

## **Web-based Information Management of Demilitarization Technology Trees at the Defense Ammunition Center**

**Christopher Dilorenzo and Kurt Gramoll**

**School of Aerospace and Mechanical Engineering  
The University of Oklahoma**

### **Abstract**

Visualization of information is a useful method of education in industry and interactive applications are beneficial to many institutions. Vast amounts of information need to be structured in a manner which will promote access and manipulation of the content for training and education in industry and at learning institutions. Tools are developed which help create and relate information to users. Every area of industry implements these tools allowing for better understand and access of pertinent information. The application focused on in this paper is an exceptional case where a visual, interactive tool was developed to provide industrial education.

The Defense Ammunition Center (DAC) in McAlester Oklahoma requires an additional informational management system for the technologies used in ammunition disposal and to assist in the training of personnel worldwide. Currently, the DAC uses a universal template which is reused with changing path lines to indicate appropriate process paths for the demilitarization of munitions. These hierarchy structures are referred to as Technology Trees. This method of documentation is static and does not allow for access of additional information. A dynamic application was created to educate and deliver information to users. The interactive informational database application described in this paper allows users to navigate through applicable technology paths for a particular ammunition family from disassembly to handling of waste streams. This user-friendly system has information that is quickly and easily accessible by all installations.

This paper outlines the design of the system created at the University of Oklahoma with DAC input. The functionality of a web-based system allows it to be easily managed and readily available for any authorized user. The system developed can also be adapted to educate and manage other information for various institutions. A web-based database editor was also developed to allow the transfer of the technology tree structures for ammunition disposal from hard copy to an interactive user format through the use of Active Server Pages (ASP). Desired information technology structures can be viewed in a graphical format by way of a Flash interface. This visualization provides excellent content relation. The Flash file has all parts and sub-parts of each munitions diagramed in a tree-type flow chart so that the disposition of the item can be easily understood. The user can get additional information about each part and how it can

be disposed. The technology structures can be created and edited from either web forms or directly from the dynamic Flash interface. This allows the administrator to see the information that they are adding or making changes to. This application shows how a graphically orientated information interface can deliver information to aid user education and training.

## **I. Introduction**

Information management applications are needed in both industrial and education sectors to deliver information to individuals and institutions. The tools developed for education and information relation continue to expand depending on the needs and requirements. The system outlined in this paper required an interactive application for information sharing and user education. Delivery of electronic media over the Internet provides an immense outlet for information sharing, especially for institutions with widely disbursed personnel that need the information and training. Use of the Internet for information distribution is viable since 87% of U.S. workers have broadband access [1].

The Defense Ammunition Center (DAC) is located in McAlester Oklahoma and is part of the United States Army Joint Munitions Command. This command stores, maintains, accounts for, issues and reconstitutes equipment and materiel for the U.S. Army. The DAC serves to provide the military services with timely ammunition training, demilitarization technology, explosives safety, engineering, career management, and technical assistance through logistics support [2].

Demilitarization processes, as well as the research and development of demilitarization technologies, for the Army's conventional ammunition are handled at this facility. Each type of ammunition belongs to a family. Each family of munitions has a unique disassembly structure with multiple methods of handling each step in the deconstruction process. The large collection of information arising from the demilitarization of ammunition requires a medium to relate that information to other individuals and institutions. This is usually the case for most areas of industry which need to provide individuals with timely information that can be accessed at any time. The current method involves a static template which contains all the available processes for ammunition demilitarization in a flow chart layout. The breakdown of each type of ammunition and the processes used are represented by path lines on the universal chart. These hierarchical structures are referred to as Technology Trees (figure 1).

