

DELOS/NSF Working Group on
"Reference Models for Digital Libraries: Actors and Roles"

Final Report
(23 July 2003)

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1. Introduction

This report summarizes the discussion of the DELOS/NSF Working Group on "Reference Models for Digital Libraries: Actors and Roles".

In the Digital Library arena, neither the traditional nor the new roles of actors are clearly understood. Identification and relevance of these roles are still open questions. Conceptualizations and definitions are biased by traditional views that are not automatically transferable to the digital world, nor are they appropriate for some new emerging environments. At the same time, definitions given to new roles depend too often on the narrow, subjective perspective of a local context. The current situation makes it difficult to understand objectively the key actor/role issues that arise in individual cases, and also to perform comparative analysis between different cases.

The lack of a means of formal expression becomes apparent in several scenarios, such as when Digital Library use case descriptions are disseminated to large audiences, shared with evaluators or potential adopters, or compared by researchers. Without sufficient means to formally express the attributes and behaviors of a network of actors related by specific services there will continue to be misunderstanding with regard to actors in terms of stating problem requirements, designing solutions, and evaluating results.

This Working Group reviewed current research and existing practice to better understand the ways in which actors and their roles are perceived within the Digital Library community; how actors interact and communicate within the scope of existing and potential Digital Library models; and the roles that actors play in the context of existing and anticipated services. The result of this investigation brought to light several issues that warrant further research and underscored the community's need for formal and objective reference models for the description of actors and their roles in digital libraries.

This report is structured in four major sections. Section two presents, in brief, references to related work (almost all of these references are, intentionally, for on-line resources). The third section describes the process and tools used and developed by the Working Group to support discussion of the issues. Section four includes several examples that illustrate the use of the tools. The fifth, and final section of the report, provides a summary of findings and a set of recommendations.

2. Related work

The identification and definition of actors and the roles they play have long been an open issue in traditional libraries, archives and museums, as described for example, in [2], [4], [5], [7], [15], [16], [17], [18], [22], [23], [25], [26], [27], [34], [35], [36] and [41].

Recent works have addressed this problem in depth, as can be seen in [6], [21], [24], [30], [31] and [42]. The problem also crops up in recent research and development as reported in [8], [9], [14], [19], [20], [37], [38] and [40]. In some cases the problem has been addressed with notable scope, such as in [1].

At the same time, it is curious to find so little mention of actors and roles in specific contexts where the issue would have a natural fit, such as [10], [11], [13], [32] and [43]. We believe that their absence is due not so much to denial of the issue as to its complexity and the fact that most Digital Library projects begin with content specifications and underlying infrastructure issues designed to address *how* the service will be provided. This system-centric approach does not take into adequate consideration the communication and interaction channels that link different types of actors within the context of a service. Nor does it explore or seek to understand in detail how different perspectives and behaviors affect those interactions, and ultimately the ability to deliver a meaningful service.

3. The process

To illustrate the discussion, we used a simple model and an analysis tool. The purpose of their use was intended *not* as a reference model in itself, but to provide a means through which to present the issues, using a format that proved beneficial to our discussions.

In addition, we agreed to use the following definitions.

- A *service* is an intangible benefit rendered by one entity to another entity. Information delivery is an example of a service.
- An *information system* is a set of services that supports electronic access to and discovery within an information base. A Digital Library is an example of an information system.
- A *Digital Library* is an information system for which the information base represents a collection of objects (digital, physical, or abstract objects), mainly used for learning and research [11].
- An *actor* in a Digital Library is a person, organization, or automaton playing a *role* in the production, dissemination, management or use of digital information.

Digital Libraries have much in common with more general information systems that support such things as commerce and entertainment; as far as actors and roles are concerned, much of what applies to digital libraries also applies to online bookstores and indeed to the Web itself.

