

# **Final Report IPRO 338, Spring 2005**

Implementing a Knowledge Management

*Sponsor: Topiary Communications*

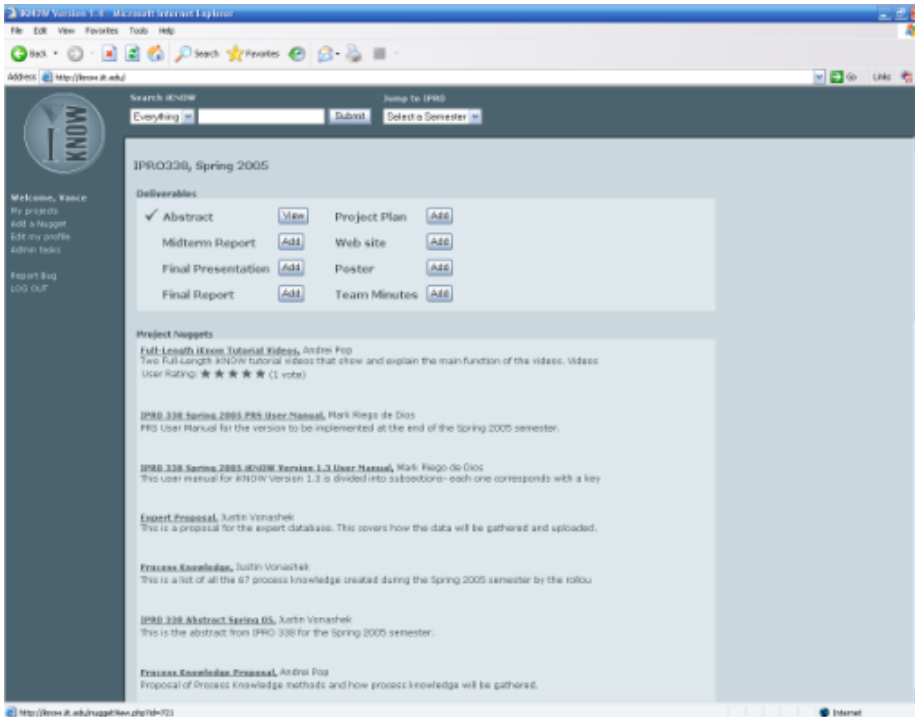


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# Abstract :: IPRO 338 :: Building a Knowledge Management System

## Background and history:



Imagine a workplace where 80% of the employees leave every 17 weeks, and are replaced by people who have no idea what the project is, have no access to old documents from the project, and are just starting to learn how to do their job. This is the plight of the continuing IPRO.

IPRO 338's iKNOW Knowledge Management System solves these problems by:

- Allowing students to store and retrieve key documents from all previous semesters
- Providing self-training applications for key IPRO skills such as project management and presentations
- Recording the experts used for each project and enabling students to locate them by their expertise.

Started in Fall, 2003, IPRO 338's set out to create an IPRO KMS (Knowledge Management System) to resolve these issues. The resulting KMS, iKNOW, includes document storage and management capabilities, extensive searching capabilities (including searching within documents in common file formats), and cross-semester and cross-project document access. To provide self-training applications, and to extend the capabilities of knowledge management within iKNOW, IPRO 338 has been working extensively with its outside sponsor, Topiary Communications, LLC. Topiary has created the Personal Pro knowledge capture tool, which enables subject matter experts to create web-based applications to transfer their knowledge. Beyond initial iKNOW rollout, Topiary and IPRO 338 are exploring a fully integrated combination of Personal Pro and iKNOW as a platform for knowledge management within corporations and large-scale organizations.

## Spring 2005 Goal:

To support and extend the first released version of the iKNOW KMS software.

