NSRP ASE

"Final Report"

FOR

Second Tier Shipyard Design Enhancement Project II

MARITECH ASE
TECHNOLOGY INVESTMENT AGREEMENT #2005-385

BENDER SHIPBUILDING & REPAIR CO., INC.
SHIPCONSTRUCTOR SOFTWARE INC.
NORTHRUP GRUMMAN SHIP SYSTEMS AVONDALE OPERATIONS
BOLLINGER SHIPYARD
MARINETTE MARINE
VT HALTER MARINE
GENERAL DYNAMICS ELECTRIC BOAT
ELLIOT BAY DESIGN GROUP
MURRAY & ASSOCIATES
GENOA DESIGN, INC.
GIBBS & COX, INC.
KNOWLEDGE BASED SYSTEMS INC.
PROTEUS ENGINEERING

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1   SUMMARY

The Second Tier Design Enhancement Project II will improve the design and engineering tools used by most second tier shipyards, some first tier shipyards and their design subcontractors. Bender Shipbuilding, four additional shipyards, and four design agents that have independently selected ShipConstructor as their product modeling software of choice will undertake intensive work with ShipConstructor Software, Inc. formerly known as Albacore Research, Ltd., Knowledge Based Systems Inc, and Anteon - Proteus Engineering. The additional project team members were comprised of the following companies: Bollinger Shipyard, Marinette Marine, Northrop Grumman Ship Systems Avondale Operations, VT Halter Marine, General Dyamics Electric Boat, Elliot Bay Design Group, Murray & Associates, Genoa Design, and Gibbs & Cox.

The proposed project was structured in 9 distinct modules, each addressing a different need. Due to funding constraints, only two of the modules were funded for development in FY2005. These were (1) integration of a second tier Common Parts Catalog (CPC) with the ShipConstructor design software; (2) development, release, testing of a ShipConstructor 3D Product Model Splitting & Merging capability.

Both the shipyards and the design agents functioned as beta test sites as the various modules and improvements were developed and released for testing and implementation. The design agents received specialized training in shipyard design methodology from working closely with the collaborating yards during the evaluation and testing of the software modifications.

Through the process of this project, fundamental design changes were made to the ShipConstructor database structure to allow use of CPC Integration and 3D Product Model Splitting and Merging modules. The following were some of the ShipConstructor software modules that needed amended to incorporate the new database structure: Hull Design, Structural Design, Piping, HVAC, Penetrations, and Build Strategy. Most of the SSI modules had to be significantly rewritten. Due to the immense change in the code, certain rewards became evident. ShipConstructor has released some significant enhancements that parallel the efforts of the project.

The project management website was updated to include those areas that would be evaluated and tested over the project duration. Each of the forums were separated so that they would be specific to each task, so developers could easily identify those messages associated with their development work.

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2   PROJECT Overview & Recap

The Second Tier Design Enhancement Project II improved the design and engineering tools used by most second tier shipyards and their design subcontractors. ShipConstructor is the design software of choice for most second tier yards, as well as for NGSS Avondale on the Deepwater project. It is the design software that will be used on the Lockheed Martin led LCS design and construction team; including Gibbs & Cox, Bollinger Shipyard, & Marinette Marine. The second project saw two of nine modules funded for development. Again, these were (1) integration of a second tier Common Parts Catalog (CPC) with the ShipConstructor design software; (2) development, release, testing and improvement of a ShipConstructor 3D Product Model Splitting & Merging capability.

3   First Technical Status Review

The project team began with typical start-up contractual and planning issues.

3.1   Preliminary Project Activities

- Pre-agreement letters were sent out to get the project started at each project participant's location.
- The pre-agreement letters were signed.
- Revised cost documentation was submitted to align with funding awarded for the project, and satisfied all responses to all cost and technical issues.
- Statement of Work was submitted and approved.
- Draft Project Management Plan was submitted for approval.
- Bender Shipbuilding signed the contract with ATI.
- Set-up Kick-off Meeting

3.2   Kick-off Meeting

The Second Tier Design Enhancement Project II was signed into contract on February 5, 2005. Technical work on the project actually began following a project Kick-off meeting was held on March 10th, 2005 at Bender Shipbuilding & Repair Co., Inc. in Mobile, AL. Participants from each of the six shipyards, four design agents, and three software development shops were present at the project kick-off meeting. The kick-off meeting was held in the effort to provide general information put together the following documents required by the contract:

- Project Management Plan
- Draft Technology Transfer Plan
- Draft Software Development Plan

3.3   Project Web Site

A project web site was set up to allow project participants to collaborate on issues. All the users have been set up and issued usernames & passwords from the list of attendees from the project kick-off meeting and those submitted in addition as seen in figure 1.

All project information and presentations provided by Pat Roberts (Bender – Project Lead), Rolf Oetter (SSI – President), Madhav Erraguntla (KBSI – Software Project Mgr), and Barry Espeseth

(GDEB – MITL) have been posted on the Project Web Site for viewing @
http://nsrp.sytes.net

Figure 1. Project Web Site

3.4   KBSI CPC Workshop

The first CPC Workshop was held on April 5th, 2005 at Knowledge Based Systems, Inc. in College Station, TX. Participants from each of the four 2nd Tier shipyards (Bender, Bollinger, Marinette Marine, VT Halter) and one of the 1st Tier shipyards (NGSS – Avondale Operations) were present at the CPC Workshop. The intent of this session was to provide the shipyard CPC end users the opportunity to familiarize them with the 2nd Tier CPC that was developed on the initial project. In addition, information was provided on what was needed to install and deploy the CPC database and software on servers at their respective shipyards in support of the ship parts population effort.

This meeting was to provide a status update and discuss feedback on the incorporated additional functionality KBSI has provided in the latest version 2nd Tier CPC tool. As a result of the action items associated with the CPC Workshop, KBSI was able to generate code to upload all of the document database information from the spreadsheets that were provided by the General Dynamics Electric Boat at the very end of initial STSDEP project. After the document database upload was completed, KBSI released the revised CPC to the group for installation at the respective shipyards. All shipyards, with exception to VT Halter have the 2nd Tier CPC installed and running on their respective SQL servers/terminals. After installation, Bender worked with Bollinger Shipyards and provided some guidance on how to go about populating part information into the newly revised and installed 2nd Tier CPC. After the population effort, Bollinger and Bender worked out a system to note part equivalencies manually (through an added attribute field to note the equivalent Bender Catalog Number and Cage Code) as they entered parts into the CPC database. This was done to expedite the part equivalency identification due to the fact that KBSI's development of the part equivalency functionality within the 2nd Tier CPC was being developed in parallel to this effort. As a result, Bollinger Shipyard identified over 800 part

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equivalencies to Bender cataloged parts (project metrics are 1000 part equivalency associations). It is anticipated that with Marinette Marine and VT Halter part equivalencies the project team will most likely finish the project with over 2,400 part equivalency associations.

4 Second Technical Status Review

The first project quarterly status review meeting was held at ShipConstructor Software Inc. in Victoria BC, Canada. Participants from the 2nd Tier shipyards (Bender, Bollinger, Marinette Marine), and two design agents (Murray & Assoc., Elliot Bay Design Group), and both software development companies (SSI, KBSI) were present at the meeting. The meeting provided an update and feedback on the development efforts from the software development companies. The meeting insured that all parties were up to date, it furthermore established plans and schedules for the next quarters work:

- Purchase Orders for subcontracts have been issued to the project participants.
- Project Management Plan was approved.
- Technology Transfer Plan was approved.
- Software Development Plan was approved.
- Project Web Site had additional users set up and issued usernames & passwords as they were identified.
- Draft CPC Integration Software Specification was approved.
- Draft 3D Product Model Splitting & Merging was approved.
- 2nd Tier CPC was released and posted on the project website for download and installation at each project participant's shipyard.
- Project Quarterly Status review meeting was held at ARL in Victoria BC, Canada.
- With exception to VT Halter, all shipyards have confirmed installation of the latest 2nd Tier CPC release on their respective SQL servers/terminals at the Project Quarterly Status meeting.
- ShipConstructor Database Redesign effort is approximately 80% complete.
- ShipConstructor Structural Stock Library is approximately 70% complete.
- ShipConstructor Association to other ShipConstructor Databases is approximately 90% complete.

The STSDEP II project had progressed at an expeditious pace. The exception was the 3D Product Model Splitting & Merging Module, the remainder of tasked work was on schedule or ahead of schedule.