In this context, it is important to note that an Actor is an entity defined as much by its identity as by the role it plays during a specific act. It is possible for an entity to change roles from moment to moment; for example, frequently, producers of information are also consumers of information. This means that an entity can play multiple roles, in other words, that one entity can represent many Actors.

3.1 Main players in Digital Libraries: A simple model

As a starting point, we propose a generalized model consisting of three main classes of actors that may appear in any kind of a Digital Library scenario. A generic, referential use case depicting these classes of actors and their interactions with a Digital Library is presented in [Figure 1](#) [39].

In this scenario, a Digital Library is seen as an information system offering a set of services ("Digital Library Services"), managed by **Professionals**, conceived for the benefit of **Users**, and possibly related to external suppliers of information or services, referred to as **Agents**.

Any instantiation of these major classes of actors can be an individual, a group, an organization, or any kind of a relevant entity acting in the use case under study (for example, automata might be actors, if that makes sense for the case). In some instantiations of the use case, each generic class can also be specialized in more than one specific sub-class (for example, two examples of Agent might be Author and Editor, while three examples of Professional might be Computer Engineer, Cataloguer, and Reference Librarian).

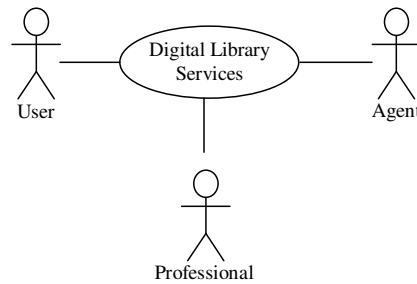


Figure 1: The generic use case of a Digital Library and its main actors.

In this User-Agent-Professional model, each class of actor represents, therefore, a particular generic role. They act with regard to Digital Library services, but also interact indirectly with the other actor classes:

- A **User** is any kind of actor that interacts with the Digital Library's services in order to consult and process information made available by the library. Examples of Users can be scholars or researchers in a university library, citizens in a public library, employees in a corporate library, etc. They can be, for example, anonymous or registered, or even non-human. However, the role of User is not necessarily restricted to consumption of Digital Library content. Users can also provide useful information to enrich the services (for example, by submitting direct feedback or service change requests), as well as the digital information itself (for example, by annotating documents retrieved). In more sophisticated scenarios, Users also interact with one another (via particular Digital Library services) in order to share digital documents retrieved from the library. They may also interact with Agents (for example, by providing authors with reactions and review comments).
- A **Professional** is an actor with authority and responsibility (direct or indirect) for the roles and missions that are carried out inside a Digital Library. The main missions of Professionals include the set up, maintenance, and evolution of the Digital Library. Professionals are those actors that have the *responsibility* to ask for new solutions and approaches, the *power* to make decisions, and the *liability* for the impacts of Digital Library's services. Examples of these actors are traditional professionals such as cataloguers, indexers, or reference and IT professionals, as well as managers. Note that roles of some classes of Professionals may be delegated at the lowest level either to other classes of Professionals or to designated Agents.
- An **Agent** is any kind of actor that supplies information or services that may or may not be adapted by the Digital Library. Agents include traditional content providers (such as authors, editors, or publishers) and intermediary actors (such as subscription services). Agents may also play roles in the conception, implementation, maintenance, optimization, improvement, or augmentation of the Digital Library's services. An example of the latter is an external reference service.

It is important to stress that the same physical entity might play several roles within the context of one case. A researcher, for instance, has a User role when he/she searches in a Digital Library for literature on his/her field, and has an Agent role when he/she contributes a paper to a journal that is archived by a deposit library.

3.2 Use cases and Relation Boards: An analysis tool

Designers of Digital Libraries usually see them as a set of services that provide particular functionalities. The main drawback of this system-centric perspective is that it takes a too narrow the view of the problem by focusing primarily on technical issues, such as functionality, interoperability, and search and retrieval issues.

