Information Architecture

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INTRODUCTION

Information architecture has become one of the latest areas of excitement within the library and information science (LIS) community, largely resulting from the recognition it garners from those outside of the field for the methods and practices of information design and management long seen as core to information science.

The term, ''information architecture'' (IA), was coined by Richard Wurman in 1975 to describe the need to transform data into meaningful information for people to use, a not entirely original idea, but certainly a first-time conjunction of the terms into the now common IA label. Building on concepts in architecture, information design, typography, and graphic design, Wurman's vision of a new field lay dormant for the most part until the emergence of the World Wide Web in the 1990s, when interest in information organization and structures became widespread. The term came into vogue among the broad web design community as a result of the need to find a way of communicating shared interests in the underlying organization of digitally accessed information.

BACKGROUND INFORMATION

Two seminal events serve as milestones in the more recent emergence of this discipline or community of practice: the publication of a book on the topic by Rosenfeld and Morville in 1998 and the organization of a preliminary summit by the American Society for Information Science and Technology (ASIS&T) in May 2000 on the theme of Defining Information Architecture. The Rosenfeld and Morville text was aimed at, in its own words, ''applying the principles of architecture and library science to web site design,'' an ambition that is simultaneously broad in its coverage of issues but narrow in its application domain, implying that IA has no role in non-Web environments, which has largely been taken as a given by most people in IA since. Now in its second edition, this text is often referred to as the ''bible'' of IA, but its focus is on the practical rather than theoretical domain, with guidance on how to implement web sites and intranets that support management and growth of information.

The original IA Summit, part of the normal, one-off midyear series run by ASIS&T, was so successful that it has been repeated annually since. The summits are now considered the primary annual conference for professionals in this area. While the first summit sought to define the field, it never actually succeeded in doing so. Instead, it brought together almost 400 library and information scientists, usability and user experience professionals, information designers, and company web masters; all of whom recognized a shared interest and a need for broader dialog. A resulting special issue of the ASIS&T Bulletin (vol. 25, part 5) (www.asist.org/) did its best to make sense of the process. As well as launching a series of summits, which at the time of writing number six, ASIS&T launched the SIGIA-L listserve to provide a forum for continuing discussions in the field. This list remains, in 2005, the most active of ASIS&T discussion lists and has many subscribers who are not even members of the parent organization.

Other groups have followed. A dedicated IA professional collective, the Asimolar Institute for Information Architecture (AIfIA) was formed in 2003 (see www.aifia.org) by a self-identified group of information architects dedicated to advancing and promoting the field. It was renamed ''The IA Institute'' in early 2005 and at this time has 500 members in 40 countries. There is a considerable overlap between the ASIS&T and AIfIA groups, though the former is largely populated with academics.

Further signs of progress can be observed in academia. There are now dedicated degree programs in IA at universities such as Kent State and Baltimore, with many IA programs and courses offered through graduate programs in library and information studies across the nation. The establishment of such programs in such a short period of time within a slow-moving university system is testimony to the interest that has been created for IA.

While the advent of formal education in IA has arrived, the majority of professionals in the field are self-identified as information architects on the basis of their work or job title. No formal credentials are required to become an IA though it is probable that the majority of people using that title have received some education or training in LIS. Perhaps

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not surprisingly, LIS programs are also the most likely home for courses and degrees in IA.

There are other routes into the profession however. A large number of IA practitioners have backgrounds in technical writing and graphic design. Skills in clear communication of ideas, structuring information flow, representing information, etc. all prove extremely valuable for the work of IA. Yet another group of IAs came from a user experience or usability background, though there remains some disagreement about the boundaries between these roles.

DEFINING IA

Formal definitions of IA tend to vary from the general to the multiple. Rosenfield and Morville offer a variety of definitions as candidates:[1]

1. The combination of organization, labeling, and navigation schemes within an information system.
2. The structural design of an information space to facilitate task completion and intuitive access to content.
3. The art and science of structuring and classifying web sites and intranets to help people find and manage information.
4. An emerging discipline and community of practice focusing on bringing principles of design and architecture to the digital landscape.

