Knowledge Management System IMMPETUS (KMSI) - Connoisseur

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***Abstract*— KMSI (Knowledge Management System IMMPETUS) is a web based portal which facilitates IMMPETUS (Institute for Microstructural and Mechanical Process Engineering: The University of Sheffield) users, potentially providing a web area where data mining, data archiving, data retrieving are systematically carried out. It is a versatile web portal which can handle raw data, research knowledge and sharing of information with transparent access by the whole of the IMMPETUS research team. This includes internally and externally generated data and knowledge, past and present. Hitherto, KMSI has focused on hierarchical structures with bi-directional communication between the various levels. KMSI's previous configuration had limited functionality in terms of collaboration among project groups and across the whole of the IMMPETUS. Contributions of knowledge by individual members are now promoted as this is vital for Information Management and help users to track their project work. In this paper, we explain how Microsoft SharePoint 2010 framework technology can easily be used to develop; a versatile web portal to systematically include optimal experimental design, data analyses, collaboration, and overall knowledge management.**

Keywords-information storage; data sharing; data mining, knowledge management; decision making.

I. INTRODUCTION

"IMMPETUS is a research institute providing its wide range of services to integrate metallurgical, mechanical and thermal considerations in developing soundly based models for process planning and control to achieve target microstructures and product properties within increasingly fine tolerances and greater efficiency" [1]. IMMPETUS constitutes itself with the help of three disciplines of control systems, mechanical systems and engineering materials to produce world leading research. IMMPETUS, as an institute, is internationally renowned for its innovative approach for the study of the thermomechanical processing of metals, which includes Steel, Aluminium and Titanium alloys. IMMPETUS research emphasizes on; (1) the deeper physical understanding of the thermo mechanical behaviour, and the development of the associated models with adequate accuracy and transparency, (2) the identification of optimal processing routes to achieve pre-defined microstructural and mechanical properties [1].

A. Requirements

Over a period of time spanning more than a decade IMMPETUS has since evolved and the number of research projects carried out under its umbrella has significantly increased. Academic supervisors are responsible for managing various research projects simultaneously from microstructure to modelling and control. During the project development phase collaboration and information sharing among the various groups is essential; once a project is completed all the artefacts and mature data are needed for future usages of development and research work.

The collection of data, analysing the results and sharing the right information across the research staff is a vital task for all researchers.

Our aim with this work was to develop, using the latest technologies, a system; (1) which easily scales across the IMMPETUS potentially giving any research project a dedicated web-based work area where one can store project artefacts and will be able to quickly retrieve the desired content whenever it is needed, (2) a team-oriented collaboration tool to help project members to monitor project progress, (3) potentially providing knowledge sharing, document storage and advanced user-controlled features, and (4) services to store and analyse experimental data.

 ISBN: 978-1-61208-162-5

II. KNOWLEDGE MANAGEMENT SYSTEM

Knowledge management systems (KMS) are IT systems developed to store, manage and share on organization's knowledge. These IT-based systems are significantly important to facilitate and enhance the processes of knowledge creation, storage and retrieval [2].

It is a challenging task to capture all the data from various sources and to disseminate the most adequate information using IT systems. Gathering all the data from various sources and processing it in order for it to have some meaningful information is in itself a thought-provoking job.

IT systems are becoming *the tool* relied upon by many organisations around the globe to decide on how to manage electronic records [3].

The list of vendors who provide various software solutions to manage data and information is rather long but difficult to report in full. Gartner has published a comparison of 'Enterprise Content Management Systems' [4] being provided by some of major vendors. It is however worth noting that it is not always straightforward to purchase ready-made systems that suit one organization's needs, but many customising work will be needed.

III. KMSI CONFIGURATION

KMSI's configuration is fundamentally organised so as to gather the experimental data, expert knowledge, preliminary results, mature data, and document storage. Because group collaboration is also promoted, it has the potential of providing a robust infrastructure for storage and collaboration, a foundation platform for a web-based project areas (workspaces) and services, and a more efficient way of using tools for information-sharing that help users stay connected and informed across the whole of IMMPETUS.