This system-centric perception of the Digital Library doesn't give enough weight to the communication and interaction channels between different types of actors, or to their particular views. Users, Agents, and Professionals usually differ in their perceptions of the system and, as a consequence, their vocabulary and expectations also differ. The traditional system-centric perspective is what currently prevails and is the case represented in [Figure 1](#). A different picture emerges, however, when relationships between different classes of actors are emphasized. [Figure 2](#) depicts this new, more actor-oriented perception of a Digital Library. The system is no longer seen as a "black box" where interactions between actors are unclear. It is conceived rather as a network of actors related by specific services.

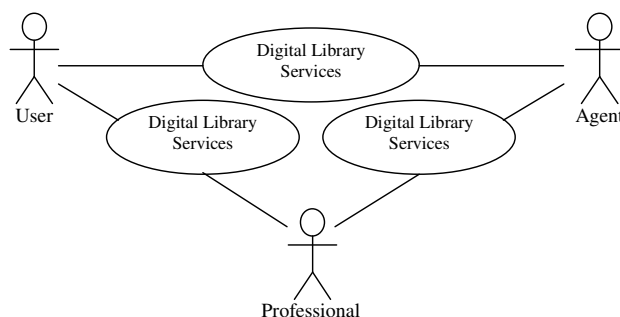


Figure 2: The generic use case of a Digital Library seen as a network of actors.

Given our three generic classes of actors, we can design a 3 by 3 matrix, referred to as the actors **Relations Board**, where each relationship between two different types of actors is marked. [Table 1](#) depicts the situation in [Figure 2](#) as an Actors Relations Board.

is related with	User	Agent	Professional
User		✓ ¹	✓
Agent	✓		✓
Professional	✓	✓	

Table 1: The actors' Relations Board for a generic use case of a Digital Library.

The strength of the Relations Board is that it provides a formal way to specify relations among actors at an abstract level. This simple template for marking relationships easily allows one to highlight the special focus of a Digital Library case. Moreover, when Relations Boards of several cases are matched, it easily correlates with where the main research in the Digital Library field is taking place and reveals (through an absence of marks) potential areas of research.

¹ Read: A User is related with an Agent.

The combination of use case diagrams and Relations Boards provides a method for describing Digital Library projects and scenarios in terms of actor classes and roles in a generic way. It forces one to clearly specify the role of an actor in a particular Digital Library case ("...is that actor an Agent or a Professional?"), to think about how actors are related to services ("...is this actor a supplier or a consumer of information?"), and to identify the communication or interaction channels between different classes of actors that need to be defined in order to provide a meaningful service ("...is this a proactive service, with a push behavior, or a passive service?").

Generic modeling like this can be used to describe actual or future cases. More detailed case diagrams can be developed in which more important details of the case are specified, by labeling relationships or by deriving subclasses of actors. For the purpose of this report, we will use this approach for simple analysis, and as a way of illustrating our discussion in the next section.

4. Scenarios

To illustrate our discussion of the problem, we will use four generic Digital Library scenarios, each one represented by two cases. Each scenario is intended to be related to a generic case, viewed from two different perspectives. This comparative approach is intended to make it easier to identify and point out examples of complementary or divergent issues with regard to actors. In addition, we used these cases as part of our analysis work.

4.1 Scenario 1: Digital Libraries for Science and Technology

The impact of the Web on scholarly and scientific communications is a subject of much interest and controversy. For example, core services provided by traditional journal publishers (registration, validation, certification, dissemination and archiving [29]), are being challenged by new electronic publishing models based on open access and self-archiving [12] [3]. As a result, traditional libraries and publishers (Figure 3) face new dilemmas regarding their actions and roles within an emerging market.