## Subteam Organization/Tasks:

- |                        |  |
|------------------------|--|
| Internal Development:  | Stabilize existing version of software through fixing of bugs and addition of necessary functionality  |
| Extension Development: | Determine functionality for future versions of the iKNOW system. Develop a SOAP interface to iKNOW to facilitate access through external software systems. |
| Roll-out               | Load existing content to ensure release version is populated, produce materials to support the use of the iKNOW system                                     |

## **Problems faced this semester:**

Technical:

- Several existing bugs needed repair; > 15 bugs identified and corrected.
- Security issues with the iKNOW server

Non-technical:

- Difficult to gather information to describe individual documents clearly in roll-out database
- iKNOW only used at beginning and end of semester

## **Results/Accomplishments:**

The iKNOW KMS has been released to the IPRO teams. Documents have been added for all continuing IPRO projects. All major bugs identified at the beginning of the semester have been addressed and new functionality has been added, including an improved expert database and a SOAP interface to external software systems. The rollout team has continued to support the release of iKNOW by creating iKNOW training manuals

## **Future:**

## **Sponsors:**

Topiary Communications Inc., CEO Dan Schramm; IIT Collaboratory for Professional Studies

## **Advisors:**

Professor Daniel Ferguson, Professor David Grossman

## **Team Members:**

Ben McInturff, Project Manager and PRS  
Dusty Hendrickson, Internal Development  
Vance Thornton, Internal Development  
Aron Ahmadi, Extension Development  
Hart Wilson, Extension Development

Atif Kahn, Extension Development  
Mark Riego de Dios, Rollout  
Andrei Pop, Rollout  
Justin Vonashek, Rollout

# The iKNOW Project

IPRO 338 attempted to continue this semester the work done in previous semesters. Specifically, this meant stabilizing the iKNOW system, creating additional materials to support it, and designing and developing a SOAP interface which will allow iKNOW to be accessed by external software systems. A limited rollout was made for this semester. Our goal for this semester was to ensure that this rollout was as smooth as possible as well as to gain as much information as possible about what needed to be changed in the system so that it will best serve its users needs.

## Roll-Out

### Introduction:

Roll-Out is the only subteam in IPRO 338 whose responsibilities and duties do not involve coding or programming within iKNOW. However, the iKNOW system designed by the IPRO 338 team to have IPRO students be able to access their as well as other IPRO teams' work experiences just as much non-programming issues as it does with programming. As a result, the existence of the Roll-Out subteam is necessary in handling the non-technical tasks and issues within iKNOW.

### Background:

Last semester, Roll-Out's main assignment at the time was simply getting continuing IPRO team's data prior to that semester into iKNOW- why? Because the point of iKNOW is for IPRO teams to be able to minimally access their documents as well as other IPRO teams as reference in completing their IPRO work and research- to have all of it in one place. Otherwise, all that information is scattered on people's computers, their IPRO team CD-ROMs submitted to the IPRO Office, PRS, and multiple-page binders- even when IPRO teams could access that, how would they still remember the context for that information to be used?

### Purpose:

In tackling the non-programming issues and aspects within iKNOW, the Roll-Out subteam was to successfully complete the following six assignments as recommended by their faculty advisor:

- 1) Data Inventory Upload: This assignment deals with uploading all IPRO team's previous data prior to this semester into iKNOW.
- 2) Expert Database: This assignment deals with providing currently existing experts IPRO teams can consult in extending on their previous semester's work and/or providing new research.
- 3) Team Liaison: This assignment deals with the IPRO 338 members working with other IPRO teams in getting them to use the iKNOW system by either training them in it or gathering suggestions and recommendations that would further render them more voluntarily to use it.
- 4) Process Knowledge: This assignment deals with identifying areas and topics IPRO teams generally need and utilize in completing their IPRO work.
- 5) User Manuals: This assignment deals with creating a User Manual in iKNOW in order to teach future IPRO students how to successfully use the system. In addition, an Administrator Manual in iKNOW as well as a User Manual in PRS are to be created as well.
- 6) Training Tutorial: This assignment deals with complementing the User Manual by devising successful visual and textual means in teaching and showing iKNOW users from its main screen what the system can and will do for them.