A. Why Dynamic Knowledge Management System ?

Dynamic Knowledge Management Systems are concerned with the sharing of knowledge that already exists but also focus on the production of new knowledge [5].

In IMMPETUS, every research project has its own boundaries and requirements; therefore the KMSI system architecture is designed to handle various types of information in a holistic way. A platform was needed where all past research information is located and current projects artefacts can be stored, content can be accurately classified, and information sharing can be made easy in a fashion where group collaboration is a core element. When new research projects are initiated in IMMPETUS more web-based project areas are required within existing KMSI structure having all modules which are vital to complete that specific project

B. Putablity and Findability

The information process should be made easy for uploading the content and retrieving the desired information effectively which represents hub of knowledge management.

"*Putability is the quality of putting content into an information management and retrieval system with the correct metadata."* [6].

"*Findability is the quality of being locatable or navigable*" [6], in other words it is the process which helps to find desired content easily even intuitively.

It is vital for better decision making to obtain the desired information whenever it is needed. KMSI is designed to put and locate the desired content quickly using 'SharePoint 2010 Search' [7] to best fit with modern age IT requirements.

C. Technology Used

Microsoft latest software and technologies are used to build such a robust portal. Some of the details about the hardware and the software used to configure KMSI are as follows:

a) Hardware

- 2 Processors, 2.53.Ghz, Core-2 Quad
- Ram 16 GB
- 2 Hard disks 250GB each for Operating System, configured on Raid-1
- 3 Hard disks 500GB each for data base, configured on Raid-5

b) Software

- Microsoft Windows Server 2008 R2 (64 bit)
- Microsoft SharePoint 2010 (64 bit)
- Microsoft SQL Server 2008 (64 bit)

D. KMSI's Architecture

KMSI's architecture has been designed so as to accomplish all IMMPETUS information management requirements; its dynamic structure can easily be extended for developing future web-based project and knowledge sharing areas. The contribution of knowledge by individual members has also been added as it is vital for Information Management and storage. Latest technologies are used to enhance the usability and boost the ability of storing, sharing and publishing information. The Server Administrator can create as many areas as required which inherit features from the core platform. The baseline hierarchy aims at providing more flexibility and knowledge sharing between members using more intuitive ways. Information retrieval from experimental equipment is integrated in a customizable manner which has the flexibility to alter interfaces as per diverse project requirements. Architecture has the potential to import experimental results directly from some modern equipment using their API (application programmable interface) which enhances its productivity.

The three main different web applications have been created on IIS (Internet Information Services) web server having their own separate data-bases to keep the process isolation. The web applications within KMSI are as:

(1) Data Libraries Area: A publication web site which archives all important information using modern web interface. Information stored here is available to all IMMPETUS members.

(2) Projects Area: The web application designed within KMSI, having multiple project sites and sub-sites. Each IMMPETUS core project has its own workspace or web site.

 ISBN: 978-1-61208-162-5

Content modification rights are only given to the members of that particular project area.

(3) Personal Area: Members have their own personal area where one can store all kind of work related information and restrict access privileges.

The two core features of the web-applications are as:

(1) Advanced Search: SharePoint 2010 Search service [7] is connected with all of three web applications. Users are able to find information quickly and easily using advanced filters.

(2) Security: Permission levels are enhanced at multiple levels especially at Project Area, Personal Area and file level.

Figure 1 depicts the current structure associated with KMSI.

1) Data Libraries Area:

One may wish to publish a particular content on the IMMPETUS intranet whether it is individual documents, web pages, theses, publications, annual reports, images, videos, experimental data or records with strict regulatory requirements being fully managed within KMSI's architecture. The documents library includes many levels of sites and sub-sites, so that one may use the navigation bar to quickly browse to the content that one wants. Data libraries are provided with advance filtering and sorting features. Information stored here is protected and only authorised users are able to read it. An on-line survey area is also created and results can be stored and viewed in an efficient graphical manner. A multimedia library is also provided where images, audio and video files are being stored; media assets such as videos can be watched directly from the library. The optimum supported media file size is 150MB but up to 2 GB of video file can be stored here [8].