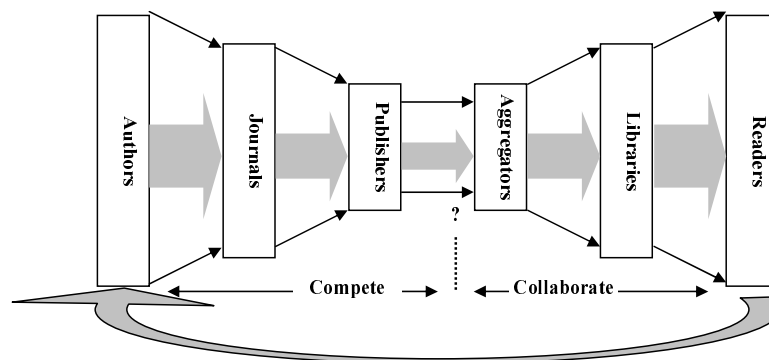


Figure 3: Digital Publishing and the strategic dilemma of the traditional publisher [28].

We detect in this scenario two extreme cases: on one side the traditional commercial publishers and on the other side the new proposals for a future without commercial actors. In spite of all the arguments for or against the new or revised visions and models, it is not clear yet if we are moving towards a completely new world based on reconceived and redesigned models, or towards a hybrid world that maintains traditional models alongside new solutions.

4.1.1 Case 1.1 - A traditional case

In a traditional case, as described in Table 2, Users and Agents see the Professionals as important actors playing important roles. Professionals act as mediators, collecting proposals and requests from Users, who act as consumers (U:P), and they also interact with Agents (P:A, A:P), which are represented by publishers and aggregators (A:A). Additionally, Professionals in this case can provide services such as selective dissemination of information to Users (P:U).

is related with	User	Agent	Professional
User			✓
Agent		✓	✓
Professional	✓	✓	

Table 2: Relations in *the traditional case* of the Digital Libraries for Science and Technology.

4.1.2 Case 1.2 - A possible emerging case

In an opposing case, as described in Table 3, Users and Agents don't see their relations with the Professionals as relevant. Professionals are still key actors in the scenario, but the roles are now played by a much larger and more diverse set of entities. This case gives new priority to community building, promoting more direct relations between Users and Users (U:U, so the Users are no longer only consumers), and between Users and Agents (U:A). With this shift in emphasis, Professionals are now occupied with the major new task of community building (P:U, P:A), and the new roles that accompany it. The most important class of Agents is now authors (or more generically speaking, the producer).

is related with	User	Agent	Professional
User	✓	✓	
Agent			
Professional	✓	✓	

Table 3: Relations in *a possible emerging case* of the Digital Libraries for Science and Technology.

4.1.3 Comparative analysis

Will either of these models prevail in future? If both will coexist, what overlap or divergence will be relevant? Substantial analysis and descriptive work focused on the multiple roles of the multiple entities involved in the processes have already been done. The results have been promoted, however, primarily from the biased perspectives of each of the extremes. Each side has been more focused on defending its own position than on identifying and promoting mutual recognition and convergence. These problems could be minimized if actors and roles were analyzed and described in more formal and objective ways, making it easier for everyone to see with more clarity the important issues that will impact the future.

From this use case analysis, we draw two observations:

- Approaches to publishing and digital rights management should take into account the possible multiple roles of Users and different motivations of authors.
- Emerging models are bringing new challenges to Professionals, who will have to adapt their processes to the new roles of Agents and Users.

4.2 Scenario 2: Discovery services based on harvesting

Since the early days of the Web, discussion has taken place about the pros and cons of Web indexes built automatically by search engines as an alternative to traditional human-built databases. Search engines are very effective in indexing the Web at a superficial level, but they miss the richest content hidden behind the more complex Web sites and databases, the so-called "deep Web". On the other hand, the relatively low cost of these engines have been making it possible to provide good services without the costs of manual cataloguing, classification, and indexing of resources. These two scenarios are both depicted by the same Relations Board in [Table 4](#).

is related with	User	Agent	Professional
User			
Agent			✓
Professional	✓	✓	

Table 4: Relations in a resource discovery service based on harvesting *structured metadata* and *unstructured data*.