Central to this mix is the idea of structuring information spaces for management and use, which can be interpreted in several ways, either as a relatively narrow concern with labeling, as in (1), or more broadly as a concern with facilitating interaction, as in (2). For present purposes, we emphasize the larger or broader perspective.

Other definitions abound, but it is clear that the precise wording of any one has failed to capture the terrain in such a way as to be taken as definitive. Even Wurman, in his original conception of the field, left scope for interpretation in his definition of the information architect as "the emerging 21st century professional ... focused upon clarity, human understanding, and the science of the organization of information."[2]

In as much as there is or could be a science of information organization, other disciplines may lay justifiable claim to the territory: library and information scientists who have long dealt with classification and categorization of recorded knowledge; cognitive psychologists who have contributed to our understanding of information use, comprehension, and problem solving; anthropologists and sociologists who analyze cultural constructions of meaning, to name but a few. To this extent, IA is an interdisciplinary field of practice and research, borrowing heavily from these domains.

Dillon offered a broad definition that attempted to accommodate the diversity of approaches by defining IA as "the process of designing, implementing, and evaluating information spaces that are humanly and socially acceptable to their intended stakeholders."[3] This not only aimed at inclusion, but bypassed any reference to IA as a discipline or field of its own, likening it more to human activities such as design or creative writing, which of necessity draw on disciplines to support process and education.

Furthermore, Dillon advocated a view of IA as craft rather than engineering, a distinction based on the lack of separation within IA between the design and the manufacture of the resulting application.[3] As craft, IA creates as it produces, often reacting to emerging elements of its own design to drive subsequent modifications. Craft-based disciplines are less amenable to formal methodological abstraction for management and instructional purposes, which can result in them shifting or being altered radically by outside forces. One problem facing the IA community in its drive to professional status is the need to overcome abstraction and education problems in order to provide the field with the legitimacy accorded to related fields within information science.

Big IA vs. Little IA?

In the absence of formal definition, a line of division has been drawn between two competing views of the field, known generally as the Big IA vs. Little IA perspectives. Big IA is used to describe those who practice or believe in IA as an all-encompassing term for the process of designing and building information resources that are useful, usable, and acceptable. From this perspective IA must cover user experience and even organizational acceptance of the resource. On the other hand, Little IA refers to those who practice or believe that IA is a far more constrained activity that deals with information organization and maintenance, but does not involve itself in analyzing the user response or the graphical design of the information space. Big IA tends to be seen as top-down, conceiving the full product and its human or organizational impact; Little IA is viewed as more bottom-up, addressing the metadata and controlled vocabulary aspects of information organization, without dealing directly with, and certainly never evaluating formally, the user experience of the resulting space.

For present purposes we adopt the view that IA is an umbrella term for the process of designing interactive information spaces, and it is likely then that within its ranks will be advocates of specific styles, and practitioners

focusing on specific architectural issues to the exclusion of others. Reconciling these niche perspectives within a unified field remains the major challenge.

WHAT DO INFORMATION ARCHITECTS DO?

One can gain an appreciation of the process of IA by examining what practitioners actually do. An incomplete list would include:

- Illustrating key concepts or steps through graphics.
- Designing site maps.
- Creating metaphors to brand content and promote navigation.
- Developing style and formatting templates for elements of information.
- Conducting user analyses.
- Creating scenarios and storyboards.
- Building taxonomies and indices.
- Testing user experience.

Engineering approaches to the building of the IA include: programming and database design, content and source code management, functional evaluation (including usability testing), as well as final information deployment and versioning.

The breadth of these IA activities suggests that most information architects perform only a few of these tasks, owing to either skill limitations or the constraints of the IA project. Generally, IA tasks revolve around four major areas of effort. The first involves understanding the information as content and shaping its organization and access; the second includes building the abstract associations between units of content; the third focuses on developing browsing and searching functionality; and the fourth is designing the graphics, interfaces, and interaction techniques to allow users to access the body of information.