4.1 ShipConstructor Software Developments

SSI provided their status on the 3D Product Model Splitting & Merging development, at the Quarterly Status Review Meeting. It is also important to note that due to the fundamental design changes of the ShipConstructor database required by the CPC Integration and 3D Product Model Splitting and Merging modules, all software modules (Hull, Structure, Pipe, HVAC, Penetrations, BuildStrategy, and so on…) had to be newly interfaced to the database and, in most cases, significantly rewritten. Due to the monumental change in the SSI software code, certain "golden nuggets" seemed to fall out during the process. The "golden nuggets" will definitely add some significant enhancements that will parallel the efforts of the project work. SSI was approximately

90 percent complete with re-implementing the ShipConstructor database to allow splitting and merging of a ShipConstructor project. Current status shows that ~400 database tables, ~3000 stored procedures, and an API/ShipConstructor Data Layer have been re-written. The original project estimate was ~300 database tables, ~2500 stored procedures.

4.2 KBSI CPC Software Development

KBSI revealed at the first Project Quarterly Status Review Meeting, that they had completed the Bulk Import and Export functionality for the 2nd Tier CPC software. The mass export functionality allows parts to be searched, filtered, and then exported to a Comma Separated Value (CSV) / EXCEL spreadsheet. The mass import functionality considers two modes of importing parts; a) Override Old Data, or b) Do Not Override Old Data. Currently since the individual 2nd Tier CPC's are not sharing a centralized CPC database, all of the 2nd Tier CPC's are functioning independently. This functionality allows some flexibility in providing, 1) Inter-Shipyard data sharing without the CPC being centralized, 2) Intra-Shipyard familiar user interface for most users, 3) Data Collection and Clean-up can be performed in a larger data set. KBSI also revealed at the Quarterly Status Review Meeting, that they had completed the Part Equivalency Interface and Shipyard Part Association functionality in the 2nd Tier CPC software. As stated earlier, over ~800 Bollinger parts have part equivalency associations to Bender's cataloged parts. Through the newly developed part equivalency interface, personal could use the interface to search, filter, view, and print these associations through the 2nd Tier CPC software. The new functionality was added in the current release of KBSI's 2nd Tier CPC software.

4.3 Technology Transfer

Pat Roberts presented the project status at the NSRP ECB Meeting at General Dynamics Maritime Systems Office in Washington, DC on Tuesday June 7th, 2005. Presentation is available through the offices of ATI or the NSRP website.

5 Third Technical Status Review

The second project status review meeting was cancelled at Bollinger Shipyards in Lockport, LA due to Hurricane Katrina, but was rescheduled and held at Knowledge Based Systems Inc. in College Station, TX on October 19, 2005. However, work continued on the project in the following areas:

- 2nd Tier CPC version 3.3.0 was released and posted on the project website for download and installation at each project participant's shipyard.
- CPC i2 Demonstration & Workshop was held at GDEB in Groton, CT.
- CPC Integration effort was approximately 80% complete.
- ShipConstructor Structural Stock Library was approximately 99% complete.
- ShipConstructor Pipe Stock Library was approximately 90% complete.
- ShipConstructor HVAC Stock Library was approximately 95% complete.
- ShipConstructor Structural Stock Library was approximately 35% complete.
- ShipConstructor Database Re-design was approximately 97% complete.

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- ShipConstructor Association to other ShipConstructor Databases was approximately 90% complete.

The team proposed a slight variation to Proteus Engineering's scope of work under the CPC task for this project. As noted in the meeting notes from the 2nd Quarterly Project Status meeting and presentations, the team began put forth an effort to integrate the CPC software with an early concept design software called FlagShip. This software was originally submitted in the project proposal as the Design Transition Module that was scoped to integrate FlagShip with ShipCostructor. The project team believed that FlagShip integration with CPC through the API layer that was already build on the project would be the first step toward future possible integration with ShipConstructor.

5.1 ShipConstructor Software Developments

The STSDEP II project was still progressing at a rapid pace but in certain areas. The CPC integration with ShipConstructor was currently on schedule. The 3D Model Splitting & Merging Module PM&S task has slipped 3 months due to the late SC2006 beta release schedule. It was determined that a project schedule extension would need to be submitted to ATI in the effort to complete this task. A contract modification was prepared and submitted to ATI & ECB for approval for a no-cost project extension. The contract extension was submitted once SSI revised it software release schedule.

An emphasis was placed on putting a strong foot forward on the evaluation and testing of the "later Beta" software releases since they had a more stable modeling version of the SC2006 software. SSI was in the process of writing User Manuals and related documentation for the SC2006 version of the software. The project management website was updated to include those areas that would need to be evaluated and tested over the remaining project duration and so that SSI's developers could easily identify those thread postings associated with their development work.

The 2006 ShipConstructor Software BETA 2 was delayed in being released. The Beta software version primarily focused on Pipe and HVAC, with a limited Alpha software version released the structure module, the 2nd BETA version of ShipConstructor 2006 was delayed into December. However, quality assurance and build work was preformed on the BETA 2.

Work done on Database Redesign consisted of issues within the DDROM engine in the SSI 06 software witch were dealt with. A new DDROM Mode option has been added that will allow users to select between 'simple' and 'advanced' modes as they become more comfortable with the software. The database tables in the SSI software increased to ~710 up from ~667 in previous quarter. The stored procedures in the software was increased to ~8200 up from ~6900. The pipe stock library has been completed during this period and it underwent finishing touches and quality assurance. The equipment stock library in the ShipConstructor software has been essentially completed with final production touches and quality assurance work still pending. The ShipConstructor software version module update, scheduled for release with 2006 R1 began

during this period and is well underway towards migrating the library components of ShipConstructor 2005 to the redesigned ShipConstructor 2006 database.
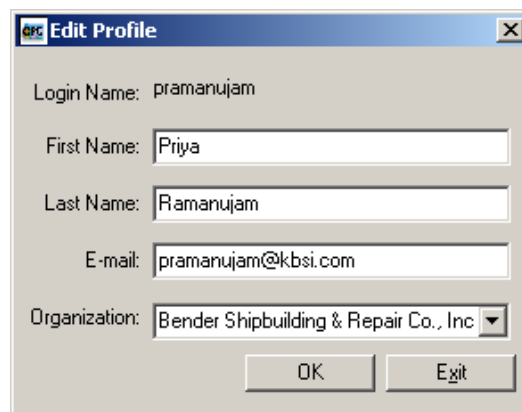
General design considerations for the Split & Merge module has continued giving SSI developers a problem. The database redesign required for the Split & Merge is almost complete. Work began on the user interface and functionality behind the Split & Merge code will begin after the release of the ShipConstructor 2006 R1 and is scheduled for completion in the ShipConstructor 2006 R2 version. The documentation for ShipConstructor 2006 release has been essentially framed in and the manuals are waiting on finalization by the development teams and revision/editing.

5.2   CPC Software Development (KBSI CPC i2 Workshop)

General Dynamics Electric Boat in Groton, CT held the CPC i2 Workshop on October 4th-5th, 2005. Participants from three of the 2nd Tier shipyards (Bender, Bollinger, Marinette Marine), one software designer (Knowledge Based Systems Inc.), one design agent (Proteus Engineering), and of course GDEB representatives were present. This workshop was held to provide the shipyard CPC end users with the opportunity to familiarize themselves with a fully functional and deployed CPC in process at the Tier 1 level.

Also, Proteus Engineering has also been given the required .dll files that implements the API calls for data transfer between CPC and ShipConstructor. The API layer will be used to integrate the CPC with FlagShip software from Proteus.

KBSI's developments on the CPC integration task as KBSI incorporated additional functionality in the 2nd Tier CPC tool during this time frame can are as follows:

Figure 2. User Profile Edit Interface

Figure 2 shows the Edit Profile screen. The user can edit his/her own profile using this functionality. This feature allows the user to change his/her First name, Last Name, Email address or Organization.