### Methodology:

The Roll-Out subteam consisted of the following members who were originally delegated in coordinating the following as well as additional and/or revised assignments, exclusive to their subteam:

Member	Original Assignment	Final Assignment
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Andrei Pop

Process Knowledge  
Training Tutorial

Training Tutorial

Mark Riego de Dios

Data Inventory Upload  
User Manuals

Data Inventory Upload  
Expert Database  
User Manuals

Justin Vonashek

Expert Database  
Team Liaison

Process Knowledge

## **Obstacles:**

For Data Inventory Upload, two main problems are still evident. First, since IPRO teams are submitting their team CD-ROMs to the IPRO Office and to PRS, iKNOW aims to have all of this same information accessible in only one place, being its system. As a result, the IPRO 338 team is forced to put that information into the system themselves. And second, because this IPRO team must initially put that information into iKNOW in order to show and coerce other IPRO teams to use it, it must upload that information to the best of their knowledge on those other IPRO teams, which is limited due to lack of metadata information.

Last semester, Roll-Out only enlisted half (four) of the IPRO 338 team members to upload only *continuing* IPRO team's data into the system. This semester, Roll-Out asked that the rest of the team (all nine members, overall) upload all IPRO team's previous data into the system. Keep in mind, this data included only CD-ROMs and PRS- some teams did not submit all their team data. So this team only worked with available data. Even after this assignment was completed, some of this data was somehow missed- most likely due to mis-transmission (copying errors of the IPRO team CD-ROMs).

For Expert Database, the "IIT Faculty and Senior Staff Expertise Database" was used last semester as its entire database. The main problem was that the site was questioned to not be updated very often. This semester, the site still hasn't been. Roll-Out has attempted to get in touch with the administrators of the site, but contact has been very difficult (erratic response time).

For Team Liaison, certain members of the team did not comply with Roll-Out's request of attending their team-liaisoned IPRO's weekly meeting, even when reported to the faculty advisor. These members did not believe in the assignment's purpose of unveiling what IPRO teams need help with pertaining to iKNOW and disregarded this in favor of their programming assignments. In spite of this, going to their team's weekly meetings eventually garnered the same results after four weeks- as a result, the team discontinued their Team Liaison practice, deeming the outcome to be a failure.

For Process Knowledge, each member could only realistically work with one IPRO teams, which means that only research on nine out of the thirty-four IPRO teams could be found- this is not reflective or valid as overall research across all IPRO teams as a whole. The only alternative discussed in rectifying the situation was simply asking other IPRO teams what they would want or need from iKNOW.

For User Manuals and Training Tutorials, there were not any major issues other than inexperience on the members when it came to these assignments- with Mark's technical experience with creating a User Manual on Microsoft Word as well as editing screenshots and Andrei's first use of his moving screenshot software.

## **Results:**

For Data Inventory Upload, some data that was said to be put into iKNOW was reported to not be there (IPRO 307 and the Bird-Collision IPRO). Other than that, nothing else has been said regarding this assignment.

For Expert Database, some of the 318 experts from the IIT Faculty and Senior Staff Expertise Database were considered to be obsolete or incomplete because they were no longer known to be currently employed at IIT. Other than that, there was a considerably substantial ratio of areas of expertise to expert.

For Team Liaison, each iKNOW team liaison would eventually get the same information- which also did not reflect all IPRO teams, anyways. The assignment was scrapped after four weeks.

For Process Knowledge, the team generalized areas across all IPRO teams and added the ones reported from their Team-Liaison assignments- IPRO 338 took the original thirty and better defined and classified them into sixty-seven process knowledge topics whose information will be researched and made available in iKNOW next semester.

For User Manuals and Training Tutorial, they were completed by the end of the semester as originally allowed.