Creating Content Organization Systems

A content inventory involves identifying, collecting, and cataloging the project's content to establish the scope of materials involved, often requiring a meeting with all of the project stakeholders and initially planning out the other IA tasks. An initial information taxonomy (sometimes called a hierarchy) is also prepared by sorting the information into common, subjectively derived sets such as alphabetical, chronological, geographical, or topical among others. Derived from this taxonomy, a set of term names or labels is established to provide naming consistency when both organizing the information and describing or representing the topics. Classifying content types and formats to provide the basis for presentation (markup) standards is also important to keep the content organized and presented consistently throughout the project, and for user consumption.

Creating Semantic Organization Systems

A semantic (logical and associative) organization of the information is created to represent the complex, objectively derived relationships that can be further understood after the project's content has been inventoried. This process may involve coding a set of data with a set of overlapping or multifaceted conceptual organizational schemes, such as those required for browsing, searching, learning a concept embedded in the information, or performing a task based on the information. In many cases, this conceptual organization has been mapped out in a content inventory, but no additional data have been added to express the more complex, often multifaceted, relationships in the information. This semantic organization would be used when accessing information via a search function and could be used to suggest alternate searches or different types of search results. These relationships are coded with metadata (information about the content such as creation date, author, location, intended use, or language) by using schemas (specific types of formal, descriptive specifications to convey syntax and structure) that can be used by machines, authors, and sometimes users to promote access for each type of information. Popular metadata schemas include the Dublin Core Metadata Initiative, which utilizes the Resource Description Framework syntax for representing this metadata in the Web.[4,5]

Other conceptual IAs needed include thesauri (synonyms, antonyms as words or phrases) and indices (terms and phrases with links to their location in the information space), which provide users with paths for browsing through information or an array of possible keywords to be found while searching the information space. These thesauri and indices are populated by controlled vocabularies (subject domain-specific sets of terms—e.g., medical) and synonym rings (groups of words not strictly equivalent) that provide a (potentially comprehensive) variety of language to enable users to locate sought-after information.[1]

Creating Navigation Systems

The user's view of an information space is influenced significantly by the navigation systems that provide points of access to associated information via any interaction method from simple Web links to more

complex animations, dynamic lists, or software application-like functional menus. Navigation can be globally and locally based, each form with specific functions. Global navigation systems serve to keep a user oriented in the information space and provide easy access to all of the main sections or functions of an information space. Typical global navigation aides could be site maps (sometimes called blueprints or flow charts when initially designed) that display graphically how the information is organized. Other textually based navigation methods can include site indices that appear as keyword organized lists (with links). More recently, customized, application-driven dynamic systems, such as intranet portals are used as global navigational hubs, which are especially useful for dynamically changing information. Local navigation systems focus on only a small subset of the total information, arranged around a specific topic or task such as an e-commerce checkout, or feature tutorial, or guide. Other local navigation may simply be a set of links embedded in content to supply supplementary information or to aid in scrolling or zooming through large units of information or graphics.

In some cases, a combination of global and local navigation systems are specifically designed to support the hierarchical or semantic relationships of the information, giving users the ability to ''drill down'' or quickly subdivide all of the possible information into a small, more viewable set. One example of this is faceted browsing where users can rapidly navigate to a subset of information by choosing links or specifying search terms in succession to find the closest fit for their information requirement.[6] There is a significant body of research literature on user navigation of digital spaces that informs IA practice.[7,8]

Creating Interaction Designs

The visual appearance, or interface to the information, is also often a responsibility for the information architect to create or advise on during development. Initially, simple wire frames (sketches and mockups of common information layouts) (see Fig. 1) are designed to show how content will be displayed including text flow, locations of menus, sizes of buttons, and other common features of the web page or information display. These wire frames are then adapted to more specific templates that are tailored to the required displays, applications, and platforms that the information will be accessed from. The templates give a baseline for populating individual pages or documents of content into a few standard layouts and organization schemes, often each representing the variety of semantic and content-related units of information defined earlier in the IA process. Style sheets are also developed to consistently control the actual text and graphical layout of the content for each type of display or task, including fonts, lists, tables, and text flow (borders, indentation, column widths, etc.) among others. The styles can also be set to describe image sizing, text colors, and basic link behavior.

