storage of key data about the current and previous condition of cultural objects, annotation and manipulation of available images, image overlay and image comparison.

### 3.2 Models

The application is built based on specific models which manage specific aspects of the application. The data model is managed using ontology models and controlled vocabularies. The behaviour model covers the availability of actions, state transitions, validation, rules and conditions as well as business processes. The view model covers the representation of the data by allowing the users to manage templates by using different rich text editors and widgets. Examples of models are given below. The models are easily configurable to meet specific need of particular organization.

**Museum Space ontology model**
Templates of documents and business object view pages
Templates define how information to be visualised. System allows users to create and update templates.

State transitions and actions
State transitions are modelled in state diagrams and implemented as XML configurations.
Business process modelling

Business processes are modelled in BPMN 2.0 using Camunda Modelling tool. The BPMN 2.0 file is then deployed on Camunda Workflow Platform which is integrated in SEP.
3.3 Screens

Cultural object’s dashboard
Cultural object’s dashboard shows all information related to the cultural object including metadata, gallery view of related images, related documents, related activities such (e.g. conservation activities, movements, loans, etc.) and other. The dashboard is split in tabs so that different aspects of the cultural object to be displayed in more details separately. Comments, discussions can be easy added.

Metadata fields
A comprehensive set of metadata fields is available. Customs metadata fields can be added via configuration.
Acquisition workflow

Formal processes may require automated workflows, for example review of acquisitions. Workflows ease the process of going through process, providing tasks assignments according to the predefined flow, visualization of the workflow and its status, reports etc.
Creating documents online
System allows users to create documents online. Predefined document templates are available and users can define their own. The online created documents can combine text, dynamically extracted information, preview of images, reports results etc. Document templates can be used.

Images
MusemumSpace provides a functionality to preview, annotate and edit images. Images can be directly previewed, manipulated or annotated on object’s dashboards and in documents.
Images can be visualised in different views – image view, book view, gallery view and scroll view.

![Fig 9 Preview of an image related to a cultural object](image)

Deep zoom on multi-resolution images is available.

![Fig 10 Deep zoom of a multi-resolution image](image)

Image annotations can be placed on a selected area of the image using various options for selection shape, collar, comment format, and more. Comments on annotated images can be easily seen at any time when pointing at the annotated area.
Fig 11 Image annotation

Image overlay allows different photographs (x-ray and a regular photo) to be put on over the other as separate layers. Changing opacity of each layer reveals mappings between the images.

Fig 12 Image overlay
Searching
MuseumSpace provides comprehensive and easy to use search functionality, based on semantic technology. It allows users to search using combination between texts, metadata and object relations.

Advanced search allows using of all metadata and relations of the objects together with full text search.

![Advanced search for objects](image)

Fig 13 Advanced search for objects

Reporting
The MuseumSpace provides a comprehensive set of reporting options. The reports show up-to date information visualized as tables or different charts. Report results can be included in any document or on dashboards.
Fig 14 Reports as charts

Received: June 19, 2018
Reviewed: July 06, 2018
Finally Accepted: July 12, 2018