Creating the Arizona Electronic Atlas: A GIS Partnership

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Introduction

The Arizona Electronic Atlas is an interactive Web-based state atlas that will allow users to create and download maps using geographic information systems (GIS) technologies. It is being created with grant funds from the federal Institute for Museum and Library Services (IMLS). Partners in this project are the University of Arizona Library (lead institution); the Arizona State Cartographer's Office; and the Arizona State Library, Archives and Public Records (the state library).

Maps and mapping tools now abound on the Web, so why is the Arizona Electronic Atlas and this project development unique? Although many other mapping tools provide data at the state and national level, local data often is not always effectively provided by broad-scale collections. The Arizona Electronic Atlas will include smaller geographic entities, such as counties, cities, and towns. It will allow users to create, ma-

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nipulate and download maps and data that are tailored to meet their specific information needs. The Atlas will be designed to be as accessible and intuitive as possible, yet provide in-depth and detailed data for a variety of disciplines. Few states have attempted to create an electronic atlas this comprehensive, providing geographic data resources for social science as well as science disciplines. Users will need only a Web browser.

The Arizona Electronic Atlas will serve as a model in several ways—in partnerships, in workflow design, and in leadership. We are seeking to broaden the collaboration between the State's libraries and other governmental agencies by using current technologies to provide data that addresses key economic and resource issues. This partnership model is very portable to other states, regardless of how their government is organized. The Arizona Electronic Atlas Project will also develop a workflow that other academic libraries can use as a model in developing their own GIS products and services. Finally, the project will model leadership by demonstrating libraries' key role in incorporating GIS into the national digital library.

The Atlas will serve as an innovative tool for improving different dimensions of information literacy. It will be used to develop geographic information literacy, support problem-based learning and encourage critical thinking and analytical skills.

This paper will describe the development of the Atlas and progress toward project outcomes. It will focus on the nature and importance of partnerships in crafting complex Web-products successfully. Issues that will be explored will include the involvement of faculty and other stakeholders in identifying data to include in the Atlas, and the critical skills each project partner brings.

Brief Overview of the History and Literature of GIS in Libraries

Brent Allison, in an Association of Research Libraries (ARL) Newsletter (ftp://www.arl.org/info/gis/gis.178) defines geographic information systems (GIS) as " software with the capability of manipulating and analyzing spatially referenced data to create maps, images, or charts that reflect the relationship of data elements to geographic reference points." Libraries began to see the advantages of GIS technology in the early 1990s when relevant software systems began to become more mainstream and user friendly.

There are many GIS software platforms available, including those from companies such as Environmental Systems Research Institute, Inc. (ESRI), MapInfo, Intergraph and Idrisi. ESRI products, however, have become the de facto industry standard. In libraries, this is largely the result of the partnership between ESRI and the ARL. In 1992, the two formed what is called the GIS Literacy Project (http://www.arl.org/info/gis/index.html). The Project, which also involves numerous ARL member libraries, was designed to "provide the tools and expertise necessary to insure that digital government information can be used effectively and remain in the public domain" (French 1999). To reach this goal, libraries are encouraged to incorporate GIS into their institution, maintain a support staff, develop partnerships between GIS agency users and continue to provide users GIS through evaluation and enhancement of programs (French 1999).

One way that libraries provide access to digital GIS data is via the World Wide Web (WWW). There are several library web sites across the United States that provide tools necessary for individuals to create maps and perform spatial queries on various data sets. Among them are the Massachusetts Electronic Atlas (http://hcl.harvard.edu/maps/massatlas.html), the Washington State Geospatial Data Archive (http://wagda.lib.washington.edu/), the University of Idaho's Inside Idaho site (http://inside.uidaho.edu/), and University of California, Santa Barbara's Alexandria Digital Library Project (http://www.alexandria.ucsb.edu/). The University of North Carolina at Chapel Hill (http://www.lib.unc.edu/reference/gis/gisinlib.html) provides additional links to GIS related web sites and is a good starting point to locate other institutions that are involved in GIS projects.