Basic interfaces may also be designed by the information architect, including prototypes that may include dynamic pull-down menus, scrolling timelines, and interactive search interfaces. It is also possible to quickly build and test application-like functionality, such as item selection or interactive survey forms that can be mocked-up using lightweight scripting languages such as JavaScript or visual interaction toolkits including Flash or ActiveX technology. By focusing on the interface as part of the overall IA, the context of the information can be kept conceptually in synchronization with the purpose of the information content, setting up the IA as a critical participant in the progressively complex development of applications or features that require heavy programming to interact with or utilize the core information of a project. Progressive, Big IA involvement in the application development process may also include focusing on the specific IA of database design, such as the types and labels used to collect and display information with users, as well as the fine-grained selection of specific vocabulary and icons to describe application functionality and enable the navigation and use of software more usable and consistent for users. Again, there is a significant body of literature on interaction design from the field of human computer interaction (HCI) that can be employed within IA to guide this process.[9]

Information Architecture as Process

It is worth noting that even while we can isolate categories of activities generally conducted under the heading of IA, the term itself can be used to describe the whole process of information systems creation. In other words, IA refers to the complete process of design with specific methodologies for managing the deployment of resources and sequencing of deliverables. There are two main approaches to architecting information spaces, which can be grossly characterized as ''top-down'' and ''bottom-up.'' Each method is more suited to certain situations and applications.

Top-down designs rely on process-driven stages which are often thought to follow sequentially, as with the classic ''waterfall'' approach of software engineering. The process allows for formalized tracking of deliverables and progress. Often a central design