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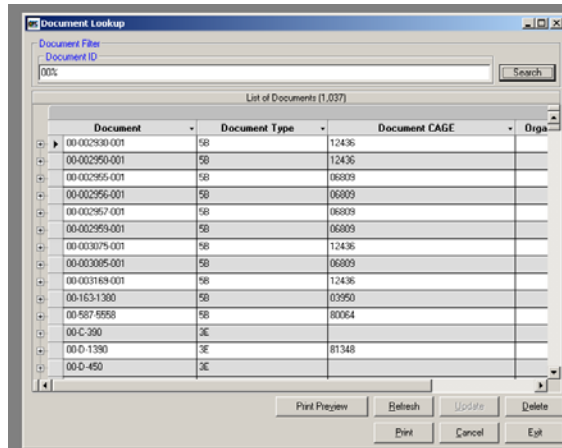
Figure 3. Document Lookup

Figure 3. shows the Document Lookup screen. The user interface changed so that the user can search for any document using the Document ID. This functionality will pull the list of documents that matches the document ID.
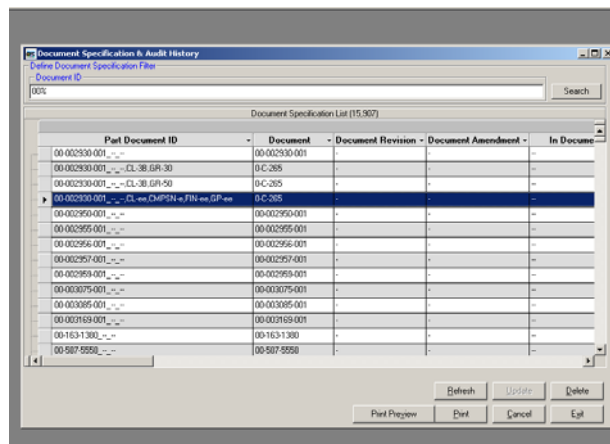
Figure 4. Type 1 Part Document ID Definition

Figure 4. shows the Document Specification & Audit History screen. The user interface changed so that the user can search for any document specification using the Part Document ID. This screen shows Category 1 method for calculating Part Document ID in CPC.

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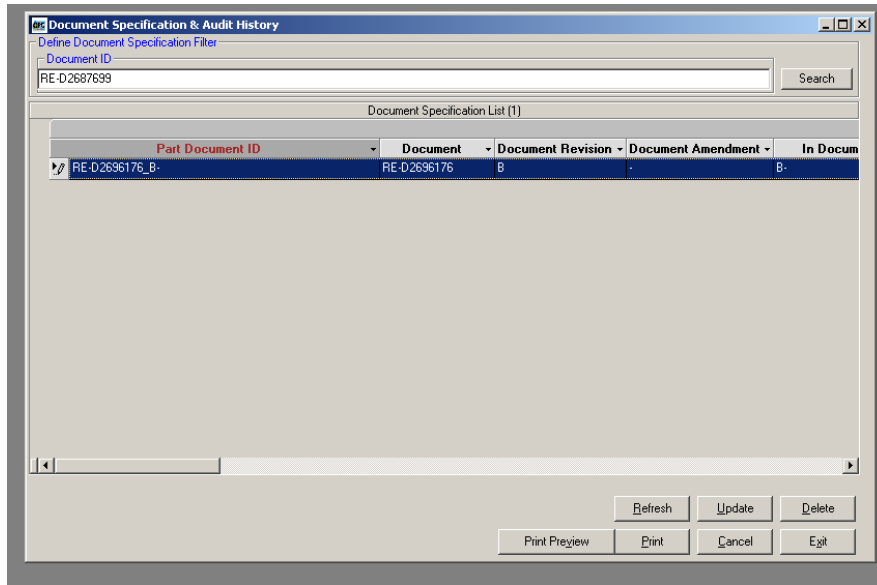
Figure 5. Type 2 Part Document ID Definition

Figure 5 shows the Document Specification & Audit History screen. The user interface changed so that the user can search for any document specification using the Part Document ID. This screen shows Category 2 method for calculating Part Document ID in CPC.
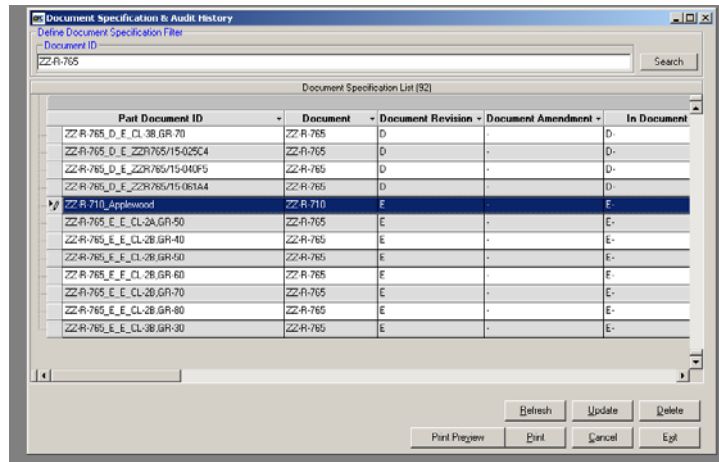
Figure 6. Type 3 Part Document ID Definition

Figure 6 shows the Document Specification & Audit History screen. The user interface changed so that the user can search for any document specification using the Part Document ID. This screen shows Category 3 method for calculating Part Document ID in CPC.

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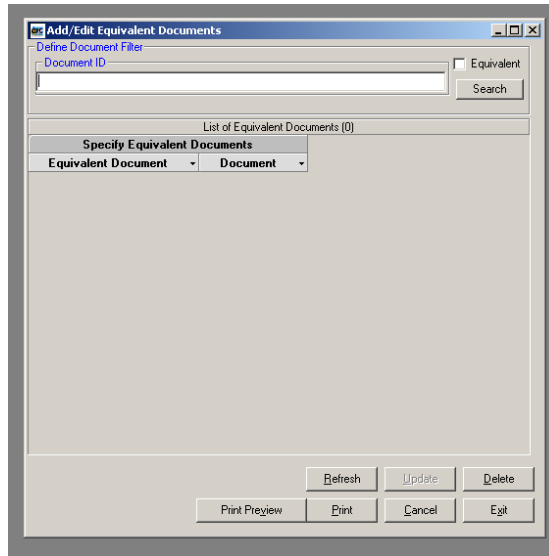
Figure 7. Searching for Equivalent Parts

Figure 7 shows the Add/Edit Equivalent Documents screen. The user interface changed so that the user can search for any document using either the Document ID or Equivalent Document ID. This functionality pulls the list of all documents that matches the ID entered.
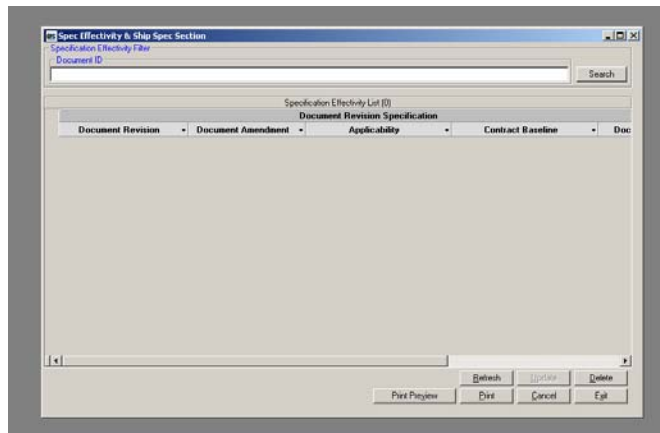
Figure 8. Spec Effectively & Ship Spec Documents

Figure 8 shows the Spec Effectively & Ship Spec Documents screen. The user interface changed so that the user can search for any Document Revision Specification using the Document ID. This functionality pulls the list of all specification documents that matches the Document ID entered.

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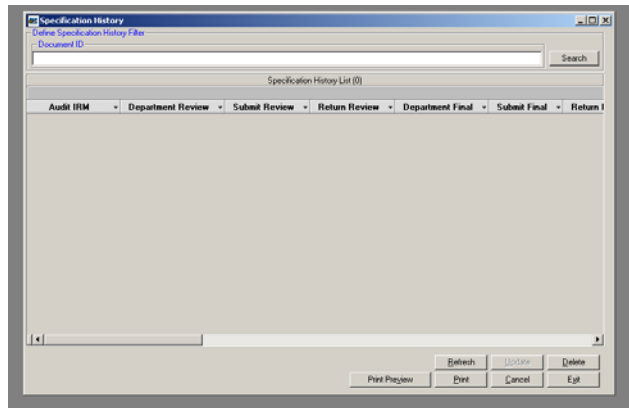
Figure 9. Document Specification History Interface

Figure 9. shows the Specification History screen. The user interface changed so that the user can search for any Specification History using the Document ID. This functionality pulls the list of all specification history that matches the Document ID entered. KBSI implemented the functionality to order the documents associated with a part. In the CPC methodology more important documents are associated at the top of the list, and less important documents at the bottom of the list. The part document association interface was modified to facilitate ordering of documents in Figure 10.
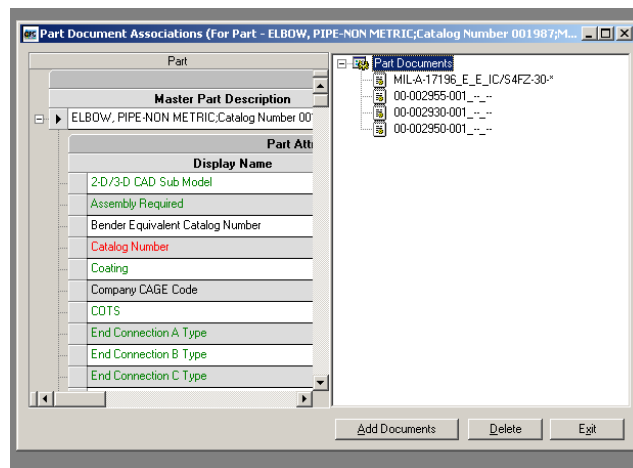
Figure 10. Ordering of Documents Associated With a Part ID

The mapping between the document type and the method to equate a part document id is performed using a lookup table.