For more background information, Gluck and Yu (1999) provide a good overview of what GIS is, how it works and is applied. In addition, they outline research done on GIS users in the library setting. The *Journal of Academic Librarianship,* vol. 21, no. 4 (1995) and vol. 23, no. 6 (1997) and *Information Technology and Libraries,* vol.14, no. 2 (1995), have devoted special issues to GIS and libraries. Among the papers in these special issues is one that describes Project Alexandria (Larsgaard and Carver 1995, 93–97) and another describing GIS implementation at North Carolina State University State Libraries (Argenati 1997, 463–86). There are several articles that discuss the management of GIS resources (McGlamery 1995, 116–21 and Stephens 1997, 498–504) and collection development policies (Longstreth 1995, 267–74). A good site to examine literature on GIS and libraries is provided by McMaster Universities Lloyd Reeds Map Collection (http://library.lib.mcmaster.ca/maps/gis_libr.htm).

Early GIS Developments at the University of Arizona Library

The University of Arizona Library instituted a GIS service in 1996 as part of the Association of Research Libraries (ARL) GIS Literacy Project. ESRI's ArcView software was difficult for non-technical users to use without one-on-one assistance. To remedy this situation, the Library partnered in 1998 with GIS campus experts to create GeoFac—a user-friendly graphical user interface to ArcView for creating maps from the 1990 U.S. census data. GeoFac consolidates a twenty-step process down to a manageable point-and-click interface requiring only three simple steps. It requires no previous knowledge of GIS or ArcView. With GeoFac, users can create their own maps within a few minutes.

One of the drawbacks of GeoFac, however, is its limited accessibility. The library loaded the program only onto certain machines that are available only during library hours. Feedback from students and faculty indicated a need for more access to the data and suggested making it available on the World Wide Web (WWW).

In addition, students and faculty requested a user-friendly interface that provides access to a wider range of Arizona-specific geospatial data, beyond census data. With the GeoFac interface, adding data is not a simple matter, Data has to be programmed in, rather than just reformatted and loaded.

The Arizona Electronic Atlas—The Grant Proposal

In order to respond to these needs, the library began to explore the concept of an Arizona Electronic Atlas. A team of librarians and staff from the Library's Social Sciences Team, the Digital Libraries Initiative Group (DLIG) and the Science-Engineering Team came together in fall 2000 as the Arizona Electronic Atlas Project Team. The Institute for Museum and Library Services (IMLS) National Leadership Grant for Libraries, Preservation and Digitization was identified as a potential source of funding.

Input from campus departments was solicited at this stage regarding potential curriculum use of an electronic atlas and data to be included. In addition, campus and statewide experts in geography and GIS contributed to the development of the proposal by commenting on the early drafts.

The proposal outlined multiple purposes: to create a dynamic Web-based interactive Atlas of Arizona that integrates disparate and distinct data sources and allows users of all skill levels to create, manipulate and download accurate and current maps and data; to ensure public access to Arizona spatially referenced data; to provide maps and data that help solve some of the issues confronting the state (e.g., population, water, natural resources, business and economics); to meet educational and research needs of the users; and to provide an innovative tool for improving geographic literacy.

The goals of the project, in addition to the primary one of creating the atlas, are to broaden the collaboration between the State's libraries and other State governmental agencies and demonstrate the value of these relationships; to develop a model and methodology that other organizations can take and use to develop their own web-based atlases and other products; and to demonstrate libraries' key roles in developing the national digital library and in the State's development.

The proposal was submitted in January 2001. Funding was requested for hardware, software and consultant time for data conversion and programming. In September 2001, IMLS awarded the University of Arizona Library a two-year (2001–2003) grant of $123,672 for the Arizona Electronic Atlas project.