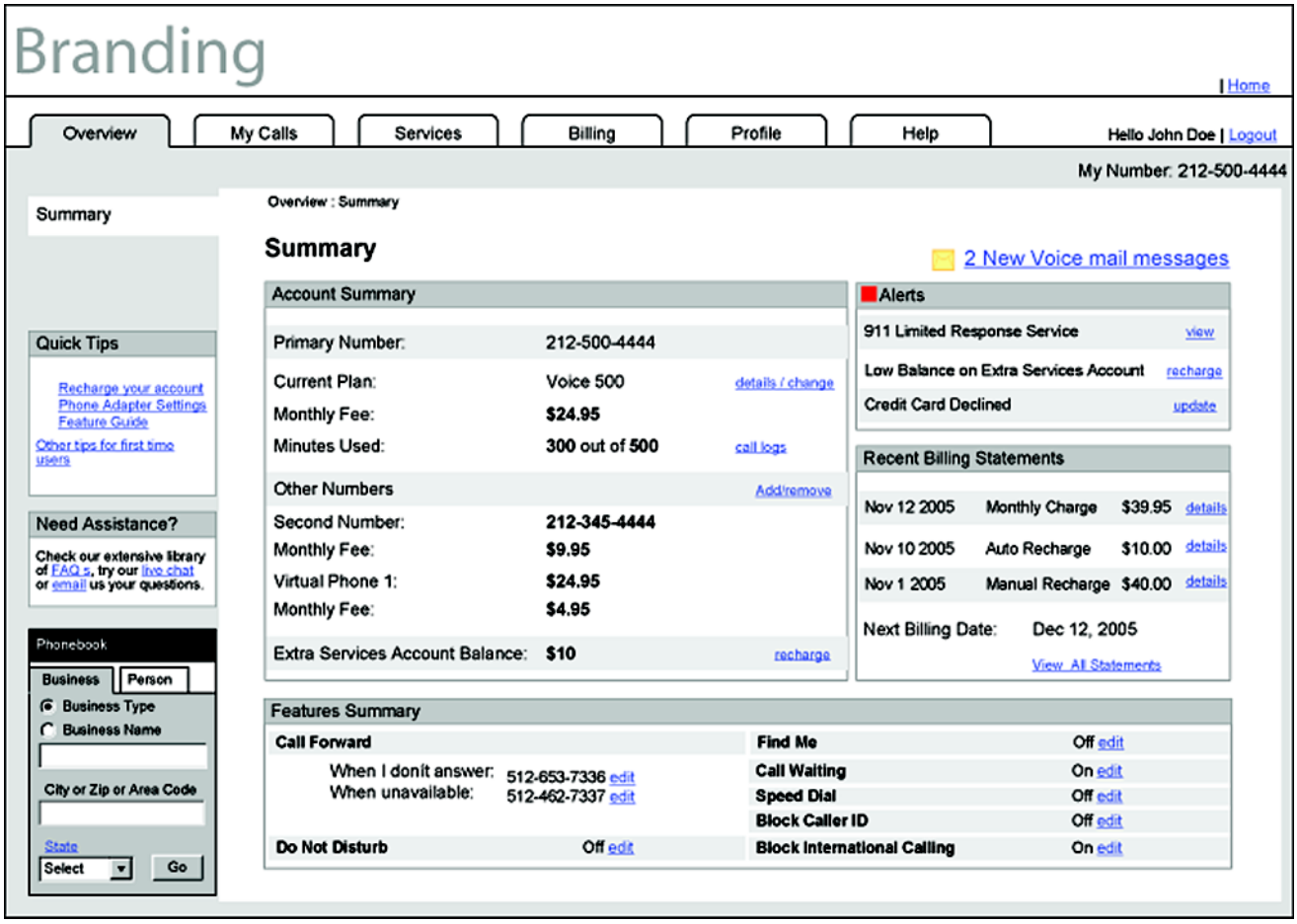

Fig. 1 A typical wire frame outlining the basic layout of navigation and design essentials. *(View this art in color at www.dekker.com.)*

specification is used as the reference point for all involved, and is continually updated to serve as a progress report and checklist. Such a methodology is often deemed advantageous for managers seeking to ensure process completion and budgetary controls, particularly where many participants are involved. Within this process, it is more typical to see the practice of IA structured around the specialized activities outlined above.

Bottom-up methodologies focus more on the end product of the design and engage in a series of iterative design proposals, each of which can be refined over time to meet known or emerging targets. This approach may be more suitable for smaller-scale projects with fewer team members. Bottom-up IA methods take more from software engineering than product design—as more web sites include application functionality, these bottom-up, prototype-driven methods are becoming more applicable to IA processes. Within this process, the practice of IA blends more seamlessly with related aspects of design such as user experience testing, scenario development, and interface design, leading to a sense of IA as the complete set of activities involved in creating a final product.

It should be noted that few design processes slavishly follow one or the other approach, and may blend parts of each according to resources, available time, competing demands, and skills of the participants. However, as IA becomes seen as a larger term for the overall process, we can anticipate greater management skill sets being required of practitioners, and fewer jobs for those with only one specific niche role.

Research Issues in IA

Pure research in IA is rare, the field borrowing more from outside as needed than tackling research questions directly. However, as the process of IA has become structured and recognized, dedicated research for IA is beginning to take form, driven largely by practitioners seeking answers to design questions.

The major theme in IA research is the study of navigation and how people find what they are looking for

in an information space. From concerns with labeling and menu structures to the development of models of navigation behavior there are now significant research publications dealing with topics of direct relevance to IA.[10,11] True, most of this work is still borrowed from outside, but this is subject to change as more academic researchers become involved in the field.