5.3   **Technology Transfer**

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Patrick Roberts, project team lead, provided a project presentation at the NSRP PDMT Panel Meeting held in Alexandria, VA on Thursday September 22nd, 2005. A similar presentation was provided by Rolf Oetter with SSI at the NSRP ST Panel Meeting held in San Diego, CA on Thursday September 22nd, 2005. Presentations were provided to the Panel Chairs for posting on the NSRP website.

During this period in time, both Pat Cahill & Rolf Oetter with SSI presented a paper and a presentation at the 2005 Ship Production Symposium in Houston, TX on October 20th, 2005.

6   Fourth Technical Status Review

The third Quarterly Project Status Review meeting was held at the ShipTech 2006 conference in Panama City, FL on January 26th, 2006. The Limited Release of the ShipConstructor 2006 software was released on March 6th. Work continued on the evaluation and testing of the ShipConstructor "Limited Release." SSI developers continued to work on the User Manuals and related documentation for the ShipConstructor 2006 software version. The project team's shipyards and design agents continued their User Testing and QA testing at their respective facilities. The project management website was maintained to reflect the current applications and issues involved in the project.

A contract modification was granted by ATI & ECB for a no-cost project extension to the project based on SSI's new revised software release schedule.

Bender Shipbuilding migrated over 15,000 parts with documentation over from its legacy catalog. Of which, 1600 have part equivalency associations that have been made to Bollinger Shipyard parts.

Also, Proteus Engineering completed implementation with the 2nd Tier CPC software. The API layer in the ShipConstructor software was used to integrate the CPC software with FlagShip software. A FlagShip workshop was planned to be held at Anteon/Proteus Engineering's office in Stevensville, MD on Tuesday, March, 21st, 2006. Other work done during this period was as follows:

- KBSI released version 4.2.0 of the 2nd Tier CPC software and posted it on the project website for download and installation at each project participant's shipyard on February 8th.
- CPC Integration effort was at 90% complete.
- ShipConstructor Pipe Stock Library was at 99% complete.
- ShipConstructor Equipment Stock Library was at 99% complete.
- ShipConstructor Splitting & Merging Functionality was at 60% complete.
- ShipConstructor Association to other ShipConstructor Databases was at 100% complete

No presentations were provided as technology transfer during this period of time. The PDMT Panel did have a meeting scheduled at ShipTech 2006, but did not invite our STSDEP II team to provide a status report presentation during that particular meeting.

6.1 ShipConstructor Software Developments

A Limited Release of SC2006 was introduced in March and testing began soon after. The product had been stabilized considerably after several QA builds and cycles were undertaken. Other work done to improve the ShipConstructor software was as follows:

- Database Redesign – Only minor changes and bug fixes had been undertaken during this period. The Database Tables were increased to ~750, up from the ~730 in last reporting period The Stored Procedures increased as well to ~9700 up from ~9200 in last reporting period.
- Pipe Stock Library – The pipe stock library was at 99% complete and only usability changes were done based on user and QA testing feedback.
- Equipment Stock Library – The equipment stock library was also at 99% complete, with only usability changes were done based on user and QA testing feedback.
- Version Converter (from ShipConstructor2005 to ShipConstructor2006) – The version converter module is still well underway. The stock libraries portion of the migration of the software was at ~ 90% complete during this period.
- Documentation – The documentation for the 2006 release was largely framed in as of this period in time. The manuals were waiting on finalization by the development teams and revision/editing and QA followed.
- There was little change on the CPC integration with the exception of some required database changes.
- There was little change on the Split & Merge with the exception of the database changes that were made necessary as a result of this project. Work began on the user interface and functionality behind the Split & Merge process after SC2006 R1 and was scheduled for completion in SC2006 R2.

ShipConstructor Software Inc. held a special evaluation, training, & testing workshop in Victoria, BC on February 6th – 10th, 2006. Attendees arrived at Victoria on or before Sunday, Feb 5th, and left no earlier than Friday, Feb 10th, 3:00 pm (as late arrivals or early departures would have disrupted the intensive training schedule that was prepared). PowerPoint presentations and a full documentation of the feedback & bugs identified during this week session were captured and placed on the project management website upon completion.

6.2 KBSI CPC Software Development

Major developments were made on the CPC integration task as KBSI incorporated additional functionality in the 2nd Tier CPC tool. The CPC project was focused towards the 2006 R1 timeframe release. The Structural, Pipe and HVAC CPC integration was stable in the Beta2 software version. However, the Equipment library CPC integration was expected to be testable at SSI later in the process. Implementation of three different methods of Part Document ID creation in CPC was released. The Type I, Type II and Type III methods of part document id creation were

implemented depending on the document type, the respective method was followed to calculate the part document.

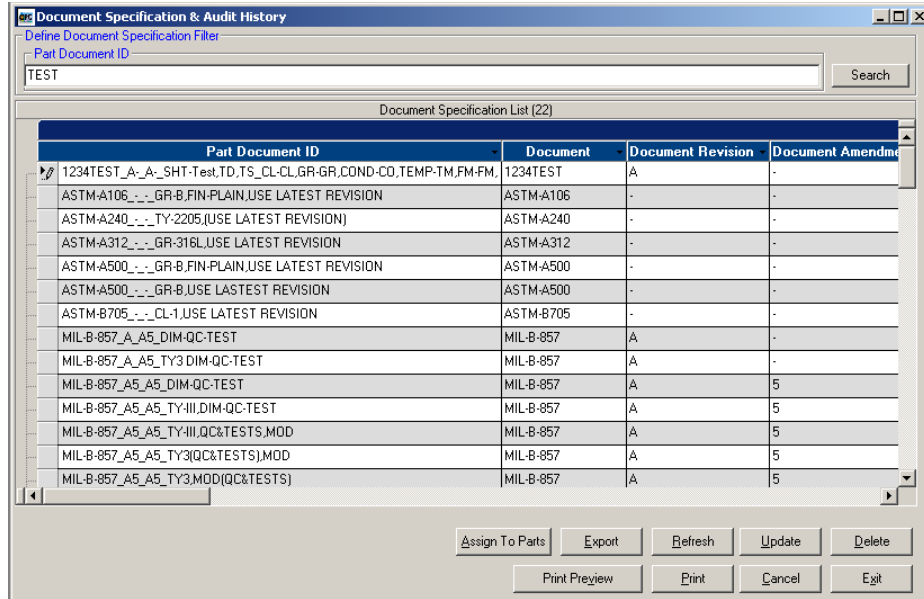*Figure 11. Type I method of Part Document ID creation*

Figure 11. shows the type I method of part Document ID creation. The User Interface was changed in all of the forms to have the search based on either Document ID or Part Description. Some color schemes were implemented in the application. A new submenu called View Part Document Associations was added to the Document menu.
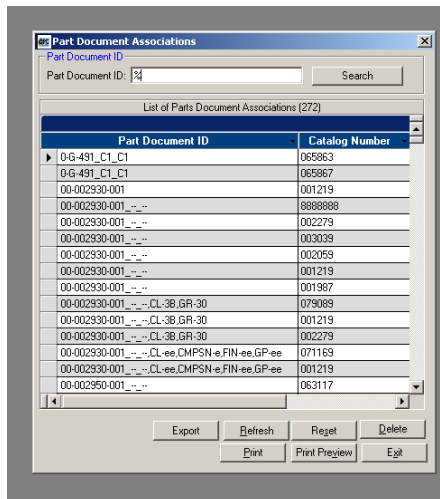

Figure 12. Part Document Associations

Figure 12. shows all the part document associations. Depending on the part Document ID entered in the search criteria, the list of all part document associations that match the part Document ID is retrieved. The list of all functionalities such as Export, Delete and Print are available at the bottom of the form. When a new Document Specification is created, only relevant document revision and document amendment corresponding to the Document ID will be displayed. This makes the user interface more friendly. KBSI spent time resolving issues from shipyard users: John Gilliam, at Bender found an issue that dealt with Import Parts functionality and Kevin Uren of Marinette Marine, experienced problems installation process. Both the faults with importing parts with an overwrite option and the installation with Power Users of the system were resolved.