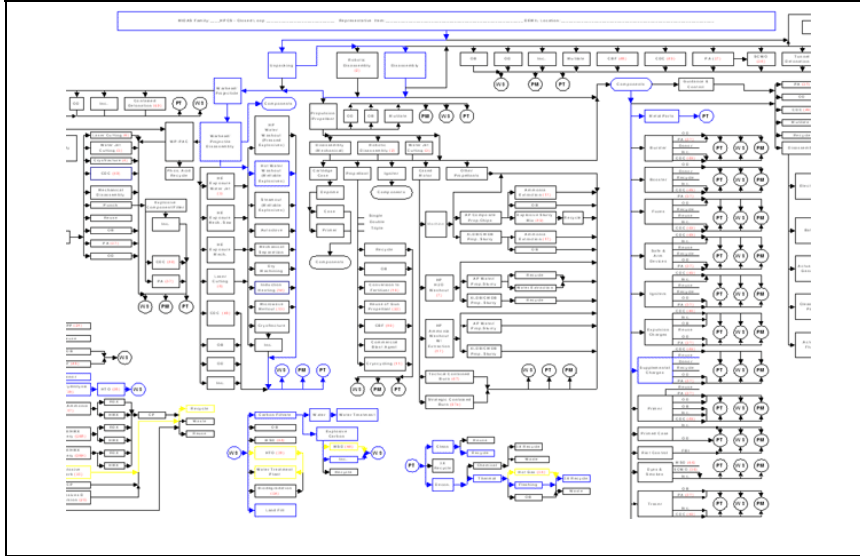


Figure 1: Portion of current Technology Tree template

With a vast variety of munitions being handled at the DAC, the number of Technology Trees has become exceedingly large. Trees must be created to document the demilitarization for each applicable process for every family of munitions. Currently the creation of a Technology Tree results only in a PowerPoint file or hard copy paper document which can be shared but relates little information. This method of documentation hinders the flexibility to provide employees with current methodologies and information. The trees are also difficult to understand for those who do not deal with them frequently. When looking at a tree it is often unclear which components of the ammunition are being referred to and which paths they follow. The charts do not offer additional information about specific parts and processes or other particular circumstances for individual munitions due to the use of a universal chart.

The desired goals of the Technology Trees are to educate and inform individuals and institutions of all the pertinent information for the demilitarization of a particular type of ammunition. With the currently implemented system, the dissemination of this information is not possible. Management, relation, and sharing of the information related to ammunition demilitarization needs to be addressed by modern means. The web-based system developed for the DAC utilizes Active Server Pages to provide an online database editing system which is geared specifically towards efficient Technology Tree building. Flash provides the best method to couple stored database information with a graphical interface to create a dynamic and interactive application for obtaining information. This system helps to ensure that education of employees will not be dependent on individual interaction and that the information can be accessed when needed.

Web sites, such as Amazon.com, utilize web based applications which recall information from databases. These sites manage multiple types of media and information to be accessed by a user anywhere through any platform. Web-based applications are developed to deliver and educate users in intuitive and time efficient ways. Connection or linking of information, the same as the relationships used in DAC demilitarization processes, is utilized at Ancestry.com, which

maintains and displays genealogy trees for their clients [3]. Accessible information from these sites consists of lines of text, pictures, or hyperlinks. These web sites provide the closest examples of available systems which are similar, but less advanced or innovative, to the research outlined in this paper. Web-based applications allow for quick access from any computer with an internet connection. The information is also easy to update and maintain as the resources are contained in a single location. The details of the application and the tools used in development are discussed in the following section.

## II. The Application

The goal of this system is to provide all the necessary information for the demilitarization of ARMY ammunition and to educate users of the correct disassembly procedures. This type of information relation for education is very desirable in all types of industry. The web-based application developed serves for both the input and the recall of information to inform institutions and individuals. Application users are either classified as users or administrators. Administrators have access to all functions of the application. They manage all the information from creating the trees to modification. However, the basic user may only view the information and not update, change or modify it. The need to transfer information from the current static outlines of technology trees to databases which can be called upon for dynamic tree generation and user interactivity lead to information input function development. The main page is shown in figure 2.



Figure 2: Main page of web application for administrator access

### *Information Management*

From the main menu, four functions can be accessed: add, edit, view and delete. While view can be used by all users, add, edit and delete functions are used to manage the system and only the system administrator can access these features. When a new technology tree needs to be added, the administrator, or operator, can select the add function from the menu. The family of ammunition for which the tree is being created can be specified from either the national security number (NSN), DODIC, or a nomenclatural name. This allows for system flexibility while providing a way of insuring technology trees are created for a proper family and that the family

does not have multiple trees. Once a tree is created, the operator can begin to populate the database information.