4.2.1 Case 2.1 - Harvesting structured metadata

This case represents a discovery service based on harvesting structured metadata. Participants in a service of this kind form a closed and defined environment where contractual and technical requirements are agreed upon by Agents (as content providers) and Professionals (as service providers). In this case, content providers agree to have metadata harvested through a contract with a service provider (A:P). In turn, the service provider might index or re-use the metadata in specialized databases according to the terms and conditions of the contract (P:A). As described, Users don't play a direct role in the aggregation of metadata; they do however, interact with the Professional and affect/influence the kind of value-added services to be created (P:U).

4.2.2 Case 2.2 - Harvesting unstructured data

This case represents a discovery service based on harvesting distributed and unstructured data. The content providers are Agents who are not necessarily aware that their resources are being harvested. By and large, an implicit agreement to be harvested can exist even if no communication between content providers and data harvesters has taken place. However, even in these cases content providers and data harvesters may also enter into specific agreements (A:P), regarding the harvesting of the resources, possibly with expressed conditions [44][45]. In this scenario, the Professional defines some type of harvesting policy based on what it might know about the Agents (P:A), which, at a minimum, would include a specification of the domains to be harvested. Finally, all of this is done taking into consideration the service to be provided to the Users (P:U).

4.2.3 Comparative analysis

Interestingly, the Relations Board for both scenarios looks the same, although the actual scenarios possess significant differences. This situation illustrates that understanding the underlying differences of the service will be of great importance when expressing the cases for actors, their roles, and interactions within the Digital Library service. We therefore believe that further exploration may reveal formalized ways of analyzing the scenarios with greater granularity. On the other hand, it may be of great significance to understand and appreciate the fact that quite different cases may have the same underlying conceptual model at a high level of abstraction, which would indicate with a high probability that they belong to the same global scenario.

From this use case analysis, we draw four observations:

- Reference models should explore and comprehend formalized ways of analyzing the cases with multiple levels of granularity.
- Practical examples of the two cases might show the potential of using both structured metadata and unstructured data for resource discovery services. However, this generic scenario could be much more interesting if both approaches could be used complementarily. This is possible in controlled systems, but not easy in open environments such as the generic Web, where trust and authentication are major problems. In that sense, it would be important to promote research in the development of models and frameworks for the analysis, identification, description, registration and authentication of trusted Agents, especially when these are authors, publishers, or generic content providers..
- The previous observation brings to light another important issue, which is the design and development of open services for the registration and identification of Agents [46], versus the development of closed or limited services [47].
- The development of customized services and user interfaces is a complex issue in any kind of service, and resource discovery is not an exception. This is relevant for traditional cases, but it might become even more important for emerging cases where, for example, structured metadata and unstructured data are used complementarily. The field would be served by having better formal knowledge about classes of Agents (producers in this scenario) and Users (consumers and potential producers in this scenario). This might in itself be an important research issue with potential to benefit the comparison of different relations and business models, and consequently to benefit the development of generic tools and systems.

4.3 Scenario 3: Libraries for Preservation

Nowadays anyone who can maintain a Web site can be an author and his/her own publisher. The easy availability and dynamic nature of Web-based content brings with it new dimensions to the problems of preservation of information held in digital form. New legal issues are now encountered alongside complex technical problems, making this one of the most challenging scenarios in digital libraries. For this scenario we conceived two use cases that share the same relations board, as presented in Table 5.

is related with	User	Agent	Professional
User			
Agent			✓
Professional		✓	✓

Table 5: Relations in the case of a library for preservation.

4.3.1 Case 3.1 - A conventional library collection

In a traditional deposit library, Professionals define and apply a deposit policy. Typically, this requires direct contact with Agents (P:A) whose main roles are publisher, author, or the equivalent. Professionals in this scenario are heterogeneous classes of staff (P:P), who select, provide metadata, and provide access according to collection development policies and legal frameworks. Collection development tends to be highly selective, with most (A:P) and (P:A) interactions deliberately undertaken. Both physical and digital objects are in the collection. Metadata is currently human-assigned and of high quality, but is expected to become automatically assigned as standards for metadata mature.