Writing the Request for Proposal (RFP)

A Request for Proposal (RFP) was needed in order to contract out data conversion and web site programming to a consulting company. In writing the RFP, the project team worked closely with the University's Purchasing Department, which provided the legal and contractual framework.

The project team wrote a purpose statement to provide guidance in the atlas' development. We also defined, for incorporation into the RFP, scope of work, timeframe and phases of the project, functional and non-functional requirements, technical specifications and cost requirements.

To inform this process, the project team conducted a focus group session with University of Arizona faculty from a wide variety of departments, including members of the Campus Advisory Group. We also met separately with other campus groups that have an interest in the Atlas project. In these sessions several questions were asked regarding use of maps in the classroom/curriculum, potential uses for the Arizona Electronic Atlas, and features to be included in the atlas. Responses included suggestions regarding provision of detailed help pages, tutorials on cartographic principles (such as scale and projection), printing functionality, availability of metadata, and how to cite the Atlas in a paper. We incorporated as many of their comments and suggestions as possible into the RFP.

Project partners and campus advisory group members were invited to comment on drafts of the RFP to help us refine and improve the proposal.

The RFP was sent out on June 13, 2002 and vendor proposals were due on July 30, 2002.

Proposal Evaluation and Consultant Selection

Team members and partners held a pre-proposal informational meeting, coordinated by the University of Arizona Purchasing Department. This meeting was required for any vendor who planned to bid on the RFP. During this time each vendor had an opportunity to ask questions. Team members recorded all of the questions and answers and followed up after the meeting with a written reply to all in attendance. The meeting gave all interested parties an idea of who might bid on the project. The session also gave project team members some knowledge of the vendors' range of concerns. There were, for example, procedural questions about the timeframe of the project and who would be evaluating the bids. There were questions about the content and format of the proposed data and metadata. Other questions involved hardware and software concerns such as our server capacity.

On July 30, we received proposals from four vendors. The proposals were in response to our request for specific information on the company's background, relevant experience and project team qualifications; information on the scope of the work and how they would manage each phase of the project; their response to our required and desired specifications and technical requirements; and a timeframe and cost proposal. One vendor submitted a counter proposal that did not address the questions outlined in the RFP. While this vendor remained in the pool, they could not be a serious contender because there was inadequate information to evaluate them.

The project team decided that it would be best for each team member to work independently in reading and reviewing each proposal. In this manner we could each become familiar with the content of each proposal and begin to form our own opinions. We would meet as a group after our individual reviews to share reactions, discuss questions and benefit from the ideas and thinking of the entire group.

The team developed a decision matrix (Appendix) that allowed each team member to evaluate the proposals using the same criteria. We modeled it after several examples that other University of Arizona departments had used to evaluate their own vendor proposals. The University's Purchasing Department requires a ranking system when evaluating vendors. The major categories used were 1) ability to meet system minimum required deliverables, 2) experience in developing and delivering similar products, 3) training, 4) support during and following projects, and 5) cost. There were subcategories under the major ones and team members rated each item under every category on a 1 to 3 scale. The matrix included a column for notes on every item.

We had several project team meetings where we discussed our individual ratings and how we came to our decisions. The project team discussed advantages and disadvantages of out-of-state vendors. We raised questions, exchanged information and brought up issues that still required clarification from the vendors. One point that needed clarification or expansion was the nature of the training for University of Arizona staff members working on the technical aspects of the project. Other points of clarification included software concerns such as the recommended use of Oracle (a database management system) and ArcSDE (a spatial database engine).

While the project team had several meetings separately, it was very important to meet with our partners so that we could all benefit from their assessments as well. A major obstacle we discussed was that all viable proposals came in above our funding allocation. Two proposals, while above our cost projections, were very close to each other while the third was much higher. We discussed a variety of options with our partners. These included allocating some of the work to be done in-house such as programming and creating the web interface. We also proposed scaling back the project by reducing the number of data sets included or eliminating some of the Atlas's functionality. We agreed however that seeking additional funding to supplement the grant award would be the best resolution to this problem. We knew that there were possibilities within the University of Arizona Library through one-time funding for special projects, as well as additional grant opportunities from local, state, or national funding sources.