KBSI released version 4.2.0 of CPC to the project participants. This version supports both SQL Server® and Oracle® databases. KBSI assisted Bender and Bollinger in the set-up of the new version of CPC.

The user groups identified CPC new enhancement requirements, the requirements are as follows:
- A dialog box interface where the user are able to map NSN numbers to different Parts
- A dialog box interface where a user can define new Ship Classes
- A dialog box interface where the user will be able to map Document ids to Ship Classes,
- A dialog box interface were the user will be able to map Parts to Ship Classes.
- A validation scheme was implemented when a document is mapped to a part. When a document is mapped to a part, there is a check to see if the document being mapped is associated with any of the Ship Classes.

KBSI created an interface for NSN/Part Mapping the user can enter new NSN(s) and assign NSN(s) to different Parts. The user then can search for existing Parts/NSNs by entering the keyword and clicking on the search button. The list of records that match the search criteria is then displayed.

7   Fifth Technical Status Review

As of the end of April, the project was essentially complete. The ShipConstructor 2006 software version was planned for release on June 16th, 2006, incorporating all of the features scoped for the project. A "Super User" training seminar was conducted in March 2006, and a follow-up SC2006 training session was held in April, 2006. All project team participants have received beta releases through Limited Release 2 (LR2).

KBSI's current version 4.2.0 of the CPC database and interface software has been placed on the project management website for download and installation by the participating shipyards. All of the changes identified at the 3rd Quarterly Meeting in Panama City, FL at ShipTech 2006 have been incorporated into the latest release.

Proteus Engineering was given the .dll files that implements the API calls for data transfer between CPC and ShipConstructor. Proteus used the API layer to integrate the CPC with FlagShip software. Proteus Engineering held a workshop at their facility in Stevensville, MD on

March 28th, 2006, to train and demonstrate the use of the Flagship software and the CPC integration that was developed in conjunction with this project. George Hazen conducted the workshop on the FlagShip software. Proteus had laptops available for attendees to use at no charge. FlagShip also loaded their software onto attendee laptops. The Flagship CDs and locks were provided to all attendees as cost share to the project. Four project participants were able to attend the workshop. At the end each project team member participating in the workshop received a copy of the latest FlagShip Designer software with the dongle hardware locks to run the software during the project timeframe. A tutorial document was also prepared and sent to the project team members that participated.

7.1 SSI Development Progress

Ship Contructor has progressed well in the past reporting period. Developers have moved head on many of the stock libraries interfaces as well as the Split and Merge module.

- Stock Libraries

ShipConstructor had updated many of the stock library interfaces to create the same usability as seen in the Structure library. Stock Library editor was mostly complete with usability, QA and stability being the primary focus items at this time. The structure stock library was complete. Each type of structural stock in the ShipConstructor Structure library is logically linked to a Part class in the CPC. When import is attempted on a CPC item, the list of items is filtered to only show those items which belong to the associated CPC Part class. Clicking the CPC Import button opens the dialog window shown in figure 13.
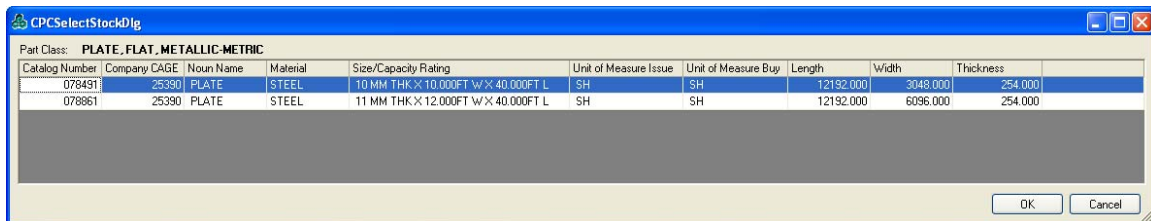
Figure 13. CPC Select Stock Dialog

The following libraries are complete: Pipe Stock, HVAC Stock, Equipment Stock. This redesign of the library interface will allow integration with the CPC. The Interface is similar to the interface used for structural stocks.

The associating of ShipConstructor Project databases are complete. ShipConstructor developers need SC2005 databases to test functionality of the associating databases. The project team members were to supply existing ship model data.

- Split & Merge Module

Splitting and Merging Module's database rework was complete. The remaining changes have been finalized based on the last minute requirements changes in the supported software. Concurrency issues and transactional behavior problems were being found and resolved as well. The usability testing had commenced. Split and Merge Functionality was at 60 percent complete.

The SSI developers and other project team members finalized the specification for Project Split and Merge module, which was also the basis for the Users Manual. The final specification was restricted to internal and NSRP project management only. At this time the shipyards and design agents have were asked to provide SC2005 projects that can been used to test the merging of the project database into a SC2006 database.

7.2   KBSI Development Progress

KBSI has continued to improve and revise the CPC software as the shipyards and ShipConstructor require the software to function. The following lists of features were implemented in CPC software:

- Implemented NSN Part Mappings

The interface for Part-NSN Mappings was implemented. The user can enter the Part-NSN mappings using this interface shown in Figure 14.
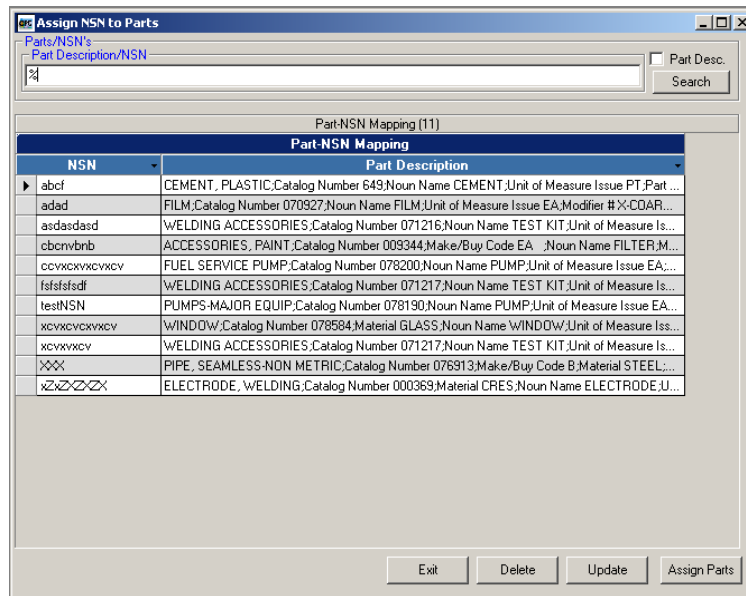
Figure 14. Part-NSN Mapping

- Part Master Interface

This interface was implemented in the menu Part Master->Part Master/NSNs. The user can enter a new Part-NSN mapping by right clicking on the form and choosing Add Part-NSN Mapping as shown in Figure 15.

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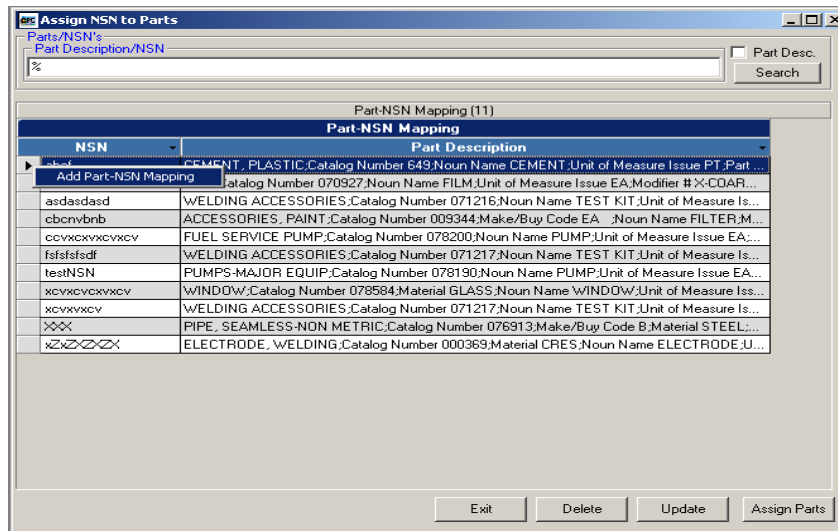
Figure 15. add Part-NSN Mapping

The user can enter the NSN, click on *Assign Parts* to search for parts, and then assign it to the NSN. The user can update/delete existing mappings using the buttons at the bottom of the form. The user can search for existing mappings by entering the search criteria and clicking *Search*.