There is also significant work that extends examinations of navigation into areas such as the perception of information shape or the emergence of web genres and their exploitation for design.[7,12] This research aims to uncover the interaction between various structural forms of information space and the user, employing a socio-cognitive based analytical approach to explaining and predicting use.

Another central theme for IA research is search behavior and the underlying design of efficient search mechanisms. Again, this research not only draws on the history of such work for information retrieval but also contains new contributions dealing with faceted metadata and image databases.[13–15]

Indeed, it is difficult to bound work exclusively as the province of IA because concerns with organization of information and user search and navigation of information spaces have such a long history. It is likely that for the foreseeable future, IA will remain a net borrower of intellectual research from other disciplines until such time as dedicated venues for IA research publications emerge. That said, the need to understand how best to design and implement IAs will remain an important driver of research work.

APPLICATION OF IA

As with any information technology-related discipline, the domain of IA is heavily influenced by the technologies that create content and permit access. In most cases, a Web browser is the primary application and interface for accessing IAs, but differences in types of users, tasks, and information content can shape IA efforts in a myriad of ways.

World Wide Web

The advent of the graphical Web browser and the near ubiquity of http (Hypertext Transfer Protocol) Web servers have fueled the growth of web page development from basic home pages to complex ecommerce sites.[16] The majority of the Web consists of these common types of Web information, which share the common properties of providing links to other Web resources and are searchable via standard Web search engines.

Information architects designing these most common, now almost prosaic, sites can fit their work into certain known genres of web sites such as news, e-commerce, entertainment, and corporate. However, not all IA is focused on these general web sites. In fact other, more user-specific domains are the areas where IA is only beginning to make an impact. In most cases, these more focused web sites use the Internet as a backbone of access, but often provide functionality beyond the typical Web browsing and information access paradigms. Each additional type of IA has its own specific set of users, use cases, and access environments.

Intranets

The use of Web standard technologies to help an organization communicate and work together has steadily increased with information technology developments. Leveraging the ubiquity and ease of use in web site design and use, organizations are primarily turning to using web sites both internally and externally to achieve business goals. Standard IAs on a corporate intranet would include company directories, policy guidelines, procedural information, and document workflow access. More recently, increased use of application-level technology has transformed the organizational intranet into a knowledge management tool with repositories of institutional knowledge being created and accessed on-line. The design of these information systems is becoming the responsibility of information architects, often under the aegis of the management information system efforts. Portals (placeholders for new information to flow into them), often from corporate databases or external information feeds, are commonplace. The challenges of designing access methods and organizational schemes to deal with dynamically changing information are not unique to intranet applications, but lately have been the primary focus of intranet and portal IAs.

Interestingly, the advent of user-driven IAs as seen in the use of webblogs (blogs) and wikis (two technology platforms that enable easy, rapid Web content development and organization) to facilitate communication among a group of similar users (or those with similar interests) may place new responsibilities on information architects as coordinators and meta-designers for these ad hoc, dynamic elements of information. The development of information taxonomies for this dynamically created information through the use of soundly designed templates may prove to increase the reach of finely architected information beyond those that IAs must explicitly manage and create themselves.

Vertical Markets

Some IAs are focused on specific industries or vertical markets. These areas can include government, healthcare, manufacturing, education, retail, and finance—each with their own characteristics for content, organization, and intended use. All of these markets require the organization of information assets and design of interaction interfaces that traditionally were developed within organizations. However, as the varieties of information access and functionality among these applications increase, so do the complexities of the information organization and user interfaces that are possible. Because of this, information architects are becoming progressively involved in these vertical application development efforts to both design and implement specific architectures to support users as well as grow organically as functionality increases.

In some cases, vertical IAs may primarily be carefully organized, task-based interfaces to databases or traditional end-user applications accessed via a Web browser and tailored to each industry, purpose, and activity. The most common example may be retail (e-commerce) applications within commercial Web sites such as shopping carts, merchandise hierarchies for browsing, and specific term creation to support searching. Also included are financial management interfaces to view and select stock market information, as well as track news related to certain stocks or economic issues. For other vertical markets, IA may be crafted to provide a directory of support information and promote discussion among members in specially organized forums. Each of these domains requires a unique set of information organization, understanding of user needs, and a facility with current application technology. The size of any of these vertical markets is such that information architects can build on specialized knowledge and experience to work successfully and persistently in these fields.