Currently, about 2800 different documents and files have been stored on various data libraries; the average size of a document/file is about 2 MB. Figure 2 shows the KMSI 'Data Libraries Area' home-page for browsing the public libraries.

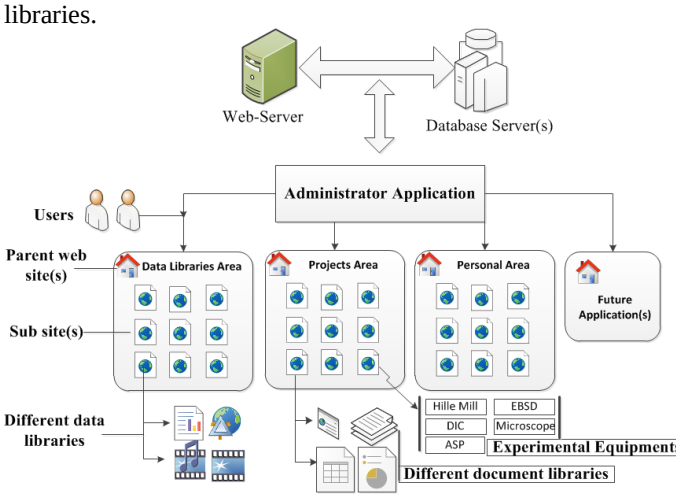

Figure 1. KMSI's configuration model

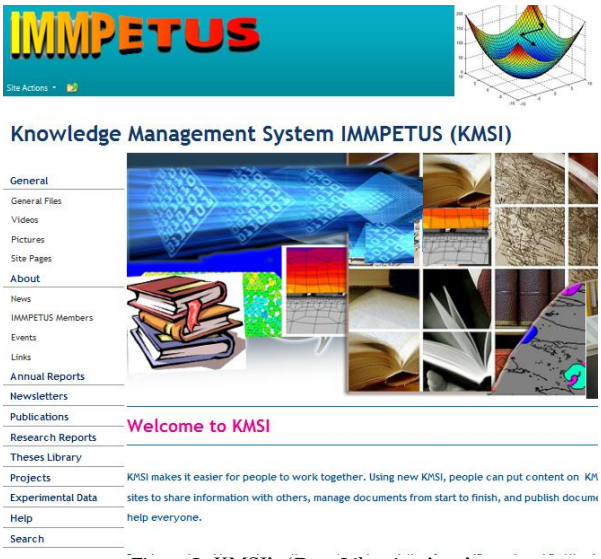

Figure 2. KMSI's 'Data Libraries Area'

2) Projects Area

KMSI has a dedicated website for each IMMPETUS project which acts as a vehicle for effective collaboration and information storage infrastructure for members. Each project area has a facility to store documents, files, experimental data, and organise stored data into different kinds of libraries. Microsoft SharePoint 2010 Team-site [9] templates are used to develop different project workspaces because they are highly flexible and designed to encapsulate collaboration features. Microsoft SharePoint 2010 and Microsoft Office are so strongly integrated that they provide a strong platform for collaboration and sharing [9]. Users having the necessary access rights are able to check-out, check-in, lock or share document(s) among whole of the project team where the permissions have been assigned. Online project management tools are also provided within Projects Area to view the progress of the project tasks. Each library is configured to store up-to 25versions of a file; the maximum file size which one can upload is restricted to 250MB. Figure 3 depicts the structure associated with Projects Area.

