NATIONAL ENDOWMENT FOR THE HUMANITIES

SAMPLE APPLICATION NARRATIVE

Preservation and Access Research and Development Grants
Institution: University of North Carolina, Chapel Hill

2. Statement of significance and impact

The Ancient World Mapping Center at the University of North Carolina, Chapel Hill, responds to NEH's call for innovative research and development projects that produce new mechanisms and models for the creation, maintenance and long-term functional preservation of important humanities reference works. The Center's **Pleiades project** establishes a functioning, international community of scholars, teachers, students and enthusiasts who collaborate in the updating and expansion of the spatial and historical reference information assembled by the NEH-supported Classical Atlas Project. Underpinning these efforts is a web-based, multi-lingual, spatially-enabled collaboration support system, built using open-source content-management and geographic information system software and made freely available for reuse by other projects. The Center and its collaborators define and enforce a flexible hierarchy of user roles and responsibilities, permitting each member of the community worldwide to contribute additions, corrections, observations and improvements to any placename, geographic location, date, bibliographic reference or explanatory essay in the Atlas Project dataset, while facilitating a rigorous process of communal and subject-expert review, preparatory to publication in print and open digital formats.

Reliable, comprehensive and up-to-date reference works are essential tools in all fields of humanities research and teaching. It was in realization of this basic truth that during the 1980s the American Philological Association began to redress a century-long neglect of cartographic tools for the study of antiquity, ultimately culminating in the publication of the *Barrington Atlas of the Greek and Roman World* by Princeton University Press in 2000 (Richard J.A. Talbert, ed.). A similar recognition, combined with an appreciation of the tremendous enabling potential of new digital technologies, led UNC's College of Arts and Sciences to establish a permanent successor to the Classical Atlas Project: the Ancient World Mapping Center (Tom Elliott, director). A central element of the Center's mission is the constant updating and diversification of the material marshaled for the Atlas in response to new scholarship, fresh discoveries and breakthrough technologies. **Pleiades** is the technological and procedural framework through which the Center will fulfill this mission. NEH support ($389,883 over 24 months) is sought for the implementation and elaboration of the collaboration environment, as well as for the initial launch of the community itself through efforts focused on the geographic area of western and central Asia Minor, where significant new discoveries have been made since the publication of the Atlas.

Key reference works in the humanities – particularly geographic ones – are increasingly prone to obsolescence even as rapid developments in the nation's information infrastructure increase their value in linking, contextualizing and analyzing primary and secondary materials of every type. The Pleiades Project offers NEH a model opportunity to overcome this problem at a critical stage, before it becomes a damaging liability for the scholarly community. Pleiades creates free, standard-compliant tools and tested procedures for applying a web-enabled, publicly collaborative approach to the creation and enhancement of humanities reference publications. NEH investment in Pleiades unlocks far-reaching innovations essential to preserving key reference works: their relevance will be maintained, and their value enhanced, for scholars, students and the general public.

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4. Narrative

Since its inception in 2000, the Ancient World Mapping Center (director, Tom Elliott) has been working to promote cartography, historical geography and geographic information science as essential disciplines within the field of ancient studies. Central to this agenda are the preservation, continuous updating and multi-modal dissemination of the rich research data assembled by the Classical Atlas Project during the 1990s. To advance these goals, the Center seeks NEH support for the development, testing and evaluation of a spatially-enabled, multilingual community support system enabling interested parties worldwide to participate in the maintenance, diversification and beneficial reuse of this essential data. When the system – dubbed Pleiades after the daughters of Atlas in Greek mythology – reaches production status, it will replicate in a virtual environment the essential processes, workflows, resources and modes of interaction used by scholars to advance understanding of ancient sites, landscapes and geographic phenomena. Moreover, it will open this environment to the widest possible range of interested participants, while retaining and enhancing those scholarly practices that promote quality, reliability and replication of results.

This resubmitted proposal addresses the only substantive evaluator's critique made during last year's review cycle; namely, that we should evaluate and select an open-source content management system (CMS) framework prior to embarking upon NEH-funded work to realize Pleiades. We have followed this advice, selecting the flexible and reliable Plone CMS (www.plone.org) as the base upon which we build the customized Pleiades work flows, content types and other capabilities outlined in this proposal. See further section 4.3.1.1.

4.1. Significance

The Classical Atlas Project reached its primary goal in 2000 with the publication of the *Barrington Atlas of the Greek and Roman World* by Princeton University Press (Richard J.A. Talbert, ed.). This 12-year effort brought together over 200 scholars and cartographers to redress a long-standing, fundamental deficiency in the range of reference works serving everyone who studies classical antiquity: a comprehensive atlas. For the first time since the completion of William Smith's *Atlas of Ancient Geography* in 1874 (John Murray, London), there became available a consistent and up-to-date presentation of physical geography, cultural landscape and multi-lingual toponomy for the entire footprint of Greek and Roman civilization.

The impact of the *Barrington Atlas* has already been immense. Instantly and uniformly praised in both the popular and the academic press, the atlas has become an indispensable and heavily consulted work in library reference sections, map collections and academic departmental libraries around the world. It is "used constantly" by the research team of the *Prosopographia Imperii Romani* in Berlin (www.bbaw.de/forschung/pir). Geographic citations in the annual review of epigraphic literature, *L'Année Epigraphique* (www.anneeepigraphique.msh-paris.fr), have been regularized to match its toponomy. The location of each settlement in the 1,400-page *Inventory of Archaic and Classical Poleis* (edd. M.H. Hansen and T.H. Nielsen, Oxford, 2004) is referenced to the *Barrington Atlas,* which is praised as "one of our generation's greatest achievements in ancient history" (p. 6).

This wide and growing dependency not only illustrates the signal importance of the *Barrington Atlas* as an aid to research, but also brings into sharp focus the urgency and challenge of perpetuating its achievement and the diverse scholarly undertakings it fosters. The Smith *Atlas* is a valuable cautionary tale: expensive to produce and unsupported by any institution or community, there was no way to disseminate revisions in response to the annual increase in discoveries stemming from

archaeological field work, scholarly inquiry in widely separated fields, and technological developments in cartography and printing. Several projects did attempt, with varying success, to redress the problem (often for shorter historical periods or smaller regions), but only a Herculean U.S. effort over a century later finally succeeded.

Inevitably, the content of the *Barrington Atlas* is beginning to age. The long-awaited publication of the so-called *Miliarium Lyciae* (an epigraphic text discovered in the 1990s) provides new toponomy and priceless insight into road linkages and distances in the Roman province of Lycia (in modern Turkey).[1] Geophysical research, published in a journal rarely consulted by classicists, has radically reshaped knowledge of coastlines and river drainages in the vicinity of ancient Troy, thereby confounding one frequent criticism of Homer: namely, that his geography is hopelessly confused.[2] These are but two examples of scholarly output that will eventually render the *Barrington Atlas* obsolete unless advances in digital technology, combined with the emergence of collaborative communities in cyberspace, can provide models and mechanisms for assuring otherwise.

Obsolescence of reference information is far from being a problem confined to large classical atlases. The phenomenon affects all classes of reference works. Although there is no coherent body of scholarly literature on this subject, the problem is widely appreciated. A search of the online version of the *American Reference Books Annual*, which provides brief but authoritative reviews of thousands of reference sources, returns over 80 reviews of works published between 1995 and 2003 in which obsolescence of content is noted.

When geographic reference works are considered, obsolescence can be expected to have a particularly damaging impact over the next few decades, hampering efforts to harness the full power of networked digital information. Accurate geographic data that can be cited and searched by other digital systems holds out promise for providing as yet unrealized synergy between digital libraries, reference databases, catalog systems and digital documents of all types. A recent special issue of *D-Lib Magazine* was wholly devoted to the subject of *Georeferencing in Digital Libraries*.[3] The issue's guest editor, Linda Hill, encourages her readers to move "beyond traditional library practices" to apply georeferencing to all types of information and to integrate geospatial description, searching and analysis into tomorrow's digital libraries.[4]

In future integrated information webs of the type Dr. Hill envisions, research will build on seamless foundations of information gleaned from multiple sources and united by automated agents. In this realm, the application of standard protocols and controlled descriptive vocabularies – together

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[1] Fahri Işik et al., *Miliarium Lyciae: Das Wegweisermonument von Patara = Lykia: Anadolu - akdeniz kültürleri* 4 (1998/1999 [2001]).

[2] J. Kraft et al., "Harbor areas at ancient Troy: Sedimentology and geomorphology complement Homer's Iliad," *Geology* 31.2 (Feb 2003), 163-166.

[3] *D-Lib Magazine* 10.5 (May 2004), http://www.dlib.org/dlib/may04/05contents.html.

[4] That the North American library community has since embraced this agenda – Dr. Hill is by no means its only exponent – is demonstrated by a recent announcement that the Geography and Map Division of the Library of Congress is convening a workgroup to investigate the development of "a system of geographic coordinates based on geographic subject headings [in order to] permit standardized computer-searchable coordinates to be placed in electronic records to support Geospatial Information System graphic interfaces and make the search for items with geographic subject headings easier, faster and more reliable" (email message from Colleen R. Cahill to the Maps-L discussion list, 22 June 2005).

with up-to-date, reliable spatio-temporal references – will provide actionable coherence between and among diverse data objects. Reference data that fails to reflect the full breadth and refinement of contemporaneous scholarly achievement risks undermining the potential benefits of such synergy. Fields like the humanities, where information problems remain complex and resources few, are particularly vulnerable to this failing. Difficulties are exacerbated by the costs of conventional publication, and by the strictures of intellectual property arrangements applied in such contexts.