- Ship Class/ Application

The Applicability-Applicability/Ship Classes interface was implemented in the CPC. The user can enter the new Ship Classes using this interface. Figure 16 shows the Ship Class interface.
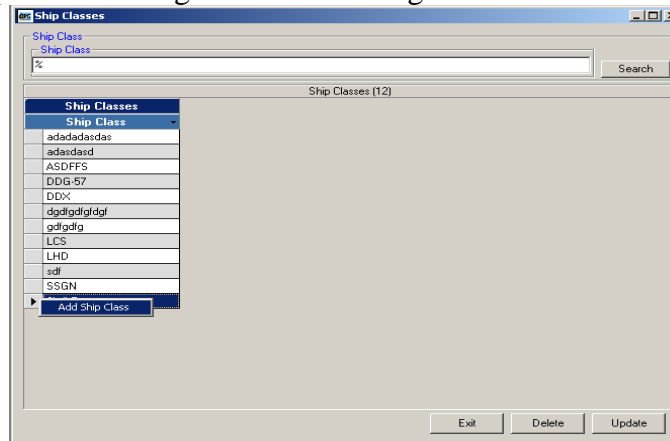
Figure 16. Applicability Ship Class

The user can enter a new Ship Class by right clicking and choosing Add Ship Class.
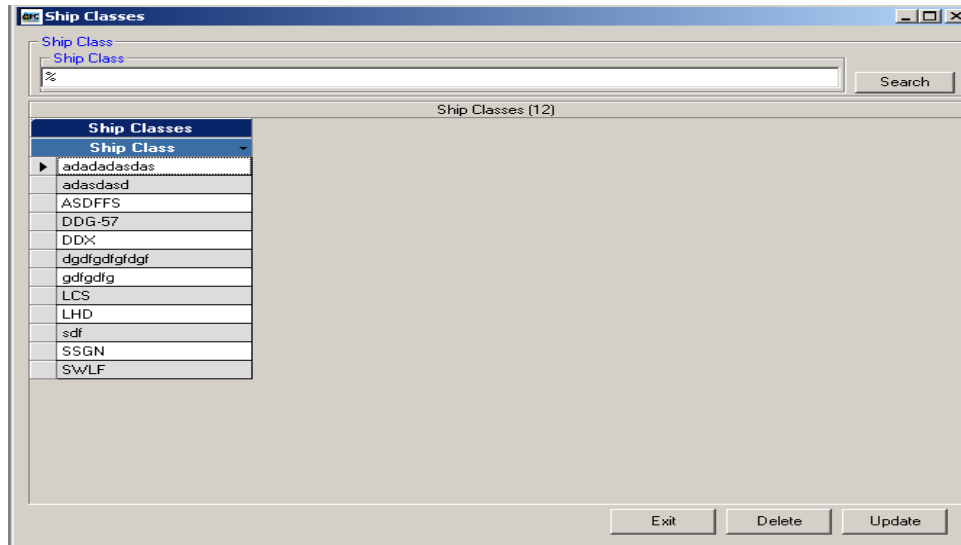
Figure 17. Add New Ship Class

After adding ship classes, the user can click on *Update* to refresh the data. Existing ship classes can be deleted by choosing the ship class and clicking on *Delete*. The user can also search for existing ship classes by entering the search criteria and clicking on *Search*. This interface is available in Administrator->Ship Classes.

- Implemented Document to Applicability Mapping

This interface for documents to be mapped to ship classes was completed. The user can map documents with ship classes using this interface. Figure 18 shows the screen shot of the Document Applicability Mapping form. This interface is accessible through Document->Document/Applicability Mappings.
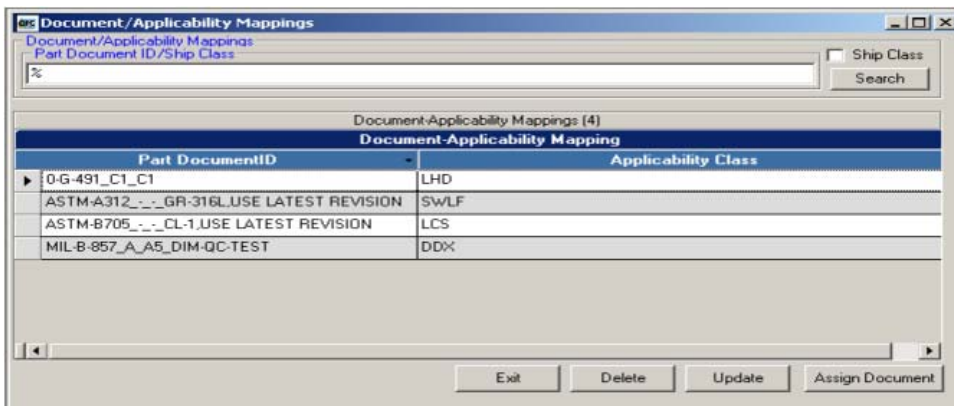
Figure 18. Document Applicability Mappings

The user can enter new mappings by right clicking and choosing Add Document-Applicability Mapping as shown in Figure 19.
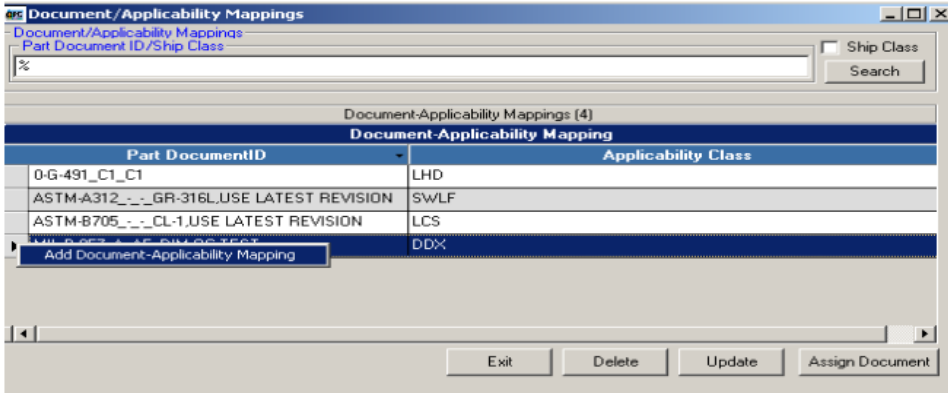
Figure 19. Add Document Applicability Mapping

- Part Document ID Mapping

The user can choose the Part Document ID by clicking on *Assign Document* and then choose the ship class to assign it to. The user can update/delete existing mappings by simply using the buttons at the bottom of the form. The user can search for existing mappings by entering the search criteria and clicking *Search*.

Implemented Part and Applicability Mapping interface where parts are mapped with ship classes was implemented. The user can map parts with ship classes using this interface.