Conference calls with our top two vendor candidates were scheduled to clarify issues and questions as well as to discuss the option of scaling back the project. While both vendors thought scaling back the project was feasible, they suggested that a staged process would be best so that additional functionality could be phased in as funding permitted. Another cost cutter proposed was bringing our own staff into the process earlier with more intense training. This of course would increase the time commitment of those project members and result in workload issues for their other assignments. This exchange of ideas with vendors was helpful and clarifying. We learned for example that it was not the number of data sets that increased costs but the Atlas's functionality. These calls also introduced us to the people we would be working with and gave us better sense of their communication skills and flexibility. While both vendors followed up with responses to a scaled back version of the Atlas, in the end we did not have to scale back at all. A proposal was submitted to the University of Arizona Library Dean of Libraries, the Budget Advisory Group and Library Team Leaders. The proposal showed how strongly the Atlas project supported the Library's strategic goals. The proposal was accepted and the library pledged the additional funding needed for the grant project.

The Atlas team also called vendors' references in order to get their customers' perspectives on their work. Several vendors' supplied specific projects and names in the RFP for us to contact. We also explored the sites developed by the vendors when available. The Atlas team created a list of questions to ask each reference. Our questions were designed to determine their assessment of the company's quality of work. The following are some of the questions we asked: How did they respond to problems and questions and what was their response time? How happy are your customers or users of the web site? What are their area of strength and in what areas do they not perform well? Were they on time and on budget? To what extent did the project/company's work meet their expectations? Would you hire them again? Such conversations were extremely useful in rounding out our picture of the different vendors.

After we had reviewed all of the documentation and reflected on all we had learned, the project team held a meeting to create one combined group matrix (rankings). This led to our final decision. Each team member presented their numerical scores in each of the categories for the four vendors. Each category had been assigned a weight based on a total weight of one hundred. The numeric scores were totaled and the weights factored into the final scores. The vendor with the highest number of points was selected. Two vendors were very close in total accumulation of points and we would have been happy with either selection. The contract was awarded to Farragut Systems, Inc. of Lafayette, Colorado, working in partnership with ESRI-Denver, Broomfield, Colorado.

Technical Issues

The Electronic Atlas includes a relational database management system (RDBMS) component, along with a spatial data engine (SDE). The SDE software will serve the geographic data, using the underlying RDBMS as a required component of the application framework.

Specifically, ESRI's ArcSDE software will provide access to both the geographic data and the associated metadata. Other components that are required to support ArcSDE are ESRI's ArcGIS, which includes ArcCatalog and ArcToolbox. ArcCatalog will be used to manage and modify the metadata associated with the geographic features. ArcToolbox will be used to re-project those geographic datasets, as necessary.

The Atlas application includes three server components:

- database server—serves metadata, geographic and attribute data;
- web server—serves the Atlas application, including maps to the end users, and provides access to the information on the database server; and
- spatial server—serves the geographic data from SDE to the Web Server. Multiple Spatial Servers may be used to keep performance in line as demand increases.

A Solaris Sunfire machine will be used as the Database Server.

The ArcIMS processes on the Web Server and the Spatial Server can be run on the same computer, but given the expected load on the Atlas, we want to define an architecture that can be extended as the load increases. In the new architecture, Atlas performance can be increased by adding relatively inexpensive Spatial Servers to the solution.

In our extensible solution, we will use a single Web server with one or more spatial servers generating maps and handling requests. The determination of whether the system installation at the Library will be two or three physical Intel-based machines in addition to the Sunfire will be made as development and early evaluation of the system progresses.