Proponents of on-line, collaborative projects often argue that problems of this type can be resolved by adopting an "open content" approach to scholarly publication. While opinions differ as to the exact nature of an "open" scholarly resource, most definitions embrace works that are digitally created, frequently updated, authored and revised freely by many parties, then distributed under license arrangements that permit wide and flexible reuse and incorporation in other works.[5] Among several examples, two that stand out are the *Suda Online Project*, dedicated to translating the immense Byzantine encyclopedia of that name (www.stoa.org/sol),[6] and *Wikipedia*, a widely publicized five-year-old effort to create an "open-content encyclopedia in many languages" (www.wikipedia.org). The former incorporates active editorial control and review, the latter by contrast allows any visitor to the site to make immediate changes to content.

Critics and adherents alike have remarked on the evident promise of such open, community-based approaches to the production of scholarly reference works. The use of Internet technologies to establish and maintain geographically and linguistically distributed communities – and to open membership of those communities to a heterogeneous public – can significantly increase the workforce available to develop important content. Enthusiasts and students can be exposed to the approaches of trained scholars, and even work alongside them. Scholars in such communities benefit from the enthusiasm and collaboration of non-academically credentialed collaborators who often adopt such roles as translator, journal monitor, grammar checker or provocative questioner. Prompt publication of individual articles circumvents delays endemic to conventional publication projects that must either wait for all content to be completed or adopt a serial publication approach (for example, in separate, alphabetically organized volumes). The ease with which individual components can be updated helps to limit the threat of obsolescence.

Apart from widely quoted arguments concerned with the shifting of publication costs, perils in "open" models can be identified. Legitimate worries about quality, reliability and permanence feature in many critiques. The collective approach of projects like *Wikipedia* can be seen to downplay the individual contributions, thus deterring participation by scholars who need individual recognition for tenure and promotion. Established processes of peer review and editorial oversight for conventional journals and monographs were developed by the scholarly community to help assure quality, and to reassure prospective readers that a given work was likely to contain reliable information of value.

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[5] One recent on-line discussion that attempts to catalog and define the variety of terms and definitions now in use has been summarized by A.K.M. Adam: "Openness, Publication and Scholarship," 28 May 2004, http://akma.disseminary.org/archives/001356.html. P. Suber gathers and disseminates timely news about the open-access movement via *Open Access News,* http://www.earlham.edu/~peters/fos/fosblog.html.

[6] One of the co-founders and managing editors of SOL, Ross Scaife, has been consulting with the Center on the development of Pleiades since it was first mooted in early 2001. He is a member of the Pleiades Steering Committee, and has also arranged for the Stoa Consortium for Electronic Publishing in the Humanities, which he directs, to provide public hosting for the Pleiades collaboration system on servers at the University of Kentucky.

Any successful application of open, community-based approaches to digital scholarship must grapple with the issues of community interaction and editorial control.[7] While the Pleiades project follows the lead of the *Suda Online Project* in effecting a content-appropriate marriage of community-oriented, collaborative editing and scholarly editorial process, the challenges faced by Pleiades are significantly greater in some areas. The data it maintains and develops is more finely grained, highly structured and heterogeneous than that translated in *SOL*. Consequently, the character of the community is more variable. For example, translation skills in ancient Greek are not essential to participation in Pleiades. Trained experts in geography, history, classical philology and archaeology combine their skills with those of local residents, information professionals, motivated students and others. Furthermore, the fundamentally intertwined geographic and historical aspects of Pleiades mark this effort as singularly innovative: to our knowledge, there is no other project that aims to apply so complete a collaborative editing model to a complex spatio-temporal data set.

Essential to the effectiveness of Pleiades (both as a widely applicable model and as a practical tool for maintaining the Atlas Project's legacy) are robust mechanisms for reviewing and editing the proposals of community members. This editorial process depends upon clearly established roles for all members, by means of which various editing and revision capabilities are assigned. The community support software built atop Plone enforces these roles and facilitates the exercise of associated privileges and capabilities. For this purpose, the **Managing Editors** of Pleiades (Talbert and Elliott) grant privilege-based roles to members of the community and subject their contributions to a structured editorial workflow. The Managing Editors, in consultation with the Advisory Board of the Ancient World Mapping Center, may add further managing editors as workload warrants and suitable colleagues are identified. This oversight role for the Center's Advisory Board provides important institutional credentialing for the Pleiades community and ensures a sustainable, long-term management structure for it, firmly embedded in the governance of the Mapping Center. The editorial workflow employed by the Pleiades Managing Editors is modeled on the procedures of the Classical Atlas Project,[8] adapted for the more heterogeneous Pleiades community. The Pleiades approach grants privileges to community members on the basis of five non-exclusive, hierarchical roles: managing editor, content editor, subject-matter expert, research specialist and collaborator. The activities and privileges of each role are described below.

Whereas scholar-compilers working on the Classical Atlas Project submitted compilation bases, draft directory entries and bibliographic listings to the Project Office, Pleiades **Collaborators** use custom templates and associated editing tools to create structured *Suggestions* whereby specific additions and changes to geographic, temporal or bibliographic data records are proposed, including the introduction of wholly new records and the creation of new classifications (e.g., a new time period; see appendix 6.7 for definitions of the custom content types introduced here). Each *Suggestion* embodies, in a standard and easily searchable manner, the essential gist of the author's intent, while providing a complete record of authorial and editorial modifications and a document history that permits restoration of accidentally deleted content and editorial assessment of the relative

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[7] P. Robinson has recently addressed this tension in the context of primary source editions: "Where We Are with Electronic Scholarly Editions, and Where We Want to Be," *Jahrbuch für Computerphilologie Online* 5 (2003), 125-146: http://computerphilologie.uni-muenchen.de/ejournal.html.

[8] The editorial procedures of the Atlas Project were carefully studied and documented by UNC Information Science graduate students in 2000, one of whom – Helen Hawkins, an Information Architect at IBM – now serves on the Pleiades Steering Committee. Their report, which includes recommendations for replication of the workflows in a digital environment, served as the foundation for further design work carried out in the interim by Elliott and Talbert. Basic analysis diagrams from this study are included as Appendix 6.4.

contributions of multiple authors. Collaborators can also create two other types of structured documents: *Explanatory Essays* and S*ummary Articles*. An *Explanatory Essay* provides a vehicle for extended argumentation in support of a *Suggestion*. A *Summary Article* provides a venue for the organization and discussion of information and bibliography related to a particular site, feature, region or theme, similar in scope to an article in the *Princeton Encyclopedia of Classical Sites* and similar encyclopedic reference works.[9] The Pleiades system permits Collaborators to develop these types of documents privately, or in collaboration with other Collaborators or groups, before making them visible to the entire Pleiades community. For their part, other Collaborators create *Peer Comments*, which permit them to concur with, or raise questions about, the *Suggestions* or *Peer Comments* of others. They may also attach their own *Explanatory Essays* to the initial S*uggestion.*

The Atlas Project employed graduate students to check bibliographic citations and other facts as submitted by scholar-compilers. In Pleiades, this role is titled **Research Specialist.** To ensure the effective operation of the community from its inception, the first user with Research Specialist privileges will be the project's paid Graduate Historian, a UNC graduate student with appropriate skills working at the Ancient World Mapping Center. As the community matures, additional Collaborators with appropriate skills and interests are identified by the Managing Editors and granted the Research Specialist privileges necessary to correct or reformat appropriate aspects of other Collaborators' *Suggestions, Essays* and *Articles* (e.g., structured bibliographic citations and geographic feature types). Refinements introduced by Research Specialists are tracked and credited by the same mechanisms that record the authorial modifications taken by the originating Collaborator(s). Cooperative arrangements with other research projects, as well as the promotion of demonstrably reliable Collaborators, increase the number of Research Specialists over time.

In addition to the unique capabilities associated with the Research Specialist role, these individuals continue to exercise the prerogatives of Collaborators, thereby permitting them to make suggestions that occur to them apart from specific assigned research tasks. This principle of role-based 'capability aggregation' is used throughout the hierarchy of Pleiades member roles, such that the Subject-Matter Experts and Content Editors (described below) also inherit the capabilities assigned to Collaborators and Research Specialists. Roles are not identical to user categories; rather, each role defines a suite of activities and privileges that share a logical unity in the context of the editorial workflow. Individual users can be granted the privileges associated with multiple roles.

Subject-Matter Experts and **Content Editors**, corresponding to the outside reviewers and vicars (regional supervisors) of the Classical Atlas Project, are initially drawn from the ranks of the Steering Committee. Pleiades workflow dictates that updates or insights advanced by Collaborators be vetted before publication beyond the confines of the community. Content Editors, under the supervision of the Managing Editors, employ flexible criteria developed in consultation with the Steering Committee to identify proposed updates and insights worthy of publication. As necessary, they commission Research Specialists and Subject-Matter Experts to check facts and provide internal reviews, which are shared with the Editors and the relevant Collaborators. These formal reviews are facilitated by the preparation of limited-access *Content Review* documents, which are permanently stored by the system alongside the *Suggestions*, *Essays* and *Articles* to which they pertain.

