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Data Interconnection Exploration

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I. Introduction and Abstract

This project involves innovating the way the Quality Assurance organization at the Jet Propulsion Laboratory (JPL) tracks the receiving inspection of JPL Critical Items (JCI) procured from suppliers. The Quality Assurance organization uses a Microsoft Access based front-end to enter items into an inspection queue. The current design has grown to be much more than was expected when the inspection queue system was created in 2007. The goal is to migrate to a web based solution that will allow the handling of more data, multiple input interfaces, and customizable display options. This has been achieved by implementing a divided tables scheme, the use of ColdFusion programming language, and the usage of Web 2.0 technologies such as AJAX and jQuery. These updates will allow for future expansion as well as the standardization of inspection queues for the Quality Assurance organization.

When engineers and scientists order flight hardware, they cannot use it straight away. After a spacecraft or a satellite has been launched, it will be impossible to repair; therefore, the parts used must be inspected to make sure they are operating correctly and within the required specifications. The task of inspecting these JPL Critical Items (JCI) falls on the Quality Assurance organization. One of the tools the receiving inspection group uses is a database to maintain a queue of inspections that need to be done and of inspections that have been completed. The current Access interface has worked well but increased amounts of data, multiple input interfaces, and changes to how data is handled have made it necessary to seek a new way of organizing items for inspection. In addition, the different inspection groups have recently been merged and each has different ways of keeping track of inspection information. The ultimate goal is for the new group to have one shared inspection queue and website. To achieve this goal, I have been working with Ian Luczon of Procurement Quality Assurance and

Myers Hawkins, another intern, to not only create the new queue for receiving inspection but also a central web portal for the newly combined inspection group.

II. Goals and Purpose

Prior to arriving at JPL, I became familiar with database design and operation as well as web programming languages that my mentor said I would use. Once at JPL, Elvis Merida and Marvin Ko showed me how receiving inspection operates and the current system of keeping track of inspections. After talking with my mentors to decide how the new web site and queue should operate, I went to talk to Ian. Ian is the one who had designed the current queue and manages a lot of the IT services for our group. He told me what could be improved with the databases and provided me with a sandbox with a copy of real data to use to develop the new receiving inspection queue.

My first task was to improve the speed of loading data from the database. Information in databases is stored in tables where each row is a separate entry and each column, or field, stores some information related to that particular entry. For example, each row in a table might represent a person and there might be columns for storing the first name, last name, phone number, etc. of that person. One could store all the information in one table, but this would slow down performance. One usually wants some of the information so it is better to split the table up and relate them using a shared column. In this way, one can go from loading a table with thirty columns to loading ten columns from a main table and five columns from another table that can be changed depending on what one wants to see. While not loading fifteen extra columns may seem trivial, when one is loading thousands of items the loading time is noticeable. The current queue information was in one table with lots of empty fields because some of the fields were

only used by some inspection types. To split up the table, I looked at what information (receive date, quantity, inspector, etc.) was common to all inspection types and put all of these in a main table. The information that was specific to each inspection type went to separate tables. With these changes, not only was the main table smaller, but there were fewer empty cells in the table which reduced the amount of memory used.

After having Ian Luczon look over my divided table scheme and making sure the main table would work with Myers' auxiliary tables for mechanical inspection, I began to create the inspection website using Adobe ColdFusion. Adobe ColdFusion allows one to retrieve information from a database and use that data to generate HTML code to create a website. Before writing the code for the website, I came up with how to divide the code that would not only create the website but also process data to and from the server. Having all the code in one file makes finding mistakes difficult as it can be hundreds of lines long. The set up I chose had a main file that generated different tables on the website depending on a parameter pasted on the URL. It also included containers where the code for input forms and editing would be imported if an inspector needed to add or edit an item. This not only kept the code needed to load small, it also helped security as code to edit items would only be loaded when an authorized user logged in.

While ColdFusion made working with the information in the database easy, the generated webpage is static. In addition, when making changes to information, one still has to reload the entire page which can be tedious when an inspector has to enter a lot of information. Fortunately, there are scripting languages to add dynamic content to websites and calls to other files without the need to refresh a page (asynchronous calls). The scripting languages I used for these two tasks were JQuery and AJAX respectively. With the dynamic and asynchronous file

calls, the final website allowed the inspectors to do all the inputting and editing of items on one page instead of having to go search through multiple sites. The one downside to these languages and plug-ins (expansions) for them is that they are open source software. While this means that the creators of the languages allow others to use them, they do not always have the best documentation or tutorials. As a result, I spent several days looking at examples on the internet and code already written by others to get the functionality I wanted in the inspection website. After testing multiple iterations of the website, I was able to integrate it with Myers' code and let my group and Ian Luczon begin to test it. Once bugs are found and fixed, the group can begin to use this improved online queue and speed up the inspection process.

III. Impact of Internship on My Career Goals

After programming for ten weeks, I was able to deliver a product that would be used by the group I was working with. Doing something that was going to make an impact on the day-to-day work of my co-workers made my time at JPL very worthwhile to me. While I am an electrical engineering major, the database and web programming that I learned during the summer are invaluable. In an ever digitized world, being able to program is essential and looked for by employees. My internship has furthered reaffirmed my goal of getting a computer science minor. My mentors were also great and helped me in preparing my presentations and reports. Elvis in particular gave me tips on how to create presentations and helped me update my resume to look more professional.

Perhaps the greatest thing I have taken from my internship has been working in a real world environment. When I arrived, I met with my mentors and they explained the current system and told me what they wanted. I then worked on my program and checked back with

them to get feedback and made adjustments as needed. I really enjoyed the group work that I did during my internship. There were three other MUST scholars working with Ian Luczon and we collaborated a lot. We had weekly meetings to go over progress and share any problems we might have encountered. We were able to share code and help each other when someone encountered a problem as one of us might already have found an answer. It was great that through my internship I was able to get experience with working in a group. Finally, I attended our section meeting and provided weekly updates to our Deputy Manager, and even got to present to our division manager. These last experiences were new to me and taught me how one interacts with different levels of management, and I know they will help wherever my career leads me.

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