## **Conclusions and Recommendations:**

If these assignments remain the same but extended for the next semester, Roll-Out has the following recommendations:

For Data Inventory Upload, particular data was discovered to be missing in the system (so far, it is with IPRO 307 and the Bird-Collision IPRO). This could be the result of last semester's attempts at this assignment. The first recommendation is to get all IPRO team's previous data in Spring 2005 into iKNOW- the next Roll-Out subteam is encourage to use the iKNOW 1.3 User Manual in uploading this data. This is to prevent Roll-Out from simply assuming and not uploading these documents correctly (for example, by not taking consideration into putting the IPRO number

and semester and type of document for Title of Document or simply putting this is an abstract in the Abstract section instead of and without further going into more detail on what the Abstract contains). The next recommendation is making sure that all IPRO data uploaded prior to last semester- some of it has been reported to be missing. With the Data Inventory List document compiled, Roll-Out can use this to gauge correction of this issue. In addition, it's most veteran Roll-Out member, Mark Riego de Dios, will still be around as an IIT Student the following year to be consulted more on these issues. Other than that, the last recommendation is to accumulate a physical inventory of all IPRO team's data- in other words, get all IPRO team CD-ROMs and store them into one, safe place. This is to preserve the documents and to have them easily accessible in one place (the reason for iKNOW!)- there were issues in copying errors as well as corruption on one of the CDs earlier this semester. That and the IPRO Office employee and former IPRO 338 member and correspondent, Ben McInturff, has moved on in his future endeavors from IIT.

For Expert Database, since the "IIT Faculty and Senior Staff Expertise Database" is not kept currently updated and that contact with the site administrators has been very difficult, Roll-Out was recommended to use professors and their course descriptions from Web for Students to compensate and keep currently updated the iKNOW expert database. With the help of the team leader, Roll-Out was able to get permission of the person in CNS to "pour" this Web for Students information- it has yet to be implemented yet.

For Team Liaison and Process Knowledge, with only two other IPRO teams in the summer semester, Roll-Out could foresee a reasonable timeframe in gathering the process knowledge topics and finally gathering their information. Based on the repeating results of this semester's IPRO team in their Team-Liaisoned efforts, even though it did not reflect all IPRO teams, Roll-Out does not see their further research in adding process knowledge areas to take a long time- contrary to gathering the information to teach these IPRO teams the process knowledge topics they requested.

For User Manuals and Training Tutorial, the main obvious recommendation is to update the chances when necessary since iKNOW Version 1.4's visual appearance was set on being changed from iKNOW Version 1.3, rendering all screen shots in the User Manuals and Training Tutorials obsolete. For the User Manuals, it was discussed that they would also be accessible in iKNOW from the search engine as well as divided into links to take the user in question to the corresponding question- this could possibly involve dividing the User Manual into segmented documents and creating hyperlinks from there. For the Training Tutorial, it was recommended that the video clips be divided and hyperlinked by feature and available in multiple video formats (Windows Media Player, Real Player, Quicktime, etc.).

## References:

\* The following referenced documents to be discussed should either be in iKNOW and/or on the IPRO 338 Spring 2005 team CD-ROM.

For Data Inventory Upload, the available IPRO team CD-ROMs were obtained from the IPRO Office and delegated amongst the team- in addition to all available IPRO team PRS documents- and put into iKNOW. Since the team only uploaded *available* data, a Data Inventory List was compiled to include the information of what IPRO teams have not submitted CD-ROMs as well as who uploaded what, at the request of the professor.

For Expert Database, the names of the 318 experts and their areas of expertise were manually extracted from the "IIT Faculty and Senior Staff Expertise Database" (IIT Graduate website). Their e-mail addresses were also manually taken from the IIT People search engine. All of this information was compiled onto a Microsoft Excel spreadsheet according to First Name/Last Name/Department/Institution/E-mail/Area(s) of Expertise and put into iKNOW.

For Team Liaison, a Team Liaison Form (questionnaire) was generated for the IPRO 338 members to use when attending their IPRO team's weekly meeting. A cumulative version of the Team Liaison results was put into one list for overall review.