Data Selection and Data Issues

Data selection for the Arizona Electronic Atlas team has been an ongoing process from the beginning. In the grant proposal we were fairly general in what data we were thinking of including. After we submitted the grant proposal, we began a comprehensive survey of what data was available. Each member of the project team was assigned different subject areas in which to look for geospatial data related to Arizona. We gathered the following information for each data set under consideration: geographic coverage, source information, brief description, format, availability of metadata, and whether conversion was needed. We used the Arizona Government Information Locator (GILS) project to identify potential data sets and looked at sources such as the Congressional Information Service (CIS) Statistical database and the Arizona Statistical Abstract for other leads on data sources. Our project partners also informed us of data sets to consider and helped us get access to data sets.

To further inform this process, we brainstormed "Why do people use maps?" Our ideas included the following—for information on directions and mileage (e.g. where is something located, relative to others), finding the appropriate political or census information, information on business and marketing issues (e.g. where to locate a business—looking at income, education, crime, land ownership, etc.), gathering information for decision-making on current issues such as environmental impacts of population growth, water consumption, and demographic variations. We looked at several paper atlases and got ideas on the variety of broad topics and themes that are included.

From this inventory, we narrowed the list of data sets to include in the atlas based on faculty input and our own experiences working with students. The project team made the preliminary identification of data sets in the following categories:

- 1990 and 2000 Tiger Files and census data (population and housing);
- business data;
- crime trends;
- voter registration and election data;
- vital statistics;
- school dropout rates;
- transportation data;
- land ownership and boundaries;
- aerial photography (DOQQ);
- topography (DEMs and DRGs);
- climate;
- hydrology (lakes, streams, springs);
- flood zones;
- wetlands inventory;
- vegetation;
- agriculture;
- environment;
- geology and mines;
- soils;
- wildlife.

The project team decided on the final selection of data layers and themes. Selection of data layers took several sessions. We looked again at each data set and as a group identified the critical layers from each data set. Some data sets such as Census of Population and Housing, Census of Agriculture, and Vital Statistics took more discussions because of the number of layers involved in these sets. We made a decision on the following four predefined themes:

1. natural resources;
2. business and economics;
3. people and society;
4. people and environment.

Of the 44 identified data sets, only five state agency data sets (labor force, crash factors, vital statistics, crime, and voting / election) were in pdf format. All other data sets were in digital formats that require little if any conversion. Converting pdf files would take more vendor time and ultimately would be expensive for this project. We contacted the key people in the state agencies and renegotiated with them in order to acquire the needed data sets in an acceptable format. We were successful in acquiring four of the data sets in their original source versions (i.e. Excel, HTML or SPSS). Only one data set (crash factors) was not available in an acceptable format or medium and we decided to drop it from our list. All data sets have been submitted to the vendor. Data format activities to be conducted by Farragut will include:

- converting geospatial data into ArcIMS-acceptable formats;
- converting all geospatial files into the same datum and projection
- determining how to handle geospatial files in different scales and resolutions

Much time was spent discussing data conversion questions and issues, including the following:

- All of the spatial data that will be used must be converted to NAD83, UTM Zone 12, and meters.
- Formats in which the data is available can be a barrier if significant time and effort is needed to convert (for example, PDF and word processing formats).
- Atlas must be designed so that data can be updated or new data can be added in the future.
- Metadata is not often available for spatial data created by state agencies.
- Annotations/footnotes found in data tables—How should these be incorporated in the Atlas? (In metadata, but requires manual inputting).
- Use of government data sources creates challenges and limitations. For example, using street data—TIGER versus commercial company—TIGER street data is not accurate. Street data from a commercial company is expensive, but is at a larger scale and is fairly accurate. Data from Arizona Department of Transportation (ADOT) is only available for highways and major roads for the entire state, not to the street level. Another example is Census data. Government census data is difficult to download and needs to be enhanced in order to use in ArcIMS, but it is free. GeoLytics (commercial) census data is easy to download and can be used directly in ArcIMS, but you have to pay their licensing fee.
- Some state agencies will not allow us to provide the ability to download their data.