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[9] R. Stillwell (ed.), *The Princeton Encyclopedia of Classical Sites*, Princeton, 1976. An unaltered electronic version is available online via the Perseus Digital Library: http://www.perseus.tufts.edu/hopper/text.jsp?doc=Perseus:text:1999.04.0006

Subsequent to this vetting process, the Managing Editors are collectively empowered to accept or reject *Suggestions*, *Essays* and *Articles* for publication. Publication occurs regularly as frequent update releases are made via the online gazetteer, website and other digital services of the Ancient World Mapping Center. In order to reach the widest possible audience and ensure that users of the print atlas have a ready path in their libraries for discovering new information, updates also appear regularly in print, gathered together into a review article submitted for publication in a standard journal (*Transactions of the American Philological Association* is one possibility). On-demand ordering and printing of revised editions of the *Map-by-Map Directory* to the *Barrington Atlas* will be accomplished through third-party vendors. Other AWMC initiatives, including textbook mapping, classroom wall maps and new editions of *Barrington Atlas* maps, also reflect the revised data. Each Pleiades Collaborator who makes a substantive contribution in the form of an accepted *Suggestion* or *Essay* is given authorial credit in all publication contexts. Reuse of the data is permitted through an open license, to be selected by the Advisory Board of the Ancient World Mapping Center in consultation with the project Steering Committee. As a condition of membership in the Pleiades community, Collaborators grant non-exclusive rights to the Center to republish their contributions.

During the last 6 months of the award period (Phase 5), recruitment of new participants is carefully managed to add reliable individuals in all roles. Both the Steering Committee and the Pleiades Managing Editors (Talbert and Elliott) identify and introduce new technical specialists and humanist scholars to the community. Veterans of the Classical Atlas Project (other than those already on the Steering Committee), as well as participants in other active scholarly projects, are prominent among the new users. These new users join with the Steering Committee and project staff to drive further refinement of existing Pleiades features and capabilities, as well as specifications for future feature additions for which new funding will be sought from Federal agencies, private foundations and corporate sponsors. Emphasis in development at this stage is placed upon ease of use and system reliability.

At the end of the award period, Pleiades opens membership to the public. Announcements of the public launch are widely distributed via electronic mail and other mechanisms. Once this stage is reached, the Managing Editors actively recruit appropriate Subject-Matter Experts, while monitoring the activities of the entire membership for internal promotion. The Managing Editors are confident that wide interest and engagement will greet the public launch of Pleiades. E-mail communications suggesting updates and modifications to the content of the *Barrington Atlas* already constitute a regular, and growing, phenomenon. In one recent such exchange, A.J. Woodman (while preparing a new translation of Tacitus' *Annals*) queried the relative placements of *Baiae* and *Bauli* in the *Barrington Atlas* in light of other publications. After consultation with the original scholar-compiler for the relevant *Barrington Atlas* map (N. Purcell) it emerges that new research has indeed altered scholarly consensus on this issue. Purcell now accepts a different identification for ancient *Bauli*, placing it at modern Bacoli. Pleiades will permit such queries, exchanges and revisions to proceed efficiently and to lead directly to published adjustments.

4.2. Background of Applicant:

4.2.1. Ancient World Mapping Center: Project Direction and Execution

The Ancient World Mapping Center was founded in 2000 by the College of Arts and Sciences at the University of North Carolina, Chapel Hill. The Center – the first of its kind anywhere worldwide – builds permanently upon the achievement of the Classical Atlas Project. The Center updates and diversifies the data assembled by that project in the light of new scholarship, fresh discoveries and

breakthrough technologies. Within the College at UNC-CH, the humanities have traditionally been a source of marked strength, and the departments of History and Classics (internationally renowned leaders in their fields) have been enthusiastic partners in the foundation and on-going support of the Center. A wide range of disciplines or programs in the humanities and beyond is collaborating in the AWMC's work: in addition to History and Classics, they are Anthropology, Art History, Computer Science, Geography, Information and Library Science, and Religious Studies. There is strong commitment, too, from the Maps Collection and from the Academic Affairs Library, where the holdings in the ancient field rank with the best in North America.

Since fall 2000 the AWMC, under its first Director, Tom Elliott, has occupied ideal self-contained space in the Library, converted for the purpose by the College. This space, which is provided rent-free to the Center on a permanent basis, includes two private studies (one occupied by the Director, the other to be used by the Pleiades Software Developer) as well as a large, well-lit work room. The work room is equipped with flat files for map storage, light tables, and four high-performance computer workstations connected to the campus network. These workstations are appropriate tools for the project's work, as are a departmental file server and departmental collaboration server (running Plone) also housed in the facility. The Pleiades development server will also be installed in this facility. The project makes extensive use of the university's campus-wide, research-class computing and network support to include: centralized backup, virus protection and software licensing; high-speed internet connectivity; 24/7 help desk for security, networking and storage support; and on-site warranty equipment repair.

4.2.2. Stoa Consortium: Project Web Hosting

The Stoa Consortium for Electronic Publication in the Humanities provides web hosting for the production/evaluation version of the Pleiades databases and collaboration environment. Under Ross Scaife's[10] executive editorship, the Stoa enjoys substantial support from the University of Kentucky, which has made a solid commitment to Humanities Computing for more than a decade. Development work benefits from the technical resources and personnel of Research in Computing for the Humanities (RCH), of which Scaife serves as co-director from July 1, 2005. RCH is located in two well-equipped rooms of the University of Kentucky Young Library, and provides numerous late-model computer workstations, development servers, an LCD projector for meetings, as well as various printers, scanners, and other equipment. Most importantly, the UK College of Arts and Sciences pays the salary of the RCH Program Coordinator, who is especially knowledgeable about text encoding and metadata issues and also serves RCH as project manager responsible for scheduling and other weekly tasks. RCH has a firm commitment from the University of Kentucky Center for Computational Sciences for continuing support in the form of graduate student Research Assistants. Moreover, RCH has strong ties to librarians at the University of Kentucky, particularly those who are working towards development of an institutional repository for electronic publications and other digital data generated by UK researchers. Stoa/RCH therefore expect to take advantage of professional archiving services as they emerge in the near future at Young Library.

4.3. History, Scope, and Duration

Pleiades creates a virtual community of scholars, students and enthusiasts who, with the aid of a web-based collaboration system supervised by the Ancient World Mapping Center, work together to

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[10] See note 6.

maintain, update and expand data inherited from the Classical Atlas Project. Pleiades requires a complex technical infrastructure, consisting of bibliographic and geographic databases whose content is manipulated and improved via an intuitive web interface by community members. The interface provides system documentation and user assistance as an integral part of the interface itself. The software supporting the interface permits easy localization, i.e., ready customization of the interface for a given language. The software also enforces hierarchical member privileges and associated workflows that provide for community-wide comment and subject-matter expert review for each new update or insight. These workflows culminate in editorial review and documented publication decisions. The resulting updates to the Classical Atlas Project data are then published digitally via the AWMC/Pleiades Digital Gazetteer, as well as in a wide variety of derivative digital and print products. Below, there follow descriptions of the major capabilities of Pleiades. A historical discussion outlines research and planning activities accomplished to date. Next, the scope of work for the current project is presented with a narrative example to illustrate the operation of the system. The Pleiades project requires 24 months to complete. Details on work phases and scheduling are provided in section 4.5.

4.3.1. Preliminary Research and Preparation

The Ancient World Mapping Center has been actively laying the groundwork for Pleiades since its foundation, when the Pleiades Project was first mooted. In particular, the Classical Atlas Project data has been readied for use in the digital realm. This work included the review and selection of candidate software products to serve as the foundation for Pleiades, as well as design and creation of two interoperable databases. The **geographic database** and the **bibliographic database** contain augmented versions of information originally presented in the *Barrington Atlas* maps and *Map-by-Map Directory;* specific improvements to the data are outlined in the next two subsections. Preparatory work has also focused on essential conversions from the hybrid print and digital formats in which the Classical Atlas Project was constrained to work.

4.3.1.1. Selection of Content Management System Software

In early 2005, the project directors, in consultation with members of the Steering Committee, selected the free, open-source Plone Content Management System (www.plone.org) as the fundamental software atop which the Pleiades collaboration environment is to be built. The original submission to NEH Preservation and Access Research and Development received high ratings from all reviewers apart from a single aspect; namely, our original intent to devote the first 6 months of the grant period to evaluating several rival community support packages. The intervening year has permitted us to follow the advice to conduct this hands-on evaluation in advance. Hence, the entire grant period may be spent productively on building the community and resolving the fundamental concerns of humanities scholars with regard to the collaborative production and maintenance of high-quality geographic reference works.

Beyond the fact that it is free, Plone has much to recommend itself for this project. The experience of setting up and evaluating Plone – from the initial trouble-free installation to recent experiments with adding plugin products to extend its capabilities – has engendered confidence in the maturity of the product. Plone has been in daily use at the Mapping Center since March 2005, where it is used for sharing notes about projects in progress and preparing documents for publication on the Center's website. Plone provides Pleiades with the following essential capabilities:

- Robust user and group management capabilities

- Well designed mechanisms for defining and managing custom content types, user roles, document states and workflows, all of which are required for Pleiades
- An extensible user interface, based on a 'portlets' model, that permits ready organization and expansion of content and tools
- Full compliance with web standards and accessibility standards, including U.S. Section 508, and the W3C's AAA rating for accessibility
- Uninhibited modification and redistribution to other projects by virtue of Plone's distribution under the GNU Public License and the fact that it is written in the powerful Python programming language
- Essential support for polyglot communities: the interface has been translated into over 20 languages and the system provides tools for managing multilingual content
- A vigorous worldwide community of users, supported by over 100 active and well organized developers who respond quickly to reports of bugs and requests for features
- A collaboration-minded Plone programming and user community in our local area.[11]

4.3.1.2. Design and Population of the Bibliographic Database

A bibliographic database containing information about all the books, collections, journals and articles cited in the *Barrington Atlas* is nearly complete. The database design is stable, and full insertion of Atlas Project data will occur by October 2005 (see further appendix 6.1).

