

Application of Robotics Technology to D&D – 17249

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ABSTRACT

The Knowledge Management Information Tool (KM-IT) is a web-based system developed to maintain and preserve the deactivation and decommissioning (D&D) knowledge base across the Department of Energy (DOE) complex. The system was developed by the Applied Research Center (ARC) at Florida International University (FIU) with the support of the D&D community, including the DOE Office of Environmental Management (DOE EM), and with the active collaboration and support of the DOE's Energy Facility Contractors Group (EFCOG). The KM-IT system is a D&D community driven system tailored to serve the technical issues faced by the D&D workforce across the DOE Complex.

As part of the D&D KM-IT, FIU has developed a robotics database in collaboration with DOE EM and NuVision/Cogentus which currently contains over 500 robotics technologies along with information about the robotics technology vendors. This information is aggregated in real time and presented as a robotics technology fact sheet to the end user based on the selected technology. FIU is researching these technologies and studying their capabilities and application to D&D. As part of the research, FIU is categorizing each technology into specific application areas: characterization, decontamination, inspection, and demolition.

INTRODUCTION

FIU is currently supporting DOE EM in their initiative to improve safety, reduce technical risks, and limit uncertainty within D&D operations by identifying technologies suitable to meet specific facility requirements including hazardous and challenging tasks during D&D operations. As part of these efforts, FIU ARC has developed a web-based system developed to maintain and preserve the D&D knowledge base across the DOE complex [1]. The system was developed with the support of the D&D community, including the DOE Office of Environmental Management (DOE EM), and with the active collaboration and support of the DOE's Energy Facility Contractors Group (EFCOG). The KM-IT system is a D&D community driven system tailored to serve the technical issues faced by the D&D workforce across the DOE Complex.

New information, including vendors and technologies related to D&D, are researched and added to KM-IT on an ongoing basis. In late 2014, DOE EM provided a database of 471 robotic technologies, originally developed by NuVision Engineering and Cogentus Consulting, with a request to evaluate the potential for integrating the data into the KM-IT framework for ongoing hosting/maintenance of the information. All of

the data from the original database as well as photographs, documents, and videos are now available on KM-IT.

The KM-IT web-based interactive system is operational and available for use at www.dndkm.org (m.dndkm.org for mobile devices). Knowledge management (KM) is the practice or process responsible for gathering, analyzing, storing and sharing insights, experiences, knowledge, and information within an organization or community [2]. The main focus of KM-IT for the D&D community is to enhance safety through improved efficiencies by reducing the need to rediscover the knowledge and experience gained over time and to promote the reuse of the existing knowledge. KM-IT facilitates the gathering, analysis, storage and sharing of knowledge and information within the D&D community and has the ability to define, store, categorize, index and link digital information corresponding to D&D problem areas. The system has the ability to allow users to search for relevant content and presents the content with sufficient flexibility to render it meaningful and applicable across multiple contexts of use.

DESCRIPTION AND DISCUSSION

The original requirement from DOE Headquarters was to develop a repository and a dynamic system to promote use of the knowledge that exists within the D&D community by allowing D&D project managers around the DOE complex to share innovative ideas, lessons learned, past experiences, and practices. As there was no off-the-shelf computer application or integrated solution available for building the D&D knowledge base, FIU ARC has built an approach that is servicing the DOE complex with a high performance, n-tier web-based system for capturing the information from the DOE sites/facilities, former ALARA centers, EFCOG and the D&D community as a whole. This system was built using Microsoft.net framework®, SQL server 2005®, and SQL server reporting services®. Visual Studio 2005™, Dream Weaver® and Photoshop® were also used as development tools to construct the system.

After receiving a MySQL database backup of 471 robotic technologies from DOE EM, FIU evaluated the potential for integrating the data into the KM-IT framework for ongoing hosting and maintenance of the information. A MYSQL server was installed on the development server and restored the robotics database for its integration into KM-IT. FIU developed the data interface and mapping file for the import process since the two data structures (robotics database on MySQL database and KM-IT database on SQL server) are different. FIU developed the data structure that could import the technology titles and description mapping to KM-IT as well as combined the technology notes and operational experience data sections and mapped it to a new comments section within the KM-IT platform. In addition, FIU ARC created a new Group within the D&D KM-IT Technology module for Robotics. Multiple categories and subcategories were also created for the robotics technologies.

KM-IT links each technology entry to a specific vendor. Within the original robotics database, the vendor information was included in a column with additional text. There was no easy way to automatically extract that information because of the lack of

structure. Identifying and extracting the vendor information had to be a manual process. FIU student research assistants from the FIU-DOE Science and Technology Workforce Development Program (known as DOE Fellows) and other FIU graduate research assistants assisted in manually extracting the vendor information from the original database, creating vendor entries in KM-IT for each, and assigning the technologies to the correct vendor.

A large number of media files were provided by DOE EM which were imported into the platform and integrated with the KM-IT database. A robotics fact sheet module was created to display the technology and vendor details along with the associated media files. A search feature was developed to allow users to search through the robotics database and display summary results and factsheet details. After performing quality checks on the new robotics entries, the robotics technology database was made live on the KM-IT production server. All of the data and accompanying information (photos, documents, etc.) within the robotics technology database from NuVision/Cogentus were integrated into the technology datasheets on KM-IT. Figure 1 shows the Technology module homepage highlighting the new robotic technology database.

