Advancing the Semantic Web via Library Functions

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SUMMARY

This article explores the applicability primary library functions (collection development, cataloging, reference, and circulation) to the