4.3.2 Case 3.2 - An archive based on generic Web harvesting

The following example illustrates the case of harvesting online content with the development of an archive as the goal. As in the previous scenario, this Digital Library has a collection development policy. The difference is that in this scenario, that policy is realized by automated harvesting processes. Professionals build purely digital collections using specific policies (P:A) that tend to be highly inclusive, with mostly passive interactions between Agents and Professionals (A:P). For example, Agents occasionally contact Professionals to request that content be withdrawn and/or excluded from harvesting activities in the future (A:P). De-accessioning is mainly Agent-driven and is unlikely to result from technical constraints (an optimistic view, based on current bandwidth, CPU power and disk storage cost trends). Metadata is currently automatically assigned and of poor quality, but is expected to become richer as standards and automatic metadata generators mature. Due to the highly complex nature of the content, Professionals have to play new key roles, especially in the technical area (P:P).

4.3.3 Comparative analysis

From this use case analysis, we draw these observations:

- The preservation of digital materials represents new challenges and requires new models, including those that encompass new roles for actors. These new roles may in fact introduce new subclasses of Professional actors in Digital Libraries, but also a potential opportunity for new subclasses of Agents. A better identification of Agents can be an important element for trust and decision making when collection building in an environment that supports exclusion requests. This implies that serious analysis of these cases must address not only a technical perspective, but also take into consideration other sensitive issues such as liabilities, scopes of responsibility, legal frameworks, etc.
- An important strategy for digital preservation might be replication, which would call for a better understanding and definition of inter-Professional relations that have to do with the sharing of knowledge and trust. That requires conceiving new roles for Professionals and, again, addressing issues such as liabilities, scopes of responsibility, and legal frameworks.

4.4 Scenario 4: Collaborative Digital Libraries

A collaborative Digital Library is a user-centered system. In addition to the traditional purpose of providing resource discovery and access services, the system is also conceived of as providing specialized User-oriented services that range from basic alerting and selective dissemination services to provision of complex, virtual community workspaces. This Digital Library scenario establishes a unique workspace for each particular community, supporting not only search and access but also process and work-flow management, information exchange, and distributed work group communications. In this scenario we consider separately the cases of the open community and the closed community.

4.4.1 Case 4.1 - A Digital Library for a closed community

One possible case of a collaborative Digital Library can be the system for a closed community, as described in Table 6. User participation is restricted to a specific set of identified members that might be, for example, invited in by a workspace owner. In this sense the workspace is owned by a particular entity that maintains the library, playing a Professional role (P:U), but who might be seen by the community also as a User (U:U). Also, entities that started by simply providing content, as Agents, can become involved as members of the community (U:A, A:U, P:A, A:P, A:A). Registration and authentication of community members is required, which might happen by invitation or as the result of a request (U:P, A:P, P:U, P:A). The workspace owner has authority to reject information submitted by community members (A:P, P:A).

is related with	User	Agent	Professional
User	✓	✓	✓
Agent	✓	✓	✓
Professional	✓	✓	

Table 6: Relations in the case of a Digital Library for a *closed community*.

4.4.2 Case 4.2 - A Digital Library for an open community

A second possible case of a collaborative Digital Library is one designed for an open community, as described in Table 7, in which the community creates the workspace itself. The registration and authentication of community members is either not required or is initiated and completed by would-be members themselves. Community members can submit information to the workspace and consult it (U:U, U:A, A:U, A:A), and Professionals play "hidden" roles (Professionals still exist, of course, but their roles are so absorbed by other entities that indicating relations among the many roles of Professionals is not especially revealing in this case).

is related with	User	Agent	Professional
User	✓	✓	
Agent	✓	✓	
Professional			

Table 7: Relations in the case of a Digital Library for an *open community*.