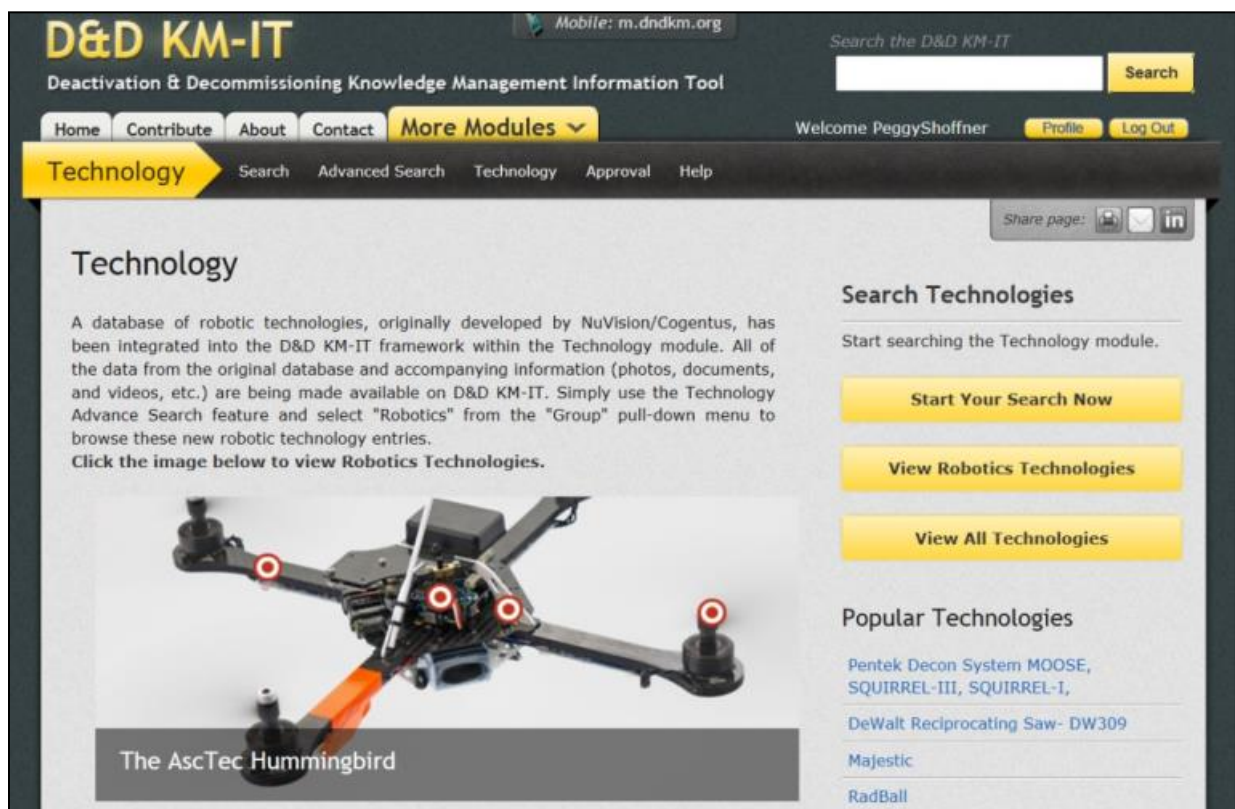


Fig. 1. Technology module homepage showing robotics technologies.

Since incorporating the robotics technology database into KM-IT, FIU has continued to research additional commercially available robotics technologies as well as robotic technologies currently in research and development for potential applications to D&D

challenges. These technologies are added to the robotics technology module in KM-IT on an ongoing basis.

KM-IT users can access the *Technology Advance Search* feature to select "Robotics" from the "Group" pull-down menu to search the new robotic technology entries for specific keywords. They may also simply click on the *Robotics Database* announcement from the *Technology Homepage* to browse all of the robotics entries. Figure 2 and Figure 3 show example robotic technologies now available in the system.



Fig. 2. Canyon disposition initiative remote characterization system by Oak Ridge National Lab.



Fig. 3. Gemini Scout by Sandia National Lab.

D&D KM-IT has also added a legacy robotics document from 1998 to the D&D Documents Library entitled, *Robotics and Intelligent Machines in the U.S. Department of Energy: A Critical Technology Roadmap (RIM Roadmap)* [3]. This legacy document was the result of a six-month, collaborative effort by a team of DOE representatives and national laboratory scientists, with input from additional DOE plants and sites. It defined, for the first time, a DOE research and development path for RIM through the year 2020.

CONCLUSIONS

DOE faces many challenges in their efforts to D&D unnecessary and/or unusable facilities across the DOE complex. Many of these facilities pose hazards which prevent the use of traditional industrial demolition techniques. Such hazards include radiological, chemical, and hazardous materials contamination and structural instability. Efficient and safe D&D of the facilities will almost certainly require the use of remotely operated technologies.

Remote handling by machines (e.g, robotics) plays a critical role in protecting personnel and the environment during potentially hazardous D&D activities and operations. By utilizing and improving the capabilities of existing remote technologies, DOE can significantly reduce the exposure of its workers to hazards.

Integrating a robotics technology database into KM-IT provides a single point of access to browse and search all of the robotic technologies for applicability to a D&D related activity. Users can access technology descriptions, benefits, limitations, photographs, videos, data specification sheets, vendor descriptions and contact information.

REFERENCES

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