For Process Knowledge, the team originally took the process knowledge areas they identified and generalized for themselves as well as other IPRO teams and gathered additional areas exclusive to their team-liaisoned teams. From there, the team better defined and expanded the overall list of about sixty to seventy areas and put it in iKNOW under "Process Knowledge".

For User Manuals, Professor Ferguson provided an SA User Manual one of his former student's created to be used as a reference.

For Training Tutorial, a specialized type of software that helps capture moving screenshots in iKNOW was used in implementing the training tutorial (with voice-over). Andrei Pop introduced and worked with this software- he can be consulted in addressing further questions and comments.



## **Acknowledgements:**

The Roll-Out team would like to acknowledge every member of the IPRO 338 team for their contributions. The rest of the team helped Roll-Out complete the Data Inventory Upload by manually uploading their team-liaisoned IPRO's documents so that the subteam would not have to take care of inserting all IPRO data prior to this semester into iKNOW themselves. Most of the rest of team also attended other IPRO teams' weekly meetings at our requests for the Team Liaison assignment- while everyone helped better identify and define the targeted Process Knowledge topics. For User Manuals, Roll-Out would like to thank Professor Ferguson for providing his former student's SA User Manual as an example and a reference in completing the ones for iKNOW and PRS.

## **Internal Development**

### **Objectives:**

The primary goal of the development team this semester was to stabilize the iKNOW code base and ensure that all functionality was in place for a full release of the system in fall 2005. This required that the system be thoroughly tested and all found bugs removed. The development team was also responsible for ensuring that any additional functionality needed for the system to be completely usable without the support of developers experienced with the system was in place and that the system was adequately documented for future teams to continue work with the system.

### **Methods:**

Development began with functional testing and bug fixing for iKNOW v1.2 beta which was completed at the end of last semester. We all bugs found in this version were corrected development began on iKNOW version 1.3. One of the key features of the system is the ability for users to be able to find relevant experts and expertises using the system. In previous versions the database design precluded this from being accomplished effectively because experts and expertises could not exist as independent entities within the system. The database design was changed to correct this and appropriate modifications to the user interface were made. Modifications were also made to the search to make use of this new database structure to locate experts and expertises. Additionally for version 1.3 we removed a PHP limitation which restricted file uploads to less than 8mb. This was done by replacing the PHP code for file upload with a Java Servlet. We also added IP address logging to the system for events such as login, nugget view, and file download. Unfortunately during the functional testing process of this version we experienced security issues with the iKNOW server. The server was down for nearly a week as the problem was determined and the system was restored to a functioning state. The next version of iKNOW developed was version 1.4. For this version we made a number of modifications to the interface which usability testing suggested would make the system easier to use. We made the jump to IPRO box more intuitive, removed the top five and newest five nugget lists from the left navigation bar, modified the color scheme, created a new logo, added indicators for required fields, and added a progress indicator to the nugget creation process. We also added functionality to eliminate shortcomings in the administration interface. The nuggets module was modified so that nugget deletion and adding nuggets as another user was supported. The development team has also worked to document iKNOW's database structure and source code.

### **Results:**

The development team was able to accomplish all of its objectives for this semester. The system code is in a stable state and is ready for functional testing in the summer.

### **Recommendations:**

The monolithic nature of the system has made it increasingly more difficult to add new functionality and correct bugs in existing functionality. Each change to the system requires that numerous source files be checked to ensure that they work correctly with the change. This process becomes more error prone as each piece of new functionality is added to the system. It is our recommendation that a new web interface be created which makes use of the SOAP interface as a backend.

# Extension Development

## Introduction:

The SOAP sub team was responsible for designing and implementing an external interface to iKNOW through which other software could add and retrieve data. In addition, the sub team was responsible for coordinating the design with our sponsor, Topiary Communications, with regards to their use for an interface between iKNOW and PersonalPro.