The database itself is fully relational, providing efficient storage of information about complex bibliographic items and citations, as well as speedy searching on the basis of indexed titles, authors' names, and the like. Database fields have been elaborated on the model of the bibliographic structure used by the Text Encoding Initiative (www.tei-c.org), ensuring easy export of individual records or entire bibliographies in this widely used format. A serialized file dump of TEI biblStruct elements is used to provide a platform-independent backup of the database. The TEI structure is readily transformed to other widely used standards including EAD, Dublin Core and even MARC, ensuring broad compatibility of Pleiades with existing and future systems. Name authority has been implemented for all authors, publishers and places of publication, so that a single authority record for each type of information links to the records for all relevant works in the database. A forms-based interface, realized in Microsoft Access, presently provides AWMC staff with input and editing features during the current period of data conversion. During the period October-November 2005, the database itself will be ported to PostgreSQL whence it can be accessed from the original interface via an ODBC connection.[12] Robust, web-browser-based editing and search interface components are to be developed as part of the project, and these will be integrated with the community support system, thereby allowing the present Microsoft Access interface (and thus the ODBC connectivity issues) to be retired.

At present, the bibliographic database cites over 2,600 journals, monographs, collections and publication series. These records have been manually cross-checked with the original *Barrington Atlas* bibliography, and computationally verified and enhanced by comparison with a MARC record for each work. Where discrepancies have been identified, AWMC staff have corrected the record in accordance with the bibliographic citation principles originally developed by the Classical Atlas

[11] The Triangle's Zope and Python Users Group facilitator (Chris Calloway) serves on the Steering Committee.

[12] ODBC = Open Database Connectivity, a widely used application programming interface, developed by Microsoft for accessing information in databases.

Project. The language and transliteration method used in each title have been identified and recorded, with provision made for the identification of multi-language titles and the correct representation of all characters in Unicode, as well as the eventual translation of titles into other languages to assist community members in content discovery. Seven hundred additional records, corresponding to all articles in bound collections cited by the *Barrington Atlas*, have also been uploaded to the database and have been checked for proper linkage to their parent volumes. Approximately 1,800 more entries corresponding to journal articles have been pre-processed from the original *Barrington Atlas* bibliography files and are slated for database integration during the period August – October 2005. Creation of records for new bibliographic works of potential interest is ongoing. For each bibliographic record, the database also records the location of the nearest library holding a copy. Holdings information for the AWMC's own journal "Tables of Contents" file and offprints file are also included where appropriate.

4.3.1.3. Design of the Geographic Database

The design of the database that will store the full information about every identified geographic feature, placename, period of occupation, and location builds upon the systematic work of the Classical Atlas Project. The Project's designers and editorial staff invested fruitful effort in developing clear map symbols, typographic conventions, and layout structures for the Map-by-Map Directory data (see further appendix 6.2). Over the past three years, Elliott has designed a database model that encodes the essential distinctions reflected in these conventions. For example, where the *Barrington Atlas* attaches a question mark to a site label on the map to indicate a degree of hesitancy (i.e., uncertainty) about the assignment of an attested name to an attested site, the database will store a record for the name, complete with a flag indicating the degree of doubt inherent in its association with a given site. Similar distinctions are accommodated at all levels (e.g., in the spelling and assignment of names).

Significant effort has also been devoted to the development of software tools that automate the conversion of information in the *Barrington Atlas Map-by-Map Directory* for insertion into the database. Extremely heterogeneous data for over 30,000 geographic entities of various types must be transferred accurately. This software is written in Visual Basic for Applications (VBA), and runs in modules inside a Microsoft Access database. Microsoft Office software has been used for this purpose because the original Directory files were produced in Microsoft Word. The tight, cross-application integration, combined with ubiquitous support for Unicode characters, ensures that the data can be extracted and modified reliably. Final testing and verification of this software are nearly complete, and preparation of all Directory data associated with point features (e.g., settlements, forts) will be finished by August 2005. Spatial coordinates for these point features are to be obtained by GIS digitization of georegistered raster images of *Barrington Atlas* maps (see further appendix 6.3). These procedures have already been tested and verified by AWMC staff. The work will be carried out by two undergraduate research assistants during the period August 2005 – January 2006 under the supervision of the Center's Director. This timetable ensures that all relevant data, whether derived from Map-by-Map Directory files or from the maps themselves, is ready for immediate use by the Pleiades project.

4.3.1.4. Initial design of workflow, content types, roles and development scenarios

Beginning with the 'Merope Workflow Analysis' conducted by graduate students of the UNC School of Information and Library Science in 2000, Elliott and Talbert have paid careful attention to the manner in which suggested modifications and additions to the information sets controlled by the Center should be handled, managed, edited and approved. These considerations, most recently

refined through discussion with members of the Pleiades Steering Committee, have resulted in a mature specification of the roles which Pleiades users assume and the tasks which the system enables them to complete.[13]

4.3.1.5. Pre-award establishment of project team

The project directors (Elliott and Talbert) have been planning for the critical human aspects of successful project completion since the Center's foundation in late 2000. Pleiades was first publicly discussed in a paper presented by Elliott at the Center for Computational Science at the University of Kentucky in February 2001 entitled, "Pleiades: Toward a Secure, Public, and Collaborative Workspace for Ancient Geography." Positive and insightful comments from classicists and computer scientists in attendance helped hone the project's goals.

Since 2001, Elliott and Talbert have secured the enthusiastic participation on the project's **Steering Committee** of a talented group of experts representing all aspects of the project's methods and content fields. Since January 2004, regular discussion with Steering Committee members has sharpened the issues that the project addresses and has set the agenda for the features and capabilities of the Pleiades system. Beginning in September 2005 (4 months ahead of project activation, assuming a successful award), close consultation with Steering Committee members via a discussion list and online forum prioritizes the baseline system features to be implemented in Phase 1 (1 January – 15 May 2006). [14]

Elliott and Talbert have also devoted significant advance preparation to staffing the full-time **Software Developer**, and **graduate student** positions essential to Pleiades' success.[15] As a 'high tech hub,' the Research Triangle area of North Carolina (anchored on the west by Chapel Hill) is one of the best places in North America to recruit talented Software Developers skilled in current programming languages and techniques and experienced in the deployment and customization of web-based technologies and network services. In choosing Plone as Pleiades' software foundation, the AWMC taps into a current 'hot topic' among programmers in the Triangle: the Python programming language and the increasing quantity of open-source applications written in it. The number of local freelance and contract programmers versed in Python is increased further by wide use on the part of faculty and students in UNC's Computer Science Department, and by the activities of a vigorous Triangle-area Python users' group. Representatives of both of these communities serve on the Pleiades Steering Committee (Gary Bishop from Computer Science and Christopher Calloway from UNC Marine Sciences and the Python users' group), ensuring that the Pleiades project and its open positions get broad, positive exposure in all relevant venues.

To ensure timely staffing of these open positions with optimal candidates, Elliott and Talbert publicly announce the full-time **Software Developer** position and the **Graduate Developer** position, contingent upon project award, in September 2005. Evaluation of applications and interviewing of

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[13] Appendix 6.4 provides an example of the output from the *Merope* evaluation. The role of the AWMC Advisory Board is outlined in section 4.4.3. The role of the Pleiades Steering Committee is presented in section 4.4.4. The individual task scenarios that drive iterative development (see section 4.4.1 for method) are changed and refined by the development staff and Steering Committee over the course of the project; the list as of late June 2005 is provided for reference as appendix 6.6. The major custom content types are described in appendix 6.7.

[14] On the composition and duties of the Steering Committee during the award period, see further section 4.4.4.

[15] Position descriptions are provided in appendix 6.9.

candidates continue until receipt of project award in late 2005, when employment contracts are quickly concluded. This timetable permits the Software Developer to begin work immediately in January 2006; it also ensures identification and engagement of a suitable graduate student developer (beginning work in mid-May 2006) well in advance of traditional late spring graduate student award and work assignments in the departments of Computer Science and Information Science. The **Graduate Historian** position (beginning work in August 2006) is filled by a skilled ancient history, classics or classical archaeology graduate student. Beginning work at the same time, the Graduate Geographer position is filled by a graduate student in Geography or an allied field. Both these positions are advertised and selected during Phase 1 (1 January – 15 May 2006).

4.3.2. Scope of Work on Proposed Grant

The Pleiades project plan divides temporally into five phases spread over 24 months. The activities planned for each phase are described in section 4.5 (Work Plan). The present section describes the scope of work in thematic terms, addressing each of the major classes of activity that comprise the Pleiades initiative. NEH support is sought for: population of the geographic database with point features and related information; development and evaluation of the community support environment; and creation of web-based mapping and gazetteer services.

4.3.2.1. Implementation of the Geographic Database

Like the bibliographic database, the geographic database is implemented in PostgreSQL with PostGIS extensions. As the design of the geographic database is already mature, implementation and testing can readily be completed during the first 3 months of the award period (January – March 2006). Immediately thereafter, the database is populated with spatial coordinates and attribute data converted from the Classical Atlas Project data set. The first set of this data, comprising all point features in the pilot area (western and central Asia Minor) together with their attribute data and bibliographic citations, is prepared by Elliott and the non-project AWMC undergraduate staff prior to and during the first phase of the project, using the techniques outlined in appendix 6.3. The geographic database provides support for the management of multiple sets of coordinates for individual features drawn from different sources. This flexibility permits lossless future updating of legacy Atlas Project coordinates with higher resolution data derived from large scale maps or field data collection. Each set of location coordinates is explicitly linked to a metadata record, compliant with relevant guidelines issued by the Federal Geographic Data Committee (www.fgdc.gov), describing its origin, geodetic reference, projection and other essential characteristics.