Figure 20 shows the screen shot of the Part Applicability Mapping form. This interface is accessible through Part Master->Part Master/Applicability Mappings.
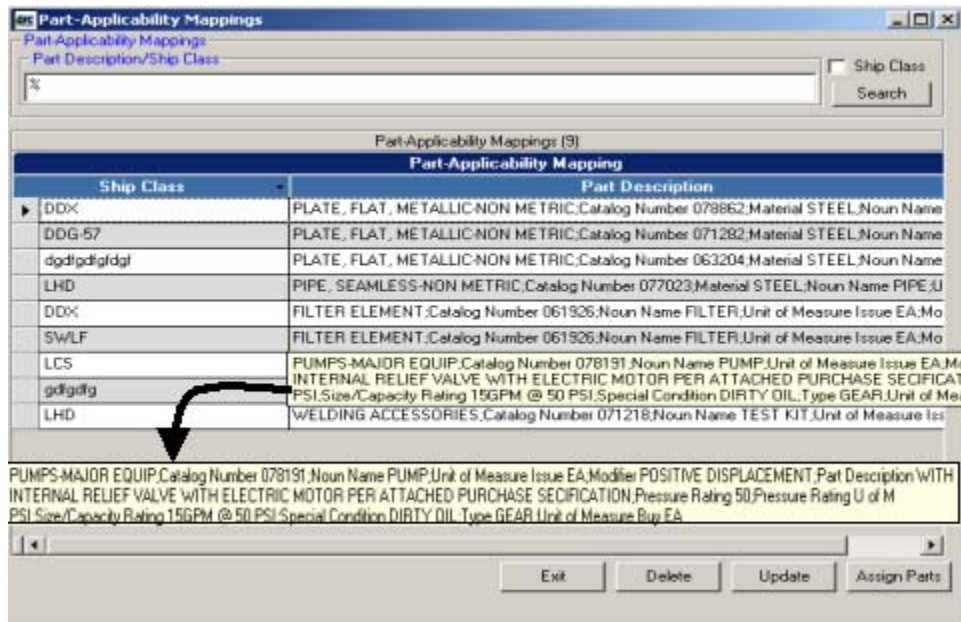
Figure 20. Part-Applicability Mapping

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The user can enter new mappings by right clicking and choosing Add Part->Applicability Mapping as shown in
Figure **2**1.
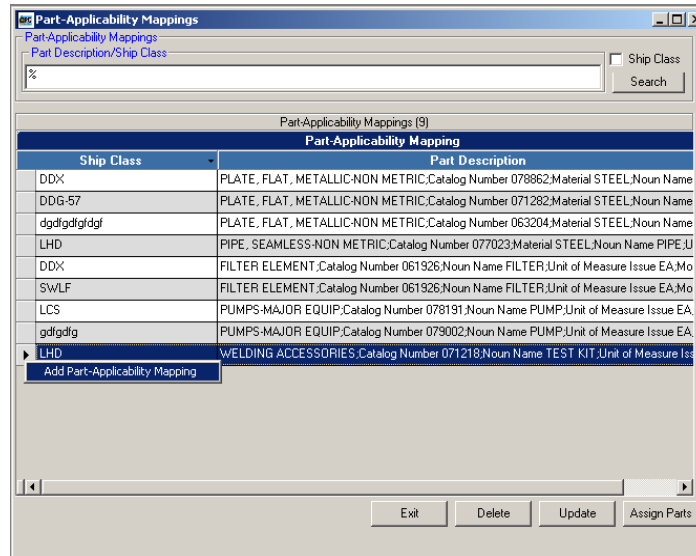
Figure 21. Add Part Applicability Mappings

The user can choose the Part by clicking on *Assign Parts* and then choose the ship class to assign it to. The user can update/delete existing mappings using the buttons at the bottom of the form. The user can search for existing mappings by entering the search criteria and clicking *Search*.

- Part Document Validation

KBSI implemented Part Document Validation. When a document is associated with a part, there is a validation check as to whether the document is associated with any of the ship classes that the part is associated with. If not, there is a message displayed on the screen as shown in
Figure 22.
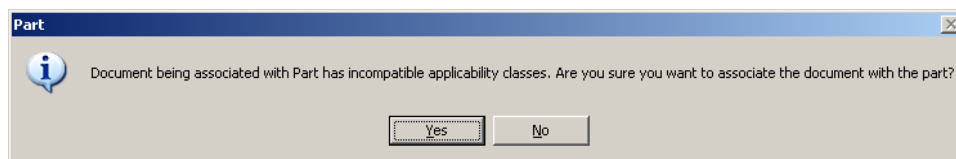
Figure 22. Validation

The option to enable/disable this validation is available in View->Options menu seen in figure 23.
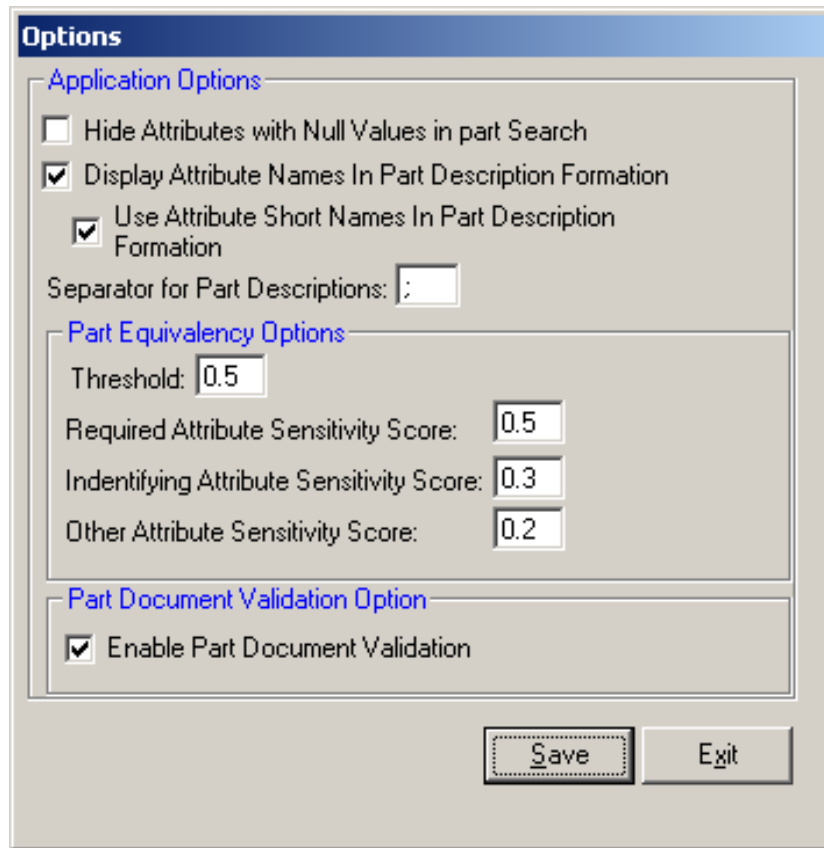
Figure 23. Options

All of the new features have been implemented in both the SQL Server and Oracle.

- CPC meeting with Bollinger

KBSI attended a CPC meeting with Bollinger on March 24, 2006. Bollinger was interested in using the CPC in their operation environment. KBSI is in discussions with Bollinger to achieve this goal. KBSI also received positive feedback and feature requests during this visit. The project team began to prioritizing and the designing these new features.

7.3   CPC/Flagship Integration – Proteus Engineering Development Progress

On March 28, 2006, a workshop was held at Anteon/Proteus in their Stevensville, MD offices. The goals of the workshop were to:
- Train attendees in the use of Designer and its linkage to the Common Parts Catalogue (CPC)
- Provide attendees with baseline version of Designer software
- Collect attendee comments for enhancement of Designer.

The following organizations were invited to send representatives: Bender Shipbuilding, Bollinger Shipyards, Gibbs & Cox, Murray & Associates, Elliot Bay Design Group, General Dynamics, Electric Boat, Genoa Design, KBSI, Marinette Marine, Northrop Grumman Ship Systems – Avondale Operations, and VT Halter Marine.

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The following organizations sent the noted representatives, who participated in the workshop:
- Bender Shipbuilding – Daniel Cavalier
- Elliott Bay Design Group – John Waterhouse
- Gibbs & Cox – Mark Masor
- Murray & Associates – Drew Hanes

The workshop commenced with introductions, and providing all participants with a laptop computer on which Designer and sample data were loaded. This was followed by George Hazen (developer of Designer) presenting Designer and its linkage to the CPC. George Hazen then trained the participants in the following areas, using a Surface Effect Ship initial design as an example case study:
- Development of vessel requirements and missions
- Data retrieval from the CPC
- Initial design wizard (resistance and power, lift system, hydrostatics, weight, and cost)
- Noise analysis and noise-reduction treatments

At the conclusion of the training, each of the participants were given an installation CD and a software dongle to allow them to install Designer on their own computer(s). While the Designer software can be installed on multiple computers at the customer's site, it will only run if the supplied dongle is attached to the computer. The training itself is captured on a tutorial that is available from within Designer by selecting 'Tutorial' under the Help menu.

7.4   Technology Transfer

Patrick David with SSI USA provided a project presentation update at the NSRP PDMT Panel Meeting held in San Diego, CA on May 9-10th, 2006. Also, Rolf Oetter with SSI, provided a project presentation update at the NSRP Joint Panel Meeting with SPPT, BPT, & ST held in Seattle, WA on May 16-17th, 2006. The presentations were provided to the Panel Chairs for posting on the NSRP website.