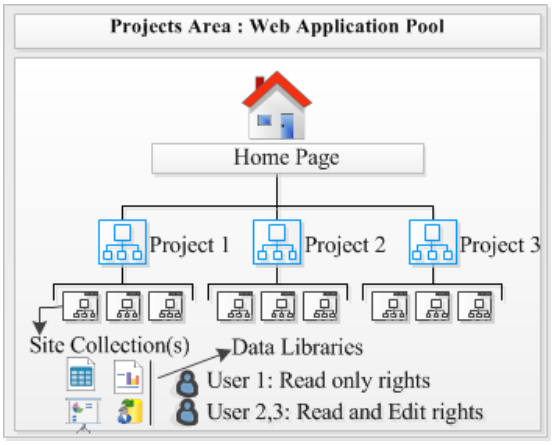

Figure 3. Projects Area structure

Five core data libraries are provided to store and share information in a 'Project Area' as follows:
a) PDF Files: This data library is built to store all PDF files which one can also share with other members.
b) Project Files: All types of project related files can be saved here such as Matlab, Abaqus, and MSC Nastran etc.
c) Presentations / Other files: This library is to store all presentations and power point slides. Users are also able to maintain versions of each file stored here.
d) Multimedia: Users are able to store all project related pictures and videos here.
e) Experimental data: This is a vital part of the Project Area where members are able to save records and data generated from experiments. Each project may have one or more records library e.g. Hille Mill, ASP (Arbitrary Strain Path), TMC (Thermo Mechanical Compression), and DIC (Digital Image Co-relation) etc. Figure 4 shows an interface to store experimental data onto KMSI server.

3) Personal Area

Personal web areas are designed for IMMPETUS academic staff, research associates and PhD students. This site provides a central location to manage and store one's documents, content, images, and useful information. 'Personal Area' serves as a point of contact for other users within IMMPETUS to find some information about the user, user skills, and user interests [10].

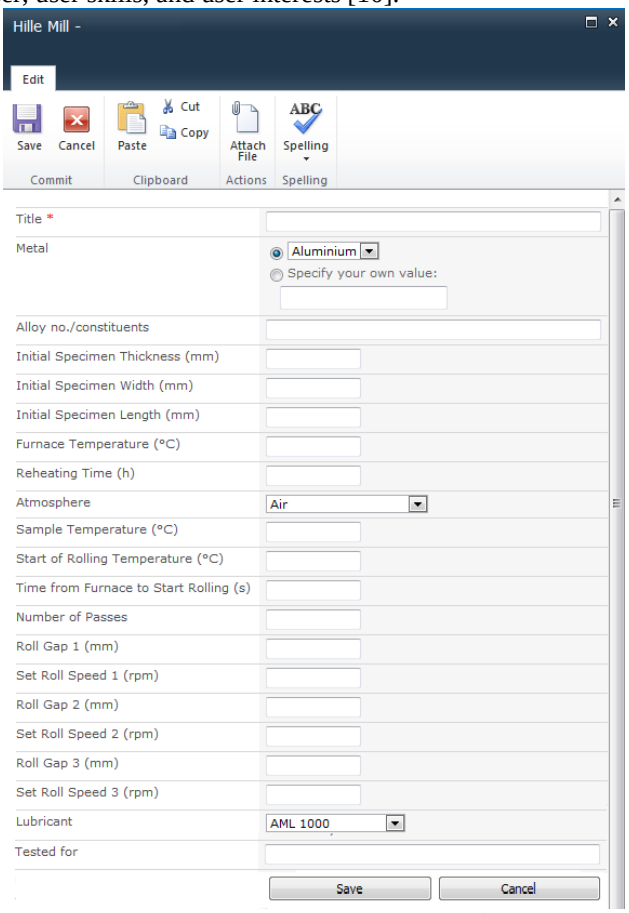

Figure 4. Hille Mill experimental data storage form

One can customise the information and the content on his/her personal web area. The user can manage (save/edit/delete) documents, lists, and images within his/her web area. Personal web area also facilitates users to organize and get their information when and wherever it is needed using a secure connection over the internet.

4) Advanced Search

A previous study [11] found the following: *(1) "Typical employees spend an average of 3.5 hours per week trying to find information but not finding it." (2) They spend 3.0 hours more recreating information they know exists, but that they simply cannot locate*".

KMSI provides an intuitive and flexible user interface, improved relevance, and the ability to search unstructured and structured information such as databases, all public information across the KMSI portal especially focusing on project sites, data libraries and experimental records. Advanced search filters help narrowing the search results to find the desired content quickly. Information can be refined using web area, author, date, document type (pdf, doc, docx, xls etc.), or using tags associated with the content. Figure 4 shows the search results returned by the system against the keyword 'steel'.