Further point feature data for the remaining Classical Atlas Project dataset is added over the remainder of the project timeline, beginning with the Aegean and working outward from the pilot area. Additions are coordinated to coincide with the ends of phase 3 (16 August – 31 December 2006) and phase 4 (1 January – 30 June 2007) to provide greater scope for the addition of new users to the Pleiades community. The extent of the data added at each of these milestones is decided by the Managing Editors (Talbert and Elliott) in consultation with the Pleiades Steering Committee in order to meet project testing and implementation goals.

4.3.2.2. Creation of Web Mapping and Gazetteer Services

On-demand mapping of geographic features is essential for the users of the Pleiades system. Moreover, on-demand mapping of data, combined with networked services for informing other systems about data published through Pleiades, are essential components in the emerging networked spatial infrastructure. To the fullest extent possible, these services are implemented using open source software. Wherever possible, those open-source cartographic technologies implemented by

other projects for use in Plone are leveraged, including: the Python Cartographic Library (PCL), Cartographic Objects for Zope (ZCO) and PrimaGIS.[16] In those instances where necessary features are available only through commercial systems, software produced by ESRI corporation is used at no cost to the project under the rubric of a UNC-wide site license. Interfaces between these services and the Pleiades community software make use of standard protocols to ensure future flexibility and insulate the project against proprietary cul-de-sacs.

4.3.2.3. The Collaboration Support System

At the heart of Pleiades is a collaboration support system built atop the open-source Plone Content Management System. This system facilitates the entire life-cycle of updates and additions to the AWMC's bibliographic and geographic data holdings, from authoring through review and revision to final publication decisions. World-wide access via the Internet permits broad collaboration otherwise impossible. Scriptable workflow management and support for custom content types enables precise control over, and historical documentation of, every editorial decision and every authorial contribution. Robust user and group definition, combined with roles-based privilege assignment, ensures the security of the system and the integrity of the publication process and its output. The rationale for the development of this system, the selection of its software base, and the manner in which it is modified and extended to support the unique needs of geographic humanities reference works, are presented in detail elsewhere in this proposal. The following hypothetical illustration gives life to these discussions by highlighting some major aspects of the operation of Pleiades:

> For the past 5 years, Dr. E. (an archaeologist and faculty member at a medium-sized Midwestern college) has been conducting walking surveys in southwestern Turkey. The fruits of this labor include a list of road stations and small fortification sites, together with their Global Positioning System (GPS) coordinates and preliminary date estimates made on the basis of surface-observable pottery. Dr. E. wishes to compare this data with information previously compiled by Dr. Clive Foss and included in his 1994 compilation work on *Barrington Atlas* Map 65, "Lycia – Pisidia."
>
> Dr. E. uses a standard web browser to connect to the website of the Ancient World Mapping Center and from there selects the link to Pleiades. On a previous visit to the website, Dr. E. had requested creation of a password-protected account, and had provided contact information and a brief description of her interests and qualifications. The Managing Editors of Pleiades, after reviewing this request and verifying Dr. E.'s contact information, provided her with the account and granted her the suite of privileges associated with the Pleiades Collaborator role. Upon logging in, Dr. E. has available to her a number of tools for comparing her data with the content of the *Barrington Atlas*, including: a dynamic web-based mapping tool, bibliographic and placename search tools, and a geospatial search tool that provides information about locations near coordinates entered by the user. Using these tools, Dr. E. comes to the conclusion that at least seven of the locations in her list constitute new discoveries. On the basis of epigraphic finds, she can also provide names for two small fortifications previously identified by Dr. Foss, but labeled in the Atlas (and the Pleiades geographic database) only by their modern names. The web interface provides a mechanism for Dr. E. to enter the coordinates of these sites –

[16] PCL: http://zmapserver.sourceforge.net/PCL; ZCO: http://zmapserver.sourceforge.net/ZCO; PrimaGIS: http://www.primagis.fi.

together with other pertinent data such as their names and provisional dates – for review by other members of the community.

Dr. E.'s entries for new sites are automatically flagged by Pleiades as *Suggestions*. Similarly, the names she provides for Dr. Foss's sites are flagged as *Suggestions* related to the appropriate records. She aggregates all the *Suggestions* about each site into appropriate *Suggestion Groups*, for each of which she writes a single *Explanatory Essay*, laying out her information sources and analytic rationale. The content of all these *Suggestions* is immediately visible to all other Pleiades members with Collaborator privileges, once Dr. E. changes their state from *Draft* to *Candidate*. In particular, for those who have selected this geographic area as a special interest, 'alert' messages summarizing the new *Suggestions* are queued for delivery at the next login.

Dr. E.'s *Suggestions* garner attention from several other members of the Pleiades Community. Within three weeks, fifteen Collaborators have posted *Peer Comments* indicating that they concur with Dr. E.'s *Suggestions*. A particularly helpful response is posted by the director of a joint American-Turkish team excavating a nearby site (Dr. S.). A Norwegian graduate student (Mr. V.) attaches an English *Translation* of Dr. S.'s Turkish-language *Peer Comment*, so that non-Turkish-speaking members of the community can understand Dr. S.'s critique of some of Dr. E.'s dating criteria. A French epigrapher, Dr. C., voices doubt about one of the proposed name associations, citing a colleague's study of several recently published documents.

After consultation with the Managing Editors, a Pleiades Content Editor contacts Dr. E. and the other substantive contributors to the discussion to inform them that the *Suggestions* are being reviewed for publication. These *Suggestions* are moved to a new state by the editor: *Under Review*, thereby locking out further changes for the time being. Meanwhile, the editors obtain commissioned evaluation from two expert sources. The first is a check of the publications cited in the documentation. This work is carried out by the Ancient History graduate student working at the AWMC (Graduate Historian). Exercising the privileges associated with the Research Specialist role, she checks the citations and ensures that complete bibliographic records for each cited work are properly formatted for eventual addition to the Pleiades bibliographic database if the suggestions are accepted. The editors also contact the Atlas compiler, Dr. Foss, and ask him to join the Pleiades community as a Subject-Matter Expert. Dr. Foss consents to do so and, after familiarizing himself with the on-line environment and community, provides the editors with a *Formal Review* of the suggestions first advanced by Dr. E. This review is shared with Dr. E. and the other substantive participants in the discussion.

Following further on-line discussion, members, reviewers and editors reach agreement on the character of the conclusions. The chief changes are addition of bibliography supplied by Dr. S. and Dr. C., and the recategorization of one of the epigraphically attested placenames as an unlocated toponym. The relevant *Suggestions* are placed in the *Under Revision* state while these modifications are made. Once finished, the editor who supervised the review and final discussions then queues these findings for publication by placing them in the *Pending Acceptance* state. The Managing Editors are automatically alerted to this change in status and, after they register their approval, the modified suggestions are moved to the *Accepted* state and queued for insertion into the geographic and bibliographic databases at the next update interval (monthly or more often). Once the

new and updated records are committed to the database, the corresponding *Suggestions* assume *Published* status. The records themselves are immediately available to all members of the Pleiades community. They are also included in the next dated release of the Pleiades Gazetteer, a publicly available digital resource for reference and research that can be downloaded from the AWMC website, or consulted directly by individuals or computer systems via the on-line Pleiades Gazetteer Service and Pleiades Web Mapping Service. The records appear, too, in an annual print update to the *Barrington Atlas* in a major scholarly journal. In all these contexts, those who made substantive contributions to the identification and refinement of the suggestions are given authorial credit on each entry as follows: *Dr. E. (Macomb, Illinois), with the assistance of Dr. S. (Istanbul), Mr. V. (Bergen) and Dr. C. (Bordeaux).* Editors, Research Specialists and Subject-Matter Experts who have provided reviews are likewise credited by name in the introductory portions of both digital and print publications.

4.4. Methodology and Standards

4.4.1. Development Methodology

The Pleiades project employs a scenario-driven, user-focused approach to software development. Each user interface component, together with underlying system functions, is created in response to detailed "story boards" and interface design mockups tied to tightly defined scenarios. "System primitives" (basic functions) are created first. For example, two primitive scenarios are "User logs in to Pleiades system" and "User modifies personal contact information." Higher-level system functions (e.g., "User suggests addition of a new settlement") are developed once the system primitives are in place and functioning correctly.

Evaluation and user testing are built into the development process, and into the software itself. Scenarios and the associated storyboards and interface design mockups are vetted as necessary by the project staff and steering committee. Vetted scenarios proceed to development, and the resulting 'live' interfaces and code are again evaluated. Plone-native content types are also harnessed in service of software improvement. As part of the Plone installation, the project maintains a 'collector' (issue tracking system) that all members of the community are free to use to report bugs and communicate feature requests to the project staff.

User assistance and information – commonly referred to as software documentation – is built directly into the Pleiades interface. Each component of the interface corresponds to a particular stage in a task that a user is trying to perform. Accordingly, task-appropriate guidance is delivered to the user via the interface itself, rather than through a link or separate manual. This approach is facilitated by the nature of web interfaces, which can easily combine text, graphics and form elements. Keeping user assistance "at the users' fingertips" speeds completion of tasks and helps to prevent 'disconnects' between revised interfaces and associated documentation. Combination of interface and documentation also facilitates localization, ensuring that translation of any user interface component also includes translation of the associated user documentation. Development standards for the Pleiades project dictate that no interface is released from evaluation to production without complete user documentation, authored by the project staff and refined in consultation with the steering committee and technical advisors. Users of the Pleiades system can comment on, and suggest refinements to, this documentation. A wiki system, also built into Plone, supports collaborative creation and update of 'how-to' and tutorial documents that augment the on-interface user assistance.