4.4.3 Comparative analysis

The main difference between these two cases has to do with the role of the Professional and its presence or absence. Moreover, the Professional might belong to the same community as the Users and the Agents, in contrast to the traditional library case, where Professionals represent a distinctly different class of actors. A further key characteristic of a collaborative system is that it might imply continuously changing roles for the participating entities, and therefore continuously changing patterns of interactions.

From this use case analysis, we can make these observations:

- The changing roles of actors within a Digital Library scenario (in both cases here, community members might be Users and Agents), and the impact of that dynamic on service provision, are issues that should seriously be taken into account for a sophisticated reference model.
- The absence of relevant Professional roles (in contrast to the case in 4.2) implies a challenge to the definition of classes and roles of Users and Agents. This requires a better understanding of Users and Agents in collaborative systems, and possibly a specialized User-Agent model.
- What changes when a Professional becomes a community member? Are we facing requirements for new subclasses and roles of Professionals? What about the exposed or hidden nature of these roles? Community membership is a further issue to be taken into account in the development of a reference model for actors and roles in Digital Libraries.

5. Research issues and conclusions

There is no doubt that the problem space involving actors, their roles, and interactions, is complex. We have some distance to cover to better understand how actors and their roles are perceived within the Digital Library community, how actors interact and communicate within the scope of existing and potential Digital Library models and the roles that actors play in the context of existing and anticipated services. As we reviewed current research and existing practice, several recurring themes emerged.

The first theme might be obvious: most digital libraries operate on models based on non-digital environments. As a result, the perceptions of actors and the roles they play are biased by traditional views, which might not be automatically transferable to the digital world, nor to some emerging environments.

That leads to the second theme: new models are challenging traditional approaches and in many cases result in the redefinition of actor roles, as well as the introduction of new roles that either previously did not exist or were not performed by the same type of entity. Finally, due to the lack of means of formal expression, it is difficult to understand objectively the key actor/role issues that arise in isolated Digital Library cases, or to perform comparative analysis between different cases.

This lack of formalism directly affects the ways in which the Technical Problem Areas identified by the DELOS/NSF Network of Excellence brainstorming report of June 2001 [11] will be addressed. The report states that the "highest-level component of a Digital Library

system is related to the system's usage." It goes on to state that by understanding that usage (i.e., by understanding actors, roles, and relationships), digital libraries will improve their ability to enable optimal User experiences, to support actors in their use of Digital Library services, and ultimately to ensure that the information is delivered or accessed using the most effective means possible.

The process of developing a sophisticated classification of actors and roles can be based on empirical analysis of actors and their relationships in existing Digital Libraries (as in [1] and [27]), or it can be developed from a more theoretical perspective (our User-Agent-Professional model might be a simple example of a starting point). The use of these models has the potential to reveal patterns of interaction among Digital Library actors in both practical and theoretical ways. New analysis of roles and interactions will lead to, among other things, precise definitions of requirements that may be applied broadly in the development of generic techniques and technology, as well as to the promotion of standardization of services, components, and interfaces (which, in turn, promote re-usability and interoperability). The impact of such work affects all areas of digital libraries, from generic, global authentication systems and models of authority control, to personalization and adaptive services and interfaces, and to new models and tools for digital publishing.

On a small scale, the Relations Board and the sample scenarios demonstrate the powerful potential for analysis tools derived from even the simplest descriptive model. Scenario 2, for example, describes a situation in which significantly different service instantiations may have the same underlying conceptual model in terms of actors and their interactions. Therefore, there is a high probability that these services belong to the same global scenario.

Without sufficient means to formally express the attributes and behaviors of a network of actors related by specific services, there will continue to be misunderstanding with regard to actors in terms of stating problem requirements, designing solutions, and evaluating results. This is the most important conclusion that can be drawn from our working group experience.