Digital Libraries

The volume and variety of information now digitally accessible in libraries of all kinds have led to significant growth in search engines, primarily because of the lack of structured access methods to get to the bulk of information being produced and provided in digital form. In some ways, any repository of digital information can be thought of as a library of sorts, and requires a set of organizational schemas and interfaces to provide access for users. However, even traditional libraries and information providers are seeing a massive shift by users to on-line, often Web browser-accessible, repositories. Projects as large as the Internet Archive and search engines such as Google are the primary ways users are accessing information.[17] In most cases, this information is loosely organized, if at all, and users are in need of structures and paths through the volumes of information they are accessing.

Standards for organizing digital libraries are in place including initiatives from both the public and the private sectors, and mostly concern the overall organization of the information along traditional dimensions, such as the consideration of digital information as an object for cataloging, preserving, and archiving. Information architecture in digital libraries will grow beyond this traditional organization, but still benefit from the approaches to collection and management, possibly to the extent that digital librarianship may be thought of as IA. The growth of multimedia information also pushes digital library research and development toward practicing IA to provide a set of best practices methods for displaying and organizing video and audio. Additional digital library responsibilities may involve the creation of collection-specific metadata as well as understanding ownership and copyright in a digital age.

Semantic Web

Information architecture may be the first profession that focuses on what many call the Semantic Web of information. Semantic Web spaces represent deeper, more meaningful relationships among discrete units of information that have ''well-defined meaning, better enabling computers, and people to work in cooperation,'' often according to user-driven tasks or taxonomies.[18] Semantic Web information is, in some proposed cases, semantically structured IAs that will be acted on automatically by groups of software agents empowered to act on behalf of individual users or organizations.[18] In this case, IA will include a more complex analysis of the information elements themselves, with a perhaps less overt focus on the interfaces for interacting with the information. As Semantic Web applications emerge, programmatic interaction will be more commonplace, which increases the importance of highly structured units of information with rich, descriptive metadata that will control its display and use.

THE FUTURE OF INFORMATION ARCHITECTURE

Information architecture seems assured of a long future, even if the term itself ceases to gain formal agreement. A world of digital information will always need people to architect spaces for sharing, collecting,

and organizing documents and resources. The current understanding of IA as a discipline is likely to evolve as the profession grows and formal education takes shape.

Technical and theoretical advances are likely to yield new opportunities for tailoring information for personal use. The dynamic structuring of information in response to user activity is likely to offer increasing challenges for research to understand how people construct meaning and navigate through fluid information environments. Current discussions talk of a movement toward design ''beyond the page,'' where the structures of the paper world are no longer applied to new information spaces. Under these circumstances we will likely witness the emergence of new information genres that cannot easily (or ever) be instantiated in anything other than digital form.

On the practical side, IA is likely to develop a set of roles that will offer an identity to the profession that is shared by more than the rather limited number of people with that job title currently. For this to occur, it is likely that a more formal educational path will need to emerge for this profession. Information architecture is not unique in this regard. There are many parallel roles within the information design community that are constantly being named and recruited, even if formal educational qualifications for them have yet to emerge (e.g., user experience designer, interaction designer, digital librarian, etc.). The term IA appropriately covers this terrain and we should not expect rapid formalism of credential or educational path to emerge. However, the trend to date indicates that IA has made impressive progress down the path to recognizable status as a professional role and this is likely to continue in the near future.

CONCLUSIONS

Information architecture has grown steadily and securely from a hot topic term to a credible application and research area within the library and information science disciplines, though formal definition of its meaning and boundaries is yet to be agreed. A growing group of professionals now use the term to describe their work, formal degree programs have emerged, and the annual ASIST Summit has established itself as the core venue for sharing ideas and findings among this community.