## Background:

Until this semester, there has been one way to externally add or retrieve information from iKNOW, the web interface. At the beginning of the semester, two tasks were identified that required creating one or more external interfaces to iKNOW: integrating the Project Reporting System (PRS) with iKNOW, and coordinating with Topiary to integrate iKNOW with their application, PersonalPro. It was not clear at the beginning of the semester whether there would be a single external interface or if both of these cases would be handled separately. Integrating PRS was the responsibility of the PRS sub team and coordination with Topiary was the responsibility of the commercial rollout sub team. Aron Ahmadi, the sub team leader of the commercial rollout sub team, identified an opportunity to accomplish both tasks with a single interface and simultaneously improve the design of iKNOW overall. He presented his design proposal to the team, and on his recommendation, the commercial rollout sub team was disbanded and the SOAP sub team was created.

## Purpose:

The main goal of the SOAP sub team's work this semester was to improve the architecture of iKNOW with future development in mind while providing an external interface by which PRS, PersonalPro, a new web interface, and any unforeseen future projects could access iKNOW. The Simple Object Access Protocol (SOAP) was chosen as a technology for this interface due to its wide popularity, relative simplicity, the fact that it is based on XML, and the fact that it is an open standard. It was realized early in the semester that there would not be time to implement a web interface, so development work was focused on the SOAP interface.

## Methodology:

The SOAP sub team did not perform original research but instead utilized standard software engineering practices, including N-tiered architecture, design patterns, and iterative object-oriented design.

Technologies for the implementation were chosen based on their fittingness to our needs and the availability of high-quality, free implementations. Java was chosen as the programming language for the implementation, due to familiarity of the developers with the language, availability on our server, and excellent support for the other technologies needed. XML Schema was chosen as the schema language for defining how data would be passed to the SOAP interface, as it is the default schema language for some of the other technologies we used. The Java API for XML Binding (JAXB) was chosen to convert the XML data received by the SOAP interface into Java objects because of its flexibility and ability to reduce development time for this part of the interface. Web Services Description Language (WSDL) is the de facto standard declaration language for interfaces such as the one we developed. Java Database Connectivity (JDBC) is a common standard for accessing relational databases in a portable manner from Java.

## Assignments:

The members of the SOAP sub team were given the following assignments for the semester.

Aron Ahmadi: initial design and strategy, meeting with Topiary Communications, coordination of development work

Hart Wilson: designing and implementing the SOAP interface

Atif Khan: implementing and testing the database access

## Obstacles:

One of the biggest obstacles encountered this semester was the learning curve for the technologies we chose to use. Hart Wilson had limited experience with XML development and no experience specifically with SOAP or JAXB. Atif

Khan had limited experience with JDBC. Time was allocated for learning, but it became clear throughout the semester that the time allocated was inadequate for our needs. Part of this problem lay in the fact that SOAP development work did not start until a few weeks into the semester, and due to the limited time frame, we had to balance our time between learning and development.

Another obstacle encountered was the lack of experience working on a software team. Poor communication resulted in some misallocation of developer time, including some duplicated development work.

## **Results:**

The SOAP sub team produced the following results this semester:

The creation of an XML Schema document for the data that would be used by the SOAP interface. Part of this process was annotating the schema for conversion by JAXB and for documentation purposes.

The creation of a WSDL document for most of the methods to be exposed by the SOAP interface.

Implementation of a Java Servlet to handle SOAP in HTTP requests.

Design and implementation of the SOAP mediator, which handles SOAP method calls and dispatches the necessary operations to the appropriate backend component (database, file system, etc.)

Implementation of the database backend for get, add, update, and delete methods on each of the data types.

Partial implementation of file system access.

## **Conclusions and Recommendations:**

Although we were able to accomplish a great deal of the development work this semester, the SOAP interface is not yet finished. In particular, certain functionality was deferred until future semesters, most notably authentication and search functionality. We recommend that future semesters consider and develop this functionality at the earliest possibility.

In addition, the system we developed has had relatively little testing. We recommend that future semesters add unit tests to the code and develop a comprehensive testing plan.