8   Final Technical Status Review

As of the end of May, the project was complete. The ShipConstructor 2006 software version was scheduled for released on June 16th, 2006. The final builds were compiled for QA testing prior to release. CPC integration was complete for all stock libraries, although further development will be required to complete the integration with the Equipment module, due to the total redesign of the module, both in design approach, database structure and user interface. ShipConstructor Splitting & Merging project was complete and functional, at the Unit level only. Further development is required to get down to the individual component level. SSI believes this functionality could be completed by sometime in October 2006.

KBSI has released version 4.3.0 of the CPC database and interface software on June 9th, 2006. The software has been placed on the project management website for download and installation by the participating shipyards. Major change was the identification of over 6400 defined part equivalencies between Bender, Bollinger, VT Halter & Marinette Marine. Each of these shipyards now has approximately 1600 CPC parts defined in the database under their respective

company cage codes. Also, an updated user manual has been released and was posed on the project management website for download.

8.1 SSI Development Progress

Stock Library Interfaces - the stock editor is complete with usability. As noted in the final status overview, equipment stock libraries need additional work although the module is functional.

Split and Merge Module - database rework is finished. The final adjustments have been made and effectively the database restructuring has been finalized.

Split and Merge Module's functionality is 90 percent complete. PS&M is well developed but has restrictions. The most significant issue that could be developed further is the Unit level limitation, which restricts splits to the unit level. Future work focused on Configuration Management issues could explore the feasibility of Split and Merge at levels defined in the topology breakdown, possibly all the way down to the individual component level.

Importing the ShipConstructor 2005 software version database is complete. ShipConstructor continues testing the import capability with model databases supplied to them from the project participants. Preliminary results show from the model data from a SC2005 project, supplied by Bender Shipbuilding, has been moved over within the 8 hour project metric. QA and in-house evaluation continues at ShipConstructor.

8.2 KBSI Development Progress

The following tasks were performed during this reporting period.

- **CPC Part Equivalencies**

The project metric/goal for the CPC task was to test the establishment of 1000 equivalent parts between at least two 2nd Tier shipyards. Figure 24, currently shows that the 2nd Tier CPC database has over 6400 part equivalencies defined between Bender, Bollinger, VT Halter, and Marinette Marine.

Figure 24. CPC Part Equivalenices

Figure 25. also shows that interface that allows an end user to view Equivalent Part Assignments from some identified part description that is defined by the part attributes.

Figure 25 Equivalent Part Assignments

- **CPC User Manual**

KBSI has release and posted the latest revised CPC user manual associated with version 4.3.0 on the project management website for download. The path name is supplied below: http://65.5.80.202/phpBB2/download.php?id=179 - _Toc135188336 If you do not have access to the project management website, please send an email to prob@bendership.com to receive access.

8.3   Proteus Engineering Development Progress

The integration of the CPC database and the concept design software of Flagship Designer were completed with great results seen in the workshop put on by Proteus Engineering.

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9   ROI Evaluation

The project team received a direct benefit from this research and technology by reducing ship design costs and improved productivity of CAD operators.

By integrating process improvements with full exploitation of state of the art tools, the project team will achieve a reduction in unit cost, an increase in unit production and an increase in net profits.

Return on Investment (ROI) is, as presented in the included ROI Worksheet. For the purposes of this project, we used the model for a small sized commercial shipyard, as done in the original proposal document. These model characteristics are as follows:

	Medium Size Commercial Shipyard	Small Size Commercial Shipyard
Throughput	**1 design/year** **4 ships/year** **72K tons of steel/year** **360K feet of pipe/year** **1,200K feet of cable/year**	**3 designs/year** **5 ships/year** **16K tons of steel/year** **90K feet of pipe/year** **260K feet of cable/year**

Employees	**200 pre-construction staff**
	      150 design
	       20 material
	       30 planning & production control
	2,400 production staff
	        1,200 steel production
	        720 outfit production
	        480 paint & service production
		50 pre-construction staff
		      35 design
		       5 material
		       10 planning & production control
		600 production staff
		         280 steel production
		         230 outfit production
		         90 paint & service production

Billing Rates	**$60/hour – pre-construction** **$45/hour – production**	**$60/hour – pre-construction** **$45/hour – production**

Cost per Ship	**$120 million/ship**
	        $72 million material
	        $48 million labor & overhead
		$30 million per ship
		        $18 million material
		        $12 million labor & overhead

9.1   ROI Assumptions

Due to the large collaborative nature of this project, a comprehensive ROI is nearly impossible to generate. However, the savings in each area are significant even for the small shipyards, so certain assumptions have been made to generate a realistic ROI.

To account for full implementation time, savings will not realized until the year 2007. Development work prior to implementation of the finished system does not contribute to savings. Approximately 3 months in year 2006 will the savings be realized.

1. A typical small ship design requires 30,000 manhours with the following breakdown:
    a. 20% structure (6000 hrs)
    b. 30% piping and HVAC (18,000 hrs)
    c. 10% foundations (3000 hrs)
    d. 10% electrical and design drawings (3000 hrs)
    e. 30% administration (including materials), reproduction, production support (18,000 hrs)
2. A small shipyard does three designs per year. The same number applies to the design agents supporting the yards.
3. Bender, Halter, Bollinger, and Marinette are considered small yards.
4. Avondale is a medium yard for the purpose of the ROI, and does 1 design per year, for 60,000 hrs.
5. Avondale counts as a 2x multiplier in the ROI.
6. Total shipyard multiplier is 6.
7. Total design agent multiplier is 4.
8. Total multiplier on per ship savings is 3 ships x 10 yards/design agents = 30.
9. EB is not included in the ROI, despite obvious improvements to their efficiency from their CPC Implementation.
10. The same percentage breakdown applies to the larger design.
11. Billing rates are $65/hr for design and planning, $45/hr for production
12. Estimated percentage reductions in design manhours per small shipyard due the design module improvements, based on best practices assessment:
    a. CPC - 10% reduction in design category (e) = 1800 hrs/ship x 30 = 54,000hrs/yr = $3,510,000/yr
    b. DB Merging – 15% reduction in design category (e) = 2700 hrs/ship x 30 = 81,000 hrs/yr = $5,265,000/yr
    c. Design Transition – savings of 10% in total design. 3000 hrs/ship x 30 = 90,000 hrs/yr = $5,850,000/yr
13. Additional impacts from material savings attributed to the CPC, schedule compression due to the overall project impact, and direct production impacts from better design documentation, better integrated planning and better project management are difficult to quantify. Given the quantifiable benefit above, no attempt has been made to skew the projected savings with difficult to quantify benefits.
14. Total annual savings, as detailed in the following ROI spreadsheet equates to $15,610,420, broken down as $950,420 in rework, $10,000 in inventory and $14,625,000 in direct or indirect labor.
15. 25% of the total savings will be realized in 2006 due to completed and implemented modules.
16. Recurring costs of $300,000 per year in license maintenance on the software will be incurred.

ROI WORKSHEET

oject Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Program Funds and Cost Share from Cost Proposal (i.e., Investment)	2117679	500832	0	0	0	0	0	0	0	0
Recurring Costs	300000	300000	300000	300000	300000	300000	300000	300000	300000	300000
Present Value of Investment	2417679	728036	247920	225390	204900	186270	169350	153960	139950	127230
Savings	4622920	15610420	15610420	15610420	15610420	15610420	15610420	15610420	15610420	15610420
Labor (Direct & Indirect)	3662500	14650000	14650000	14650000	14650000	14650000	14650000	14650000	14650000	14650000
Maintenance Rework	950420	950420	950420	950420	950420	950420	950420	950420	950420	950420
Scrap Services Equipment Inventory	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000
WIP Material & Supplies Schedule Cost Avoidance Time Value of Money Additional Income Other										
Present Value of Savings	4622920	14191433	12900451	11728109	10661917	9692510	8812082	8011268	7282260.9	6620379.1
Net Benefit	2505241	15109588	15610420	15610420	15610420	15610420	15610420	15610420	15610420	15610420
Present Value of the Net Benefit	2205241	13463396	12652531	11502719	10457017	9506240	8642732	7857308	7142310.9	6493149.1
Discount Factors	1	0.9091	0.8264	0.7513	0.683	0.6209	0.5645	0.5132	0.4665	0.4241
Cumulative Present Net Value	2205241	15668637	28321169	39823887	50280904	59787144	68429876	76287183	83429494	89922643
Net Present Value	89922643	The method chosen to represent ROI for NSRP ASE ranking purposes. Equal to the Cumulative Present Net Value at the end of the 10 year period.								

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