6. References

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 - [15] EUAN – European Union Archive Network <<http://www.iisg.nl/~euan/>>
 - [16] HKCAN - Hong Kong Chinese Authority (Name) Workgroup <<http://hkcan.ln.edu.hk/>>
 - [17] ICA/CDS – International Council on Archives/ Committee on Descriptive Standards – ISAAR (CPF): International Standard Archival Authority Record for Corporate Bodies, Persons and Families <<http://www.ica.org>>
 - [18] IFLA – Universal Bibliographic Control and International MARC (UBCIM) <<http://www.ifla.org/VI3/ubcim.htm>>
 - [19] IMS Global Learning Consortium Metadata Specification <<http://www.imsglobal.org/metadata/index.cfm>>
 - [20] INDECS – INteroperability of Data in E-Commerce Systems <<http://www.indecs.org/>>
 - [21] InterParty - a framework for the unique identification of parties in e-commerce <<http://www.editeur.org/interparty.html>>
 - [22] LC Authorities <<http://authorities.loc.gov/>>
 - [23] LC Authorities on the WEB <<http://lcWeb.loc.gov/ils/ala02arv.ppt>>
 - [24] LEAF – Linking and Exploiting Authority Files <<http://www.leaf-eu.org/>>
 - [25] Living Canadian Artists - Centre for Contemporary Canadian Art <<http://www.ccca.ca/>>
 - [26] MARC21 – Authority Data <<http://lcWeb.loc.gov/marc/authority/ecadhome.html>>
 - [27] MARC21 – Relators <<http://lcWeb.loc.gov/marc/relators>>
 - [28] Michael A. Mabe. Digital Dilemmas: electronic challenges for the scientific journal publisher. Aslib Proceedings, Volume 53, Number 3, 2001, p. 85-92.
 - [29] Michael A. Mabe; Mayur Amin. Dr. Jekyll and Dr. Hyde: author-reader asymmetries in scholarly publishing. Aslib Proceedings, Volume 54, Number 3, 2002, p. 149-157 <<http://www.emeraldinsight.com/0001-253X.htm>>
 - [30] MPEG-21 <<http://mpeg.telecomitalialab.com/standards/mpeg-21/mpeg-21.htm>>
 - [31] MPEG-7 <<http://mpeg.telecomitalialab.com/standards/mpeg-7/mpeg-7.htm>>
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- [32] OAI - Open Archives Initiative <<http://www.openarchives.org/>>
- [33] OCKHAM – Open Standards for Digital Library Development <<http://ockham.library.emory.edu/>>
- [34] OCLC Authority Control in the 21st Century – Workshop
<<http://www.oclc.org/oclc/man/authconf/confhome.htm>>
- [35] RAMEAU <<http://rameau.bnf.fr>>
- [36] ULAN – The Union List of Artist Names, Getty Centre
<<http://www.getty.edu/research/tools/vocabulary/ulan/index.html>>
- [37] UM2001 - 8th International Conference on User Modeling <www.dfki.de/um2001/>
- [38] UM2003 - 9th International Conference on User Modeling <<http://www2.sis.pitt.edu/~um2003/>>
- [39] UML - Unified Modeling Language. Resource Page <<http://www.omg.org/uml/>>
- [40] VCard <<http://www.imc.org/pdi/>>
- [41] VIAF - Virtual International Authority File <<http://www.oclc.org/research/projects/viaf/>>
- [42] Visual Resources Association, Core Categories, version 3.0 <<http://www.vraWeb.org/vracore3.htm>>
- [43] Z39.50 Next Generation <<http://www.loc.gov/z3950/agency/zng.html>>
- [44] robotstxt.org <<http://www.robotstxt.org>>
- [45] GOOGLE - Add Your URL <http://www.google.com/add_url.html>
- [46] InterNIC <<http://www-whois.internic.net/>>
- [47] DOI - Digital Object Identifier <<http://www.doi.org/>>