Under the main menu, the edit feature (see figure 3) brings up the information as it appears in the database table with sub functions attached to each row of data. These rows can contain any type of data including the name, weight, type of node, location of additional media, and other information. Currently, the system allows for the input of the new data name, type, the process it belongs to, its availability and general information. The main focus of the information management is to maintain a virtual tree structure. Addition, deletion and other forms of information manipulation have been carefully designed to maintain hierarchical structural integrity. Technology trees are built by adding on to existing information developing a hierarchy. From one element, or node, another can be added. This is a parent-child relationship necessary to keep information in a structured order.

Technology Tree: HPCS

Node	Parent	Type	Status	Process	Notes	Delete	Edit	Insert Child	Add Child	Change Parent	Delete Branch
HPCS 155 mm		Part	A	C,O	This is the 155 mm projectile.	Delete	Edit	Add	Add Child	Change Parent	Delete Branch
Warhead	HPCS 155 mm	Part	A	C,O	This is the Warhead component.	Delete	Edit	Add	Add Child	Change Parent	Delete Branch
Palette	HPCS 155 mm	Part	A	C,O	This is the Palette which contains the warhead.	Delete	Edit	Add	Add Child	Change Parent	Delete Branch
Warhead Disassembly	Warhead	Process	A	C,O	This is the Process for disassembling the warhead.	Delete	Edit	Add	Add Child	Change Parent	Delete Branch
5x Palette	Palette	Part	A	C,O	No trace of explosives.	Delete	Edit	Add	Add Child	Change Parent	Delete Branch
3x Palette	Palette	Part	A	C,O	Trace quantity of explosives.	Delete	Edit	Add	Add Child	Change Parent	Delete Branch
Hot Water Washout	Warhead Disassembly	Process	A	O	A water cutter is used to remove explosive from the shell.	Delete	Edit	Add	Add Child	Change Parent	Delete Branch
Components	Warhead Disassembly	Part	A	O	These parts are removed from the warhead.	Delete	Edit	Add	Add Child	Change Parent	Delete Branch
Autoclave	Warhead Disassembly	Process	A	C	Steam & High pressure submersion.	Delete	Edit	Add	Add Child	Change Parent	Delete Branch
Metal Shell	Hot Water Washout	Part	A	O	The shell of the warhead.	Delete	Edit	Add	Add Child	Change Parent	Delete Branch
Contaminated Water	Hot Water Washout	Part	A	O	The water used to during washout process.	Delete	Edit	Add	Add Child	Change Parent	Delete Branch

Figure 3: Editing function of application

New nodes can be added to or between other nodes. For fast information input by an administrator, options are available to continue building upon the path they are working on or to return to the updated table. The same applies to deletion where the parent-child relationship must be maintained. In cases where entire branches of information need to be removed, a recursive delete function removes the data node and any node related below that one. The information contained in the database for a particular node can also be edited. Once a technology tree has been completely and correctly inputted into the system it is finalized.

Changes made by the administrator to the information after finalization is documented. The information which was edited, the administrator who made the changes and the point in time of when the changes were made is kept in database tables referenced to the ammunition family the changes were made too. Records of these changes are maintained for two main reasons; ISO certification requires documentation of information management during auditing and keeping records of changes to information also allows for backtracking and correction of changes which need to be undone. Complete deletion of a technology tree, using the delete function on the main

menu, will create a backup copy and allow for a new tree to be generated for that ammunition family.

### Information Display

Information visualization is a rapidly growing field that is emerging from research in human-computer interaction [3]. The view feature on the main menu allows any user to select a technology tree for viewing. A web application, built with Macromedia Flash, was developed for this purpose (see figure 4). The application dynamically creates technology tree structures which are user interactive for information access. The primary node is displayed in the upper-left corner of the stage. Clicking on a node will result redrawing of the tree with the related child nodes a level below. When a terminal node is reached, it becomes brown. The node features an icon to indicate whether it is a part or a process performed on the munitions and the name of the node. Two buttons are featured on right side of the node. Clicking the top button will bring up a menu with access to various information such as, cost, weight, technical drawings, 3D animations and other forms of data and media (see figure 5). The bottom button brings up an edit window.