4.4.2. Procedures, Standards and Software Selection

4.4.2.1. Markup and Format Standards for User Interfaces

To ensure temporal viability and the widest possible accessibility, all Pleiades user interfaces comply fully with the latest technological standards. Proprietary and platform-dependent deviations from, or extensions to, such standards are eschewed. Web forms and pages are therefore delivered to the browser in "XHTML 1.0 Transitional" and formatted for presentation using the Cascading Stylesheets Specification, features readily provided by the underlying Plone software. The use of different modern and ancient languages is signaled with the standard "xml:lang" attribute. Values for these attributes are drawn from standard authority lists.[17] All text is encoded in accordance with the Unicode Standard font specification (www.unicode.org).

4.4.2.2. Backup, Archiving and Export

The content of Pleiades databases, digital gazetteer and web mapping system, together with all middleware code and user interfaces, are backed up nightly for both the development server in Chapel Hill and the production server in Lexington. All software releases are made via sf.net, which retains a permanent copy; project copies on durable media are also archived offsite. In addition to the nightly backups of content, monthly content snapshots are archived offsite on durable media. Content of the bibliographic database is archived as both PostgreSQL tables and independent XML files in which the data is structured as a bibliographic list in accordance with the guidelines of the *Text Encoding Initiative* (www.tei-c.org). Content of the geographic database is archived as both PostgreSQL tables and independent XML files in which the data is structured in accordance with the *Alexandria Digital Library Gazetteer Content Standard*. Separate archiving in standalone, standards-compliant XML ensures that the data can be easily repurposed or transferred to a new system at a future date. Data export for user purposes benefits from an accretive, 'shopping cart' style interface that permits a user to collect bibliographic and geographic records of interest and store them according to theme or download them in a range of formats suitable for use in standard bibliographic and GIS software. Detailed features and formats are to be prioritized for implementation by the Steering Committee at its first meeting in Phase 1.

4.4.2.3. Geospatial Services and Software

Insofar as possible, the web mapping and digital gazetteer services that support the Pleiades community and publish its findings are implemented with open source software in order to limit the costs of software adoption for other projects. We have secured agreement from the Alexandria Digital Library (ADL) project (www.alexandria.ucsb.edu/gazetteer) to obtain and run a copy of their gazetteer server code, modified as needed, to provide the AWMC's digital gazetteer service. To provide the cartographic elements within the Plone environment, the project team expects to make use of the open-source Python Cartographic Library (PCL) and Cartographic Objects for Zope (ZCO) libraries, possibly with the edition of the new PrimaGIS components.[18] Data structures for spatial features in the geographic database are implemented in accordance with ADL and OGC standards. Adherence to these standards in the storage and retrieval of spatial data makes it easier to develop compliant interfaces to the web mapping and digital gazetteer services, positioning Pleiades for easy upgrade and integration with future systems. AWMC publications derived from Pleiades-authored

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[17] In accordance with *IETF (Internet Engineering Task Force) RFC 3066: Tags for the Identification of Languages,* ed. H. Alvestrand. 2001, http://www.ietf.org/rfc/rfc3066.txt.

[18] See note 16.

data include not only the gazetteer service, but also GIS datasets in standard formats (e.g., shapefiles). All such datasets are accompanied by appropriate metadata conforming to guidelines promulgated by the Federal Geographic Data Committee (www.fgdc.gov).

4.4.2.4. Database Software

Databases supporting Pleiades are implemented in PostgreSQL (www.postgresql.org) for two reasons. First, the open source license structure associated with PostgreSQL ensures that any future projects can afford to adopt Pleiades code without incurring significant software or licensing costs. Secondly, the PsycoPG PostGres/Zope database connector (initd.org/projects/psycopg1) is also much more robust than similar Zope connectors for other open source database systems; in particular, it supports supports multi-threaded database connections. Finally, PostgreSQL with PostGIS extensions provides mature GIS database support and boasts a large support community which has developed an extensive tool base for PostGIS/MapServer interoperatbility, especially in the area of Open GIS Consortium standards (www.opengis.org; see also postgis.refractions.net). The OGC standards provide for publishing, storage, access, and simple operations on basic geographic features, including points, lines, and polygons. These components permit the project – and those who adopt its software in the future – to interact reliably with complex relational and spatial data without purchase of a proprietary database or geodatabase extension.

4.4.2.5. Server and Middleware Software

Pleiades runs under the Linux operating system and is built by customizing the open-source Plone content management system. The rationale for adoption is presented in section 4.3.1.1.

4.4.3. Role of the Ancient World Mapping Center Advisory Board

The AWMC Advisory Board (appendix 6.10) plays a limited, but essential role in the Pleiades Project. The Board provides guidance and assistance to Elliott as the Center's director in all aspects of its operation. Its members, drawn from a variety of fields, also serve as liaison to the various scholarly disciplines that intersect with the aims and competencies of the Center. In the context of Pleiades, the Board consults with Pleiades Managing Editors (initially Elliott and Talbert) on issues directly affecting the quality of publication emanating from Pleiades. Many of the publication and community management criteria for Pleiades are developed by the Project Steering Committee, but it is the AWMC Advisory Board that will continue to monitor these criteria – and modify them as necessary – once Pleiades is mature. This arrangement provides essential institutional integration, as well as scholarly oversight for published output which bears the imprimatur of the AWMC. The Board advises on important decisions relating to the long-term management of the mature community (for example, the addition of more Managing Editors).

4.4.4. Role of the Steering Committee

Talbert and Elliott have recruited a talented and supportive Steering Committee (which Talbert chairs) that assists them in setting design criteria for Pleiades and evaluating their implementation. All committee members are recognized leaders in their fields, and as such represent a cross-section of the disciplines relevant to the project. Academic specialties represented include: archaeology, classics, digital publication and content management, geography/geomatics, history, software engineering, and information and computer sciences. Steering Committee members are listed in section 4.6.5 and résumés are in Appendix 6.8. Steering committee members:

- Participate in two meetings/workshops of 2-3 days duration in Chapel Hill at critical stages of the project's development in order to consult with fellow Committee members and project staff. The first meeting occurs during Phase 1 (March or April 2006, depending on members' schedules), the second early in Phase 4 (March or April 2007).

- Regular participation in the online community to be constructed by the Project. Steering committee members are committed to log on and test major revisions to the code and community interface a monthly basis, if not more frequently, in particular during the second year of the project. Sustained interaction with the system, focused on the pilot research issues identified during the first Steering Committee meeting, will generate invaluable procedural critique, development guidance and software improvement.

- In the second year, Steering Committee members each recruit between one and three further suitable individuals. These new project participants are willing to become members of the Pleiades online community, and are able to provide substantive evaluation and assessment of the system's quality and relevance to their research or teaching interests. Steering Committee members act as mentors to these new community members as they become familiar with the online environment. Emphasis is placed on recruiting individuals into all three of the non-editorial roles defined for the Pleiades community. The project directors (Elliott and Talbert) include in their recruitment efforts veterans of the Classical Atlas Project and members of active scholarly research projects engaged in archaeological, geographic and epigraphic work relevant to Asia Minor.

- Consult (in person or via email, phone or video conference) with the project directors or members of the project staff as necessary to solve problems or to enhance system features relevant to individual areas of expertise.

4.4.5. Evaluation and Dissemination of Results

On-going evaluation and system improvement are integral parts of the Pleiades development methodology (see further section 4.4.1). Integration of bug tracking and user-suggestion capabilities into the system itself is combined with a phased approach to review and comment on the system in order to identify and improve workflow and interface design issues quickly. The first of two 'white papers' prepared by the project during the award period documents customizations and extensions to Plone necessary to achieve the desired workflow and content objects. It serves as a guide to other projects for setting up their own community support environments on the basis of Pleiades'.

Qualitative evaluation under 'real world' conditions is the primary purpose of the final six months of the project performance period (1 July – 31 December 2007), prior to public launch of the system. This phase begins with the introduction of new community members identified and recruited by the Steering Committee and the project directors. During this period, the project directors, with the assistance of the Graduate Historian and in consultation with the Steering Committee, evaluate the achievements and effectiveness of the project in light of its use by its members. The character of member participation is assessed anonymously in aggregate in order to ascertain frequency of use, applicability of *Suggestions* made, and efficiency of the publication workflow. The main focus of this evaluation is assessment of the value and quantity of *Suggestions* received for updating and improving *Barrington Atlas* information, as well as evaluation of the degree to which a productive, cooperative community is forming. A 'white paper,' documenting these assessments is released publicly via the AWMC website.

Dissemination plans are outlined in more detail in section 4.7.

4.5. Work Plan

Twenty-four months of work (1 January 2006 – 31 December 2007) are staged as follows:

1. Instantiation of development infrastructure and baseline system, scenario refinement (1 January – 15 May 2006)
2. Database integration and iterative development 1 (16 May – 15 August 2006)
3. Gazetteer and web mapping service integration and iterative development 2 (16 August – 31 December 2006)
4. Iterative development 3 (1 January – 30 June 2007)
5. Community Trials and System Improvement (1 July – 31 December 2007)

As explained in section 4.4.1, an integrated and agile approach to software development is followed at all times. System components (including workflow functions, management capabilities and interface modules) are defined as the aggregate of scenario, code, data, software user documentation and community evaluation. No component is added to the production system without completing a structured development cycle that is scenario and user-profile driven, culminating in unit testing, community evaluation and acceptance. Insofar as possible, scenarios are written to be 'atomistic,' that is, a single scenario constitutes the smallest possible incremental addition of function to the system. Development cycles are structured in such a way as to implement support for processing of each scenario, and to deliver a working system that incorporates it, in as short a period of time as possible. This commitment to 'release early and often' permits the community to evaluate changes to the software frequently, and to catch modifications that are problematic from a user's point of view before they become heavily intertwined with other aspects of the system. The detailed plan of work for each phase is described in the following subsections. The timeline in Figure 1 illustrates the phases of the work and also indicates staff work periods.