Finally, we conclude that it is essential to allocate enough time for learning the technologies used by iKNOW before beginning development. We are preparing a document outlining more specific recommendations for development in future semesters.

## **References and Acknowledgements:**

We acknowledge: Dan Schramm and Cliff Wagner of Topiary Communications for contributing their experience and insight into knowledge management; Dr. David Grossman of the Computer Science department for advice and comments on our design; Dr. Virgil Bistriceanu of the Computer Science department for advice related to authentication and roles.

# **Project Reporting System (PRS)**

## **Background:**

The Project Reporting system was developed as a means of online support for the creation and submission of IPRO deliverables. The system was implemented from another system named SMS (Strategy Management System) that was the project of a prior IPRO team. The Project Reporting System provides examples and instructions to assist in document composition. It then provides and facilitates the submission of those documents. It is one of the many tools provided by the IPRO Office to support project management.

## **Purpose:**

The PRS team was created to handle both usability tests of the iKNOW and PRS systems. It was also tasked with creating a consumer application of the iKNOW webservice developed by the SOAP team.

## **Methodology:**

### Usability-

The usability test invoked the same methodology of usability testing that had been used in the previous semester's usability test. The test was comprised of monitoring the use of the systems to perform preset tasks on both systems, and time was allotted for the use of both. Eight users were selected from IPRO teams to go through the system and perform various tasks, noting that the system was being tested, not themselves. There were two administrators for the tests, a facilitator and a note taker. The ease with which the users navigated the system, trouble points, and the user feedback was noted so that recommendations could be made.

Recommendations were made from the notes on the usability tests, with priority established for certain items. These results were mainly recommendations for changes to the User Interface (UI).

### UI Changes-

The majority of the recommendations compiled on the systems referred to the appearance of both systems. In the Project Reporting System, this amounted to a change of the navigation ordering for a more intuitive design. In addition, a cascade style sheet (css) was applied to all pages, since the usability test had indicated a need for more readable text (specifically the users consistently noted that there was too much text for the web based medium used and that it was too bold). The testers also desired one convenient place to get all examples from. This was implemented by placing the examples on one download page.

## **Assignments:**

There was only one assignment to this team as I was the only member of it. I handled all responsibilities of the PRS subteam.

## **Obstacles:**

The greatest obstacle facing the PRS subteam was a lack of resources. As the PRS team gave one of its two members to the SOAP team in the early part of the semester the PRS team had a significant amount of work to do with a very finite amount of labor. As such the accomplishments of the team must be held in the light of a team that has only one member.

Another obstacle of the PRS team is the [unmaintainability](#) of the PRS code-base. The code that comprises the PRS backend is quite rigid and is very voluminous, with not much of it in the object oriented or well written area of code. This poor code-base entailed a greater amount of time to change for any of the changes applied, especially those occurring on every page.

## **Results:**

The main results of the PRS sub-team are the changes that were applied to the user interface. These are a result of the usability test that was performed on the system, and recommendations were produced for the both iKNOW and PRS will be applied before the summer 338 team convenes. PRS has had a style sheet implemented for the first time this semester. As mentioned previously, it also got a complete reorganization of its menu and examples, into a logical set that will be applied to the system as soon as the semester is over.

## **Recommendations:**

It is the recommendation of this team to continue to usability test and upgrade the PRS system. It is a slow process that slowly will improve the system until it is easy to use. It is also the recommendation of this team to develop in the next semester a consumer of the SOAP web service that was developed by the aptly named subteam. At a later date, it may be necessary to totally refactor the PRS code-base to improve maintainability. It is also the recommendation of this team that the information and examples and all of the functionality of the PRS system be moved to the iKNOW system to remove redundant functionality.

## **Acknowledgements:**

We would like to recognize the UTEC testing center at IIT and especially Dr. Susan Feinberg for the assistance given in usability testing the two systems, iKNOW and PRS.