Core competencies in IA include the semantic organization of information, the creation of navigation systems and the design of user interfaces, with any individual professional tending to have greater interest or strengths in one or other of these areas. These skills are applied to the design of websites, intranets, and digital libraries in multiple environments and markets.

As research into user search behavior, navigation, content management, information structures continues, it provides IA with a growing body of findings on which to create a more formal knowledge base, though the categorization of IA as a craft discipline that extends beyond the LIS world is likely to remain.

REFERENCES

1. Rosenfield, L.; Peter, M. *Information Architecture for the World Wide Web: Designing Large-Scale Web Sites*; O'Reilly & Associates, Inc.: Sebastopol, CA, 2002.
2. Wurman, R.S., Bradford, P., Eds.; *Information Architects*; Graphis Press: Zurich, Switzerland, 1996.
3. Dillon, A. Information architecture in JASIST? J. Am. Soc. Inf. Sci. Technol. **2002**, *53* (10), 821–823.
4. Weibel, S.L. The Dublin Core: a simple content description model for electronic resources. Bull. Am. Soc. Inf. Sci. Technol. **1997**, *24* (1).
5. Beckett, D.; McBride, B., Eds.; RDF/XML Syntax Specification (Revised): W3C Recommendation 10 February 2004. World Wide Web Consortium, Cambridge, MA., http://www.w3.org/TR/2004/REC-rdf-syntax-grammar-20040210/ (accessed Mar 29 2005).
6. Instone, K. Fun with faceted browsing. American Society of Information Science and Technology Information Architecture Summit, Austin, TX, Feb 28, 2004.
7. Dillon, A. Spatial semantics: how users derive shape from information spaces. J. Am. Soc. Inf. Sci. **2000**, *51* (6), 521–528.
8. Nielsen, J. *Designing Web Usability*; New Riders: Indianapolis, 2000.
9. Helander, M.; Landauer, T.; Prabhu, P.V. *Handbook of Human Computer Interaction*; North-Holland: Amsterdam, 1997.
10. Jacko, J.A.; Slavendy, G. Hierarchical menu design: breadth, depth and task complexity. Percept. Motor Skills **1996**, *82*, 1187–1201.
11. Pirolli, P.L.; Fu, W. SNIF-ACT: a model of information foraging on the World Wide Web. 9th International Conference on User Modeling, Johnstown, PA, Jun 22–26, 2003.
12. Kwasnik, B.; Crowston, K. A framework for creating a faceted classification for genres. Hawaii International Conference on Systems Science (HICSS 04), Los Alamitos, CA, Jan 2004.

13. Bates, M.J. The design of browsing and berry-picking techniques for the on-line search interface. Online Rev. **1989**, *13*, 407–424.
14. Yee, K.; Swearingen, K.; Li, K.; Hearst, M. Faceted metadata for image search and browsing. Proceedings of CHI'03, Annual Conference of the ACM SIGCHI, New York, Apr 2003; ACM Press: New York, 401–408.
15. Wildemuth, B.; Marchionini, G.; Yang, M.; Geisler, G.; Wilkens, T.; Hughes, A.; Gruss, R. How fast is too fast? Evaluating fast forward surrogates for digital video. ACM/IEEE Joint Conference on Digital Libraries, Los Alamitos, CA, Jun 2003; 221–230.
16. Berners-Lee, T. The World-Wide Web. Commun. ACM **1994**, *37* (8), 76–82.
17. Lyman, P.; Kahle, B. Archiving digital cultural artifacts: organizing an agenda for action. D-Lib Mag. **1998**, *4* (7); http://www.dlib.org/dlib/july98/07lyman.html (Apr 5, 2005).
18. Berners-Lee, T.; Hendler, J.; Lassila, O. The Semantic Web. Sci. Am. **2001**, *284* (5), 34–43.