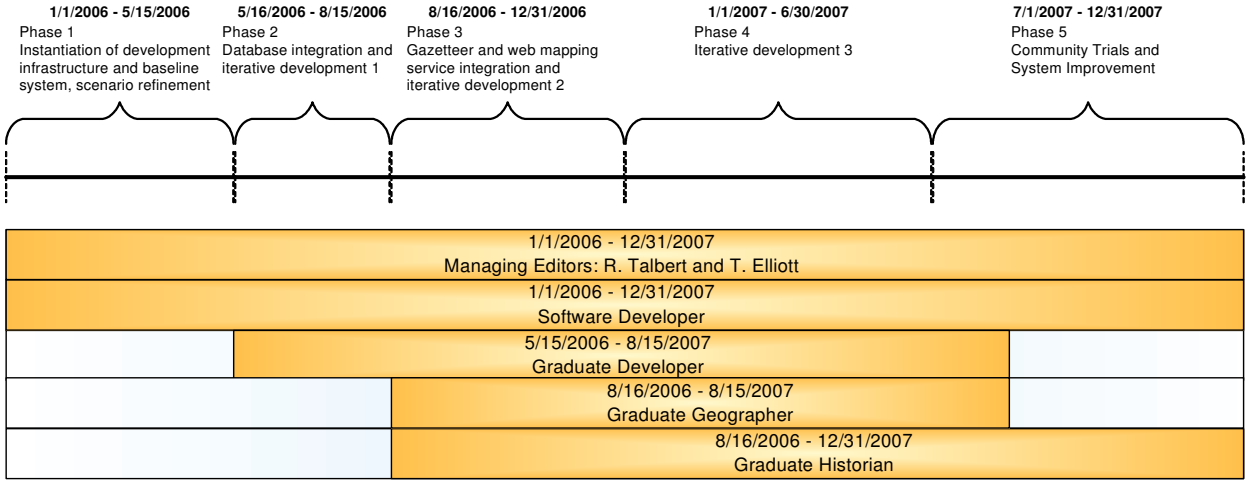

Figure 1: Project Phases with Staff

4.5.1. Infrastructure, baseline system, scenario refinement (1/1-5/15/2006)

Work on Pleiades begins with the hiring of the full-time **Software Developer**, the establishment of an appropriate software development infrastructure, the installation of Plone and related software

packages, and the instantiation of the baseline workflows, roles and document types that have already been designed by the project directors. The project directors begin well in advance of this phase (15 August 2005) to solicit resumes and conduct interviews for the Software Developer position. During Phase 1, the Software Developer and Elliott establish a Subversion (SVN) repository for versioning and control of software and documentation, create a SourceForge project space for software releases, and set up the 'in-house' development server in Chapel Hill.[19] Once a baseline instance of Plone is up and running on the Chapel Hill machine, a second, identical instance is configured on a server controlled by the Stoa Consortium for Electronic Publication in the Humanities (section 4.2.2) at the University of Kentucky. Two versions of the Pleiades system are maintained throughout the award period: a 'development snapshot' version on the server in Chapel Hill (running the latest, experimental build of the software for testing), and a 'production' version on the server in Lexington (running the latest stable release of the code and supporting evaluation by the Steering Committee, and later by an expanded community). Once the development environments are thus configured, the Software Developer and Elliott use Plone's built-in tools and add-on 'products' to configure the custom roles and workflows already identified and explained in this proposal. Templates for the Pleiades custom content types are also created. These templates are fleshed out during subsequent phases of iterative development and testing in accord with scenarios defined and prioritized by the Steering Committee and the project directors, with input from the Software Developer. During this phase, Elliott and the Software Developer also implement the geographic database, as described in section 4.3.2.1. The Software Developer conducts an evaluation of the current state of Plone add-on 'products' for database integration, with an eye toward the central focus of Phase 2.

Phase 1 also sees the first meeting of the Pleiades Steering Committee, which Talbert chairs. Planned for March or April 2006, depending on the schedules of the participants, this meeting provides a venue for several important tasks. Steering Committee members with particular areas of expertise prepare briefings for the rest of the committee. At a minimum, presentations on the use and applications of Plone, current trends in digital geography, and topics and problems in Mediterranean/Asia Minor history and archaeology will be featured. The project directors provide overviews of project plans and status. The Software Developer demonstrates the 'production' development environment and confers with technical members of the Steering Committee concerning development milestones for the remainder of the year. A significant portion of this meeting is devoted to discussion and prioritization of scenario-driven system features and capabilities. Project staff leave this meeting with a clear vision for order in which scenarios are to be implemented and tested. Discussion also focuses on the essential issue of the licensing agreement that governs the relationship between Pleiades community members' contributions and AWMC publications.

4.5.2. Database integration and iterative development 1 (5/15-8/15/2006)

Summer 2006 sees the addition to the team of the first graduate research assistant (the Graduate Developer) and the establishment of essential linkages to the geographic and bibliographic databases.

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[19] At the time of proposal submission, SourceForge does not yet provide Subversion hosting arrangements, but has announced plans to do so in the near future. It does currently provide the older CVS system. If SourceForge is not yet providing these services at the time of project award, Pleiades will operate its own Subversion repository until such time as SourceForge makes this capability available. There is not space in this proposal for a comparison of SVN vs. CVS functionality; however, the deciding factor in its selection for use by this project is that the Plone software community uses SVN, which provides the ability to link software releases to plugins and modules (and their release versions) created by others so as to ensure easy and functional installation of compatible code from multiple repositories. Further details on SVN at: http://subversion.tigris.org.

First, the Software Developer, Elliott and the Graduate Developer install production copies of the geographic and bibliographic databases on Stoa-administered servers at the University of Kentucky. Then, they integrate appropriate Plone add-on products for database connectivity into the Pleiades code (both the 'development snapshot' system in Chapel Hill and the 'production' system in Lexington connect 'read-only' to the same database instances in Lexington). This integration, guided by appropriate development scenarios, leads to the first major 'fleshing out' of the Pleiades custom content types. In particular, the *Suggestion* object acquires a structured data segment in XML, mirroring the content of the relevant database records and capturing the changes, additions or deletions that constitute the gist of the *Suggestion*. Software methods and interface components necessary to effect database searches, *Suggestion* creation and searching of *Suggestions* by content are also added to the system.

4.5.3. Gazetteer/mapping integration, iterative development 2 (8/16-12/31/2006)

The Graduate Geographer and Graduate Historian join the project team at the beginning of fall semester 2006. The Geographer works alongside the Software Developer and Graduate Developer, under Elliott's supervision, to add integrated mapping and spatial editing features to the Pleiades system, and to begin providing an online digital gazetteer service drawing upon the content of the geographic database and employing the Alexandria Digital Library Gazetteer Protocol. Addition of these features, guided as always by appropriate development scenarios, drives further 'fleshing out' of the data and method aspects of the Pleiades custom content types and user interfaces. The Graduate Historian assists the development team by rigorously testing all first-year development scenarios with the active code. Furthermore, under the guidance and direction of Elliott and Talbert, s/he refines the list of 'real-world' development scenarios to be presented to the Steering Committee for vetting and prioritization. These scenarios are designed to exercise the full range of Pleiades capabilities through the realization of actual additions and updates to the geographic and bibliographic databases. Issues for these scenarios are garnered from two sources: bibliographic and topical update information already identified by the AWMC and queued for follow-up, and matters raised by content experts on the Steering Committee during and after the first meeting in Phase 1. Scenario discussion with the Steering Committee occurs electronically via the project mailing list and culminates in the second Steering Committee meeting during Phase 4.

4.5.4. Iterative development 3 (1/1 – 6/30/2007)

The six-month-long Phase 4 provides the project team with a concentrated period for the improvement of features already specified and for the creation of additional features identified in the course of scenario refinement begun in Phase 3. First steps toward the full internationalization of the Pleiades interface are also taken during this phase. The Steering Committee considers staff and committee member skills and project needs as it selects the languages into which the project-specific components of the Plone interface are to be translated (the base Plone interface is already available in many languages), probably from the following list: French, German, modern Greek, Italian, Latin, Turkish. A highlight of this phase is the second Steering Committee meeting in Chapel Hill, held in March or April 2007 depending on the schedules of the participants. The central emphasis of this meeting is 'hands-on' use and discussion of Pleiades for real-world issues. Steering Committee members go away from this meeting proficient in the use of the system and ready to recruit additional colleagues into the Pleiades community. The project staff leaves this meeting with a clear understanding of Steering Committee priorities and concerns and with a detailed list of usability improvements and feature enhancements to drive remaining development. At this meeting the Steering Committee also finalizes its recommendations for the Pleiades licensing arrangements.