Progress and Next Steps

On November 20–22, 2002 the project team and partners participated in a three-day kick-off meeting conducted by Farragut at the University of Arizona. In January and February 2003, we will have signed off on the requirements document and the applications design documents. These two documents will guide Farragut specifically on how to develop the Atlas. Farragut will proceed with data conversions, programming / customizing of ArcIMS. By March 2003, Farragut will provide a pre-delivery URL for a web site on their server. This web site will have some of the functionality and some of the data. We will do intensive in-house testing for one week, then will start doing usability testing with faculty, students and other users. In April 2003, Farragut will install the Atlas on the library's servers. We will then have 90 days to do the final acceptance testing.

Once the atlas is installed on the library's servers, we can start to actively market the Arizona Electronic Atlas, although this process will begin sooner as we do usability studies. We expect that several classes at the University of Arizona will integrate the Atlas into their curriculum for fall 2003 or spring 2004.

Challenges/ What We've Learned

The Arizona Atlas Project Team has faced numerous challenges as our work has progressed but our learnings have been great.

We have learned that it is critical to have some basic understanding of the technical issues involved with the software and spatial data and/or to have people on the project team who conversant in software and data issues. Choosing the right hardware also requires expertise and advice from those who have worked with GIS applications.

Data issues take a lot of time in project planning and decision-making. Identifying, prioritizing and finalizing of data selection is a major time commitment. Some of the data is available from several sources and deciding what source will be "the best" can be a challenge. Obtaining data from government agencies in source version is not always easy. We learned to be persistent with government agencies to obtain data. Finding the right contacts in government agencies was important in this regard.

Selecting data layers from large data sets is a complicated process. We have gained a better understanding of metadata and the established standards for spatial metadata.

Developing a RFP is a major time commitment. There is a learning curve in understanding vendors responses and terminology. It is critical to clarify assumptions and goals of the project with the vendor before they start their work.

We have learned that this kind of project is a lot more complex than we had at first realized. It takes a lot of planning. Communication with a wide range of people is essential. It is important to consult with faculty and other experts for ideas and suggestions. It is important to know what other similar projects are going on.

Recommendations to Others Contemplating a Similar Project

Start by first describing functionality in terms of what goals users will want to achieve in using your atlas. Consider broadly what you want the atlas to include. From this develop the Purpose Statement. Next describe the systems performance objectives and develop system and technical requirements.

Make sure to involve the right people with the project. It is very important to bring in people with needed technical expertise.

Everything takes longer than you think it is going to take. Allow sufficient time in the planning and vendor selection process. Your organization must be willing to make a major time commitment for your staff on a project similar to this and therefore it is critical to have the support of library administration. To facilitate this, you must communicate progress frequently and emphasize the strategic nature of the project.

The Arizona Electronic Atlas—A Collaborative Effort

From the very beginning, the Atlas project has been a collaborative effort. It is vital to include people with the right combination of skills and expertise in a project such as this. In addition to bringing together librarians and technical specialists from several library teams, the Arizona Electronic Atlas includes as "official" partners (listed on the grant proposal) five representatives from the State Library of Arizona, the State Cartographer's Office, Arizona State University and the Arizona Geographic Information Council (AGIC).

The state-level partners have been invaluable in helping get access to data and providing technical expertise and feedback concerning data and atlas functionality. While each brings their own area of skills and experience, their expertise and perspective add to the shared knowledge of the project team. They have provided an excellent overview of GIS projects of interest around the state. Their experience contributed to technical decisions on which server to purchase for the project. They have given useful feedback on the RFP drafts and to the consultant selection process.