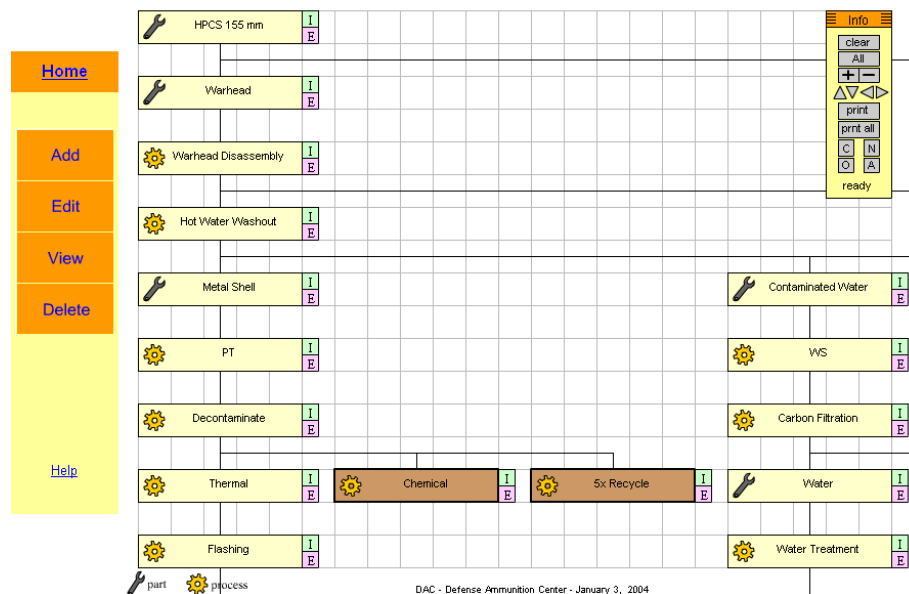


Figure 4: Interactive graphical Flash interface

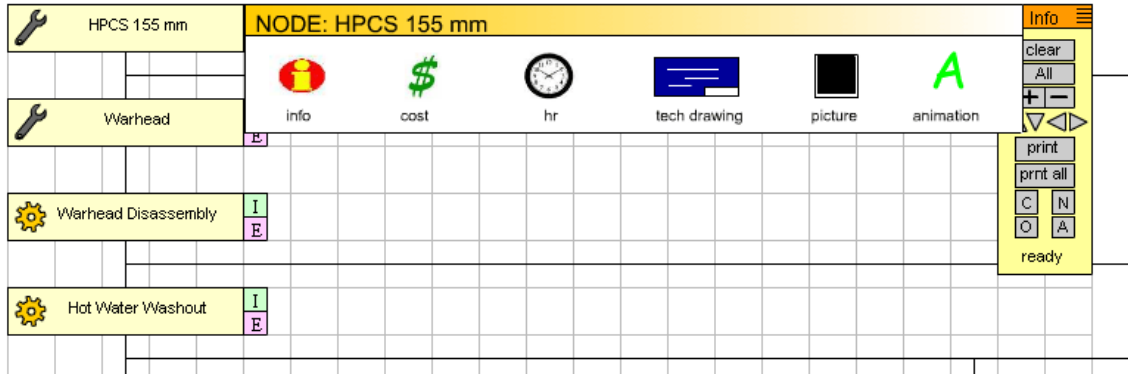


Figure 5: Information access from Flash interface

If a user has administrative privileges, then information input and management can also be performed from the Flash graphical interface. This insures for proper data placement. All of the information management features available from outside the graphical interface, excluding tree creation and deletion, are available within it (see figure 6). The Flash menus call ASP pages on the web-server which updates the database with the changed information. Editing of any information currently contained in a technology tree is updated instantly both in the database and on the client’s browser. Other changes, which alter parent-child relationships, require a refresh to see the changes.