4.5.5. Community trials and system improvement (7/1 – 12/31/2007)

July sees the expansion of the Pleiades community through the recruitment of new Collaborators. The Steering Committee and project staff work together to ensure that outside scholars and technology experts identified during phase 4 are quickly integrated into the community and trained to use Pleiades efficiently. Elliott and the other development-oriented members of the project team provide rapid support for usability improvements, bug fixes and limited feature expansion. The Graduate Historian functions as a Research Specialist, augmented in this role by some Steering Committee members, many of whom are also granted Content Editor privileges. Community members are free during this period to suggest to the Managing Editors (Talbert and Elliott) additional individuals for recruitment, who are similarly invited to join. Plans for the public launch of Pleiades, after which prospective community members are encouraged to self-identify to the Managing Editors, are executed during this phase. Publicity via electronic fora, targeted mailings to relevant institutions and research projects, direct contact between participants and colleagues, and public announcements in appropriate journals and newsletters are all employed to raise awareness and encourage broad participation. The date for the public opening of Pleiades, not later than the end of this phase, is selected by the project directors in consultation with the Steering Committee.

4.6. Staff

Pleiades project staff consists of two Project Directors (R. Talbert and T. Elliott), an unnamed Software Developer, an unnamed Graduate Developer, an unnamed Graduate Historian, an unnamed Graduate Geographer, the Advisory Board of the Ancient World Mapping Center and the Pleiades Project Steering Committee.[20]

4.6.1. Project Co-Director: Dr. Richard Talbert

Dr. Richard Talbert, Kenan Professor of History and Classics, Director of the Classical Atlas Project, and Editor of the *Barrington Atlas*, serves as one of the two **Project Directors.** In partnership with Dr. Elliott, he oversees all aspects of the project. Dr. Talbert also serves as the chair of the Steering Committee, coordinating its interaction with the project staff. Dr. Talbert devotes 10% of his time to the project, all donated by UNC.

4.6.2. Project Co-Director: Dr. Tom Elliott

Dr. Elliott, the Center's Director, serves as the other Pleiades **Project Director.** He combines in-depth practical experience and training in ancient history, computer science and project management. He directs day-to-day aspects of the Pleiades Project and works closely with the rest of the project staff to include 'hands-on' software development. Dr. Elliott has played the central role in design and planning to date, and has deliberately honed his skills and experience in preparation for this project. Dr. Elliott has built upon his formal undergraduate training in Computer Science, and his subsequent commercial work as a programmer, by learning the Python programming language, engaging in 'hands-on' experimentation with Plone and attending Plone and Zope-related seminars and workshops. Most recently, he is participating in the North America Plone Conference (20-22 July 2005) at the Map Center's expense, which includes a series of tutorials and talks whose content has a direct bearing on tasks necessary for successful completion of this project. Given the central urgency

[20] Steps taken by Talbert and Elliott to ensure timely filling of unnamed positions with appropriate individuals are outlined in section 4.3.1.5. Detailed position descriptions to be used in recruiting are provided in appendix 6.9.

of Pleiades to the full extent of the Center's mission, Dr. Elliott devotes 66% of his time directly to Pleiades. NEH support is sought for half of this effort, with guaranteed income from the Center's endowment permitting UNC to donate the other half. External to the project, Dr. Elliott's support is derived from the endowment and other UNC sources.

4.6.3. Full-time Software Developer

The full-time Software Developer undertakes, in collaboration with Elliott, the essential software development tasks inherent in customizing Plone and realizing the unique features of the community support system for Pleiades. The developer begins work in January 2006 and continues in this role throughout the award period, concluding in December 2007. NEH support is sought for 100% of the Software Developer's effort.

4.6.4. Graduate Assistants

The Pleiades project employs three graduate assistants for varying lengths of time during the award period. NEH support is sought for 100% of the necessary costs of these positions. Each graduate assistant is selected competitively from among qualified and currently enrolled graduate students in appropriate programs at UNC-CH. During their individual terms of service to the project, they work a number of weekly hours and are compensated at rates consistent with those that apply to their peers in their home departments. This arrangement ensures that the project can compete for the best possible assistants. Once selected, the academic advisors of these students are invited to join the Pleiades Steering Committee in order to maintain close academic contact between all parties and ensure that the students are not inadvertently penalized for working outside their academic departments. Each graduate assistant has a different role to play in the Pleiades project. Detailed position descriptions for each graduate assistant are provided in appendix 6.9. Overviews of the three different positions are provided below.

4.6.4.1. Graduate Developer

The Graduate Student Developer assists the Software Developer and Elliott in programming and system management tasks critical to project completion. This individual is recruited from currently enrolled students in Computer Science and Information Science. The Graduate Developer begins work in mid-May 2006 and continues through mid-August 2007. During each summer, this individual works 40 hours/week for 10 weeks. During the academic year 2006-2007, the Graduate Developer works 20 hrs/wk while classes are in session.

4.6.4.2. Graduate Historian

The Graduate Student Historian assists the entire Pleiades community and, in particular, the Pleiades **Managing Editors** by filling the role of **Research Specialist**. Without this individual, the capacity of **Content Editors** and **Managing Editors** to respond to **Collaborators' Suggestions** in a timely manner is severely constrained. Applicants for this position are recruited from currently enrolled graduate students in History (Ancient) and Classics (including Classical Archaeology). This individual begins work in mid-August 2006 and continues through the end of the award period (December 2007). During academic year 2006-2007 and the fall semester of academic year 2007-2008, the Graduate Historian works 15 hrs/wk while classes are in session. During summer 2007, this individual works 40 hrs/wk for 10 weeks.

4.6.4.3. Graduate Geographer

The Graduate Student Geographer assists the Software Developer and Elliott in development, integration and evaluation of geographic and cartographic components of the Pleiades community support system. This individual is recruited from currently enrolled students in Geography and allied departments. The Graduate Geographer begins work in mid-August 2006 and continues through mid-August 2007. During the academic year 2006-2007, the Graduate Geographer works 20 hours/week while classes are in session. During the summer, this individual works 40 hours/week for 10 weeks.

4.6.5. Steering Committee

The committee's role is outlined in section 4.4.3. Résumés are in Appendix 6.7.

- Dr. Gary Bishop, Professor
  Department of Computer Science, UNC
- Dr. Riet van Bremen, Senior Lecturer
  Department of History, University College, London, United Kingdom
- Christopher Calloway, Applications Analyst
  Department of Marine Sciences, UNC, Triangle Zope/Plone Users Group coordinator
- Dr. Hugh Cayless, Web Application Software Developer
  Lulu.com; Adjunct Assistant Professor of Practice, School of Information and Library Science, UNC
- Dr. Paul Conway, Information Technology Services Director
  Perkins Library, Duke University
- Dr. Gregory Crane, Professor of Classics and Editor-in-Chief, Perseus Project
  Tufts University
- Helen Hawkins, Information Architect
  Rational Software Development Platform, IBM
- Dr. Anne Knowles, Assistant Professor
  Department of Geography, Middlebury College
- Dr. Scott Madry, Research Associate Professor
  Department of Anthropology, UNC; President, Informatics International, Inc.
- Dr. Duane Marble, Professor Emeritus
  Department of Geography, The Ohio State University
- Dr. Ruth Mostern, Assistant Professor
  Department of History, University of California, Merced
- Dr. Gary Reger, Professor
  Department of History, Trinity College, Connecticut
- Charlotte Roueché, Professor of Classical and Byzantine Greek
  Department of Byzantine and Modern Greek Studies, King's College, London
- Dr. Ross Scaife, Professor of Classics and Editor-in-Chief, Stoa Consortium
  University of Kentucky
- Fred Stutzman, Senior Staff Member
  ibiblio.org

- Dr. Richard Talbert, William Rand Kenan Jr. Professor
  Departments of History and Classics, UNC; Pleiades Project co-Director and Chair of the Steering Committee
- Dr. Nicola Terrenato, Associate Professor of Classical Archaeology
  Department of Classics, UNC
- Dr. Helen Tibbo, Professor
  School of Information and Library Science, UNC-CH

4.7. Dissemination

Activities in Phase 1 include the establishment of a project software archive at Sourceforge.net, the world's largest open source software development website. This archive is the primary repository and distribution method for Pleiades software, thus making each release immediately available to other interested projects and individuals. Use of SourceForge ensures wide, multiply archived, long-term availability of the software, and provides significant visibility within the open source development community. As the project matures, its visibility attracts other Software Developers within the open source community who are willing to help improve and expand the Pleiades code, or apply it to other projects.

The work of the Pleiades community results in regular publication of updates to the *Barrington Atlas*. These updates take three immediate forms: a digital gazetteer (available via download from the AWMC website or by on-demand consultation using the Alexandria Digital Library Gazetteer Protocol), downloadable GIS datasets, and regular print updates, submitted as articles for publication in a standard journal. Additional digital publication modes are added as new venues develop.

The Pleiades project produces two 'white papers,' to be distributed via the website of the Ancient World Mapping Center and archived in the SourceForge software archive. The first such paper details the customizations and extensions to Plone necessary to achieve the desired workflow and content objects. The second 'white paper' emerges from the final phase, during which the achievement of the project and the effectiveness of its approaches are evaluated. In addition, the Managing Editors organize panels at appropriate academic conferences where project participants (ranging from Collaborators to Content Editors) are invited to present original analysis and observations on the project, its process and outcomes. These occasions afford wide exposure for the project's progress, methods and results.

4.8. Conclusion

Pleiades addresses both existing and emerging consequences of obsolescence in geographic reference works for the humanities. Its particular creative focus ensures replicable solutions for a great range of essential resources that hold the key to integration, contextualization and exploitation of tomorrow's digital libraries. Through the innovative application of new technologies and models of collaboration, Pleiades demonstrates to the humanities as a whole that community-based approaches to scholarly publication challenges can be undertaken with lasting success. By this means, fruitful communication between scholars, students and enthusiasts worldwide is enhanced far beyond anything that could be achieved with conventional approaches.