The project team also established a six-member Campus Advisory Group whose function is provide technical expertise and to give feedback regarding data and the formation of the electronic atlas. Members of the advisory group include faculty and research staff from the Geography and Regional Development Department; several units in the College of Agriculture and Life Sciences (Educational Communications and Technologies, Office of Arid Lands Studies, and the School of Renewable Natural Resources); the College of Social and Behavioral Sciences; and the USGS Sonoran Desert Field Station. The Advisory Group was selected so that its participants covered a range of disciplines that all utilize cartographic materials on a regular basis. By drawing on multiple users, it was believed that the questions the Atlas Team had could be addressed by diverse opinions thereby eliminating bias from one particular user group.

The Arizona Electronic Atlas collaboration also ultimately includes the consultant selected to do data conversion and web site programming and, perhaps most importantly, the Atlas users. Each partner, informal or formal, provides valuable perspective and unique contributions that are essential to the success of the project.

Selected Web Sites

Arizona Electronic Atlas—http://www.library.arizona.edu/library/teams/sst/atlas/home.htm.

Association of Research Libraries Geographic Information Literacy Project—http://www.arl.org/info/gis/index.html.

Delaware Census 2000—http://datamil.udel.edu/census/.

Delaware DataMIL—http://datamil.udel.edu/nationalmappilot/.

Inside Idaho—http://inside.uidaho.edu/default.htm.

Kansas GIS Portal—http://gisdasc.kgs.ukans.edu/.

Massachusetts Electronic Atlas—http://hcl.harvard.edu/maps/massatlas.html.

University of North Carolina at Chapel Hill's Geographic Information Systems (GIS) Resources and Services in Libraries—http://www.lib.unc.edu/reference/gis/gisinlib.html.

University of California, Santa Barbara's Alexandria Digital Library Project—http://www.alexandria.ucsb.edu/.

Washington State Geospatial Data Archive—http://wagda.lib.washington.edu/.

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Appendix

DECISION MATRIX FOR THE ARIZONA ELECTRONIC ATLAS

Key:
3 = Excellent, exceeds our expectations **2** = Good, meets our expectations **1** = Fair, does not quite meet our expectations but almost **0** = Does not meet criteria

Criteria	Criteria notes	Vendors & Scoring		
		Vendor A	**Vendor B**	**Vendor C**
	Vendor Names:			
1) Ability to meet system minimum required deliverables				
Method or approach	Thoroughness & clarity of response, good models			
Will meet specs	Will methods lead to desired end result for users?			
Flexibility in growth & design	Thoroughness & clarity of response showing flexibility			
Security	Does vendor choose best practices			
Software (type, cost, licenses)	Fewer, lower cost licenses = good			
Documentation	Thoroughness of documentation			
Timeframe	8 months = good; less = better			
Warranty	At least one year or longer (1 year = good)			
2) Experience in developing & delivering similar products				
Overall similar experiences (type, #, dates, timeframes)	More experience = higher ranking			
Previous customer references	Contact info provided, customers provide good refs			
Qualifications of key personnel	Higher qualifications = higher ranking			
Quality of previous work	URLs provided; ease of use, good design principles, etc.			
3) Training				
Training methods	Thoroughness, ease (in person = higher ranking)			
Availability	Higher number of hours, greater phone availability, etc.			
4) Support during and following project				
Frequency of updates, reports	How will communicate, include Lib in development			
Availability of project personnel	Higher number of hours, greater phone availability, etc			
Support for bug fixes				
5) Ability to meet desired deliverables				
Desired specs that will be met	Realisticness & thoroughness of response			
Method or approach	Thoroughness & clarity of response, good models			
Will meet specs	Will methods lead to desired end result for uses?			
Flexibility in growth & design	Thoroughness & clarity of response showing flexibility			
Security	Does vendor choose best practices			
Software (type, cost, licenses)	Fewer, lower cost licenses = good			
Documentation	Thoroughness of documentation			
Timeframe	8 months = good; less = better			
Warranty	At least one year or longer (1 year = good)			
6) Cost				
Cost Scenario I	Less cost and more data = higher ranking			
Cost Scenario II	Less cost and more data = higher ranking			
More deliverables	More deliverables = higher ranking			
Totals		**0**	**0**	