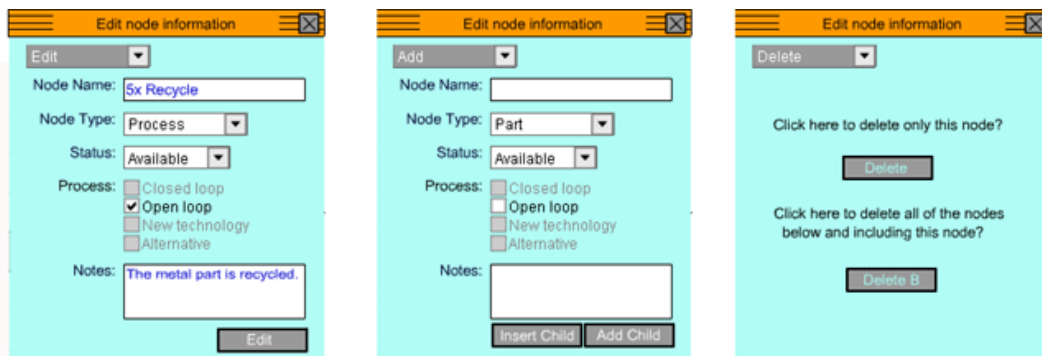


Figure 6: Technology Tree editing from Flash interface

A floating control menu allows the user to manipulate the graphical representation of the stored information. This menu allows for movement around the stage and zooming in and out. Due to limitations of screen size and the unlimited size of technology trees led to the additional functionality of grab and drag navigation. Displaying all of the nodes of a technology tree or clearing the nodes on the stage is also possible from the navigational menu. Buttons on the menu will generate process-specific tree structures. Certain processes are closed loops where all waste is reconstituted while an open loop generates waste. In the old paper-based system, these process-specific trees required individual technology trees for an ammunition family. Now all

trees can be quickly and dynamically generated with the use of the Flash application. Two printing features are contained on the menu. A user can either print just the tree structure which is visible on the screen, or they can print the entire technology tree.

### *Implementation*

Technology trees for several ammunition families have been completed and used. In the coming year, it is planned that database-based technology trees for all current ammunition families will be created will be implemented at DAC. Also, addition methods of modifying existing databases will be evaluated to avoid unnecessary information logging. Once the application is brought on-line, authorized individuals will be able to access the system and learn from the information it delivers. Evaluation of what processes are being used, as well as the costs and hours involved in those processes at multiple facilities will allow for optimization. The option of accessing the system from handheld computers, including PDAs, for education in the field is currently in the development stage.

### **III. Application Components**

The scripts for the HTML ASP pages, and the actions called upon them by the user through use of the application, are kept and maintained on the server. The server also contains the data, in both an Access database and file folders. The web-connected client computer views the application through a web browser. The client computer also handles the SWF files which are accessed. The function structure is depicted in figure 7.

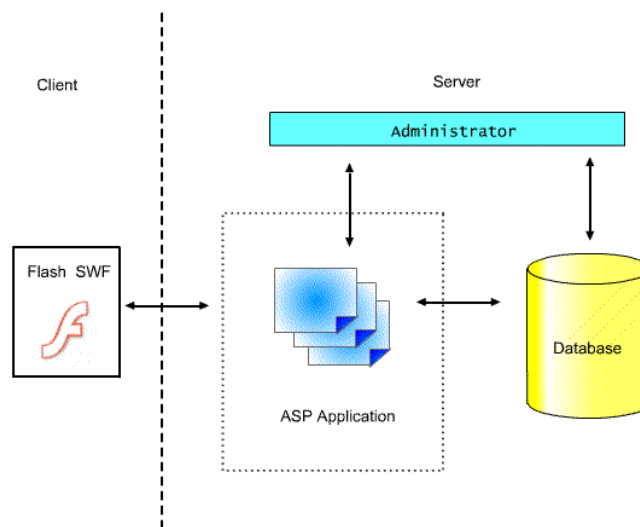


Figure 7: Application system structure

### *Active Server Pages*



A web server runs an HTTPD (Hyper Text Transfer Protocol Daemon) program [5] which provides quick, simple, and non-intrusive methods of servicing a website. The connection between a server and a client, the individual users, is temporary and must be reestablished for every data transfer. Web pages are viewed with browsers which are typically, Windows Internet Explorer and Netscape. A browser is needed to access pages on the World Wide Web. Hypertext Markup Language (HTML) is a set of special codes referred to as "tags," which instruct a web browser how to display a hypertext document. Scripting languages can be used within HTML pages to create the functions of an application.

Active server pages (ASP) were developed by Microsoft and are an open, compile-free application environment in which you can combine HTML, scripts, and reusable ActiveX server components to create dynamic and powerful Web-based business solutions [6]. Active Server Pages enables server-side scripting for IIS with native support for both VBScript and Jscript. ASP was utilized for this application due to its ease of use, versatility, and speed.

### *Database*

A database management system is a collection of data. The database is organized with tables which contain data pertaining to a specific group. These tables can be related to one another and used to store information, which can be retrieved and manipulated by statements contained in web page coding. Today, some of the most popular databases include Oracle, Microsoft SQL, MySQL and Microsoft Access. The Windows operating systems on the DAC machines currently use Access database. The drawback to Access is it was not designed for large amounts of data to be stored and managed. Implementation of this system on the scale indicated will require the use of a more robust data management system in the future.

### *Database Management*

IBM developed Structured Query Language (SQL) in the late 1970's and is currently the standard language used for database communication [7]. SQL statements are used which allow the user to define and manipulate the data in the database. Data retrieval, and other editing tasks such as adding, deleting of data and updating of data, is performed through SQL statements. Open Data Base Connectivity (ODBC) is an Application Programming Interface (API) which allows a program access to a database. Regardless of the database type being used, all calls made to the ODBC API. This application currently uses Microsoft Access as a database, but could easily be shifted to any other since SQL and ODBC work with all databases

### *Flash Interactive Graphical Display*

Flash MX, developed by Macromedia, is a useful animation and web graphic creation tool which was used to develop the interactive-graphical interface of this application. Flash's scripting language, ActionScript, provides scriptors with highly sophisticated interface and application design [8]. Flash animation and interactivity are created, in the Windows world, in Flash-format files with the extension .fla. These files are published to be used with web pages and have the file extension .swf. These SWF files are viewed on client machines through a Flash Player. Flash player is a component of Windows Internet Explorer and most users will not need to

download additional software to use and learn from the online application. The Flash files are executed on the client machine which frees the server from being responsible for running the application for multiple users.

## **VI. Impact on Industrial Education**

The research in this paper outlines an effective and conducive method of information management which allows for educational access. While this application deals with a particular situation and content, the premise is the same with many types of information structures used for education. It is easy to see how this system could be adapted to conform to the needs of other industries or educational institutions. The aspect of focus is the effective and efficient management and relation of information. Any information management system requires a structure which makes navigation and access as intuitive and simple as possible. It can be difficult enough for most individuals to absorb new information without having to seek it out. The way in which information is presented is as important as its management. Providing visual methods of information access is, of course, beneficial. The visual system allows for the relation of more content and improved understanding with less effort on the part of the individual.

## **V. Conclusion**

The goal of the new Technology Tree management system for the DAC was to allow access to all information available for ammunition demilitarization and to educate users of the correct disassembly procedures. The application developed for the DAC provides a great amount of functionality. Being web-based it is accessible from any internet connected computer. The method of content generation is efficient due to the availability of database editing in both the web forms and Flash interface. The necessary hierarchal relationship of information is handled by the application making Technology Tree generation easy for the administrator. The Flash interface allows for outstanding information access in an intuitive format. This application exemplifies how a graphical interface can be implemented to aid in education and information sharing in industry. The system design is adaptable for other types of information management for education.

## **VI. Acknowledgment**

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### **Biography**

#### **CHRIS DILORENZO**

Chris Dilorenzo is currently a masters student of Aerospace and Mechanical Engineering at the University of Oklahoma. His research work focuses on online information management system development and implementation. He received his B.S. degree in Mechanical Engineering from the University of Oklahoma in May of 2003.

#### **KURT GRAMOLL**

Kurt Gramoll is the Hughes Centennial Professor of Engineering and the Director of the Engineering Media Lab at the University of Oklahoma. He has developed and published CDs and websites for engineering education, K-12 instruction, and industrial. Dr. Gramoll received his B.S. degree in Civil Engineering and his M.S. degree in Mechanical engineering from the University of Utah. He received his Ph.D. in Engineering Science and Mechanics from Virginia Tech and has taught at the universities of Memphis, Georgia Tech and Oklahoma.