5) Security

A set of permissions can be granted [12] to KMSI members on a securable object such as a project site, document library, experimental data rig, folder, item, or document. Permission levels enable the user to assign a set of permissions to other KMSI members so that they can perform specific actions on their project area.
The following permission levels are granted:

- **Full Control:** This permission level contains all permissions (Administrator rights).
- **Area Members:** Can add, edit, and delete items in existing lists and document libraries. Assigned to those who are members of that project area.
- **Read:** Read-only access to the KMSI, users with this permission level can view items and pages, open items, and documents. This permission level is by default assigned to all IMMPETUS members within 'Data Libraries Area'.
- **File Level Permission:** Each site contains additional securable objects that have a particular position in the site hierarchy, and user can also set different levels of permission on various folders, files and contents. Figure 6 illustrates file level permissions for different users.

 ISBN: 978-1-61208-162-5

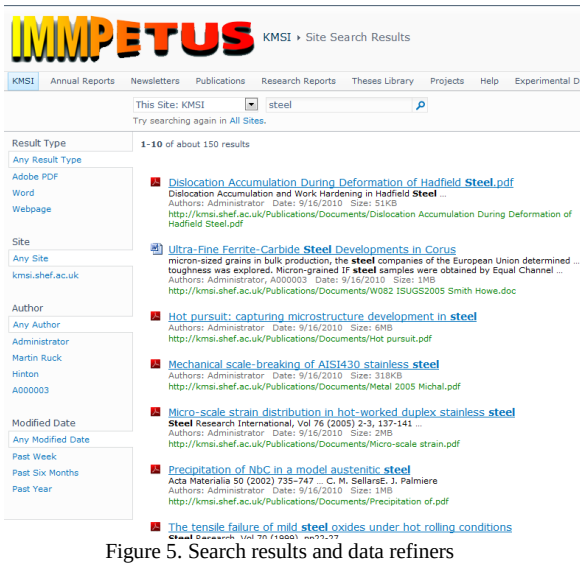

Figure 5. Search results and data refiners

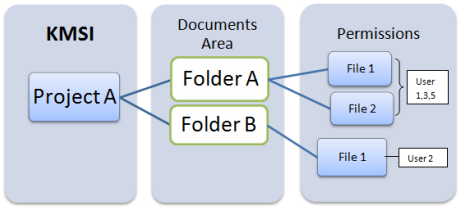

Figure 6. File level permissions for four different users.

IV. CONCLUSION

IT tools and technologies, such as Microsoft SharePoint 2010, are providing robust platform which can be used to develop the Knowledge Management Systems as per one's requirements. Our system (KMSI), which is based on Microsoft SharePoint 2010 technology, helps users gather information in a holistic fashion, regardless of the type of file or information. It also helps users to find, manage and keep track of the updated information in an efficient manner.

KMSI provides IMMPETUS members the necessary tools to manage their documents, research papers, and experimental records in an efficient way. Even more importantly, all this information is easily shared between users, such as project teams, Departments, and/or IMMPETUS members. The experimental data storage facility is improved and data can be easily exported to comma separated values (CSV) or Microsoft Excel format.

We were required to disseminate the required information to subsribed users whenever it is added onto the public libraries or in some project areas. Information is normally filtered and processed using 'managed meta data' [13], content types or using file attributes which help the system to identify information and re-route the information to the appropriate data libray or to some 'Project Area'.

We are having some difficulties to incorporate experimental data directly from some experimental equipment. It is also required to crawl inside some content like Matlab and Abaqus data-files; we are still doubtful how iFilters [14] help to dig inside those files. In future, we are also willing to add virtual experimental equipment inside the KMSI to perform experiments remotely using various data models which is a challenging and brainstorming job.

ACKNOWLEDGEMENT

The authors gratefully acknowledge the Engineering and Physical Sciences Research Council for their financial support under grant Ref. No. EP/E063497/1.

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 ISBN: 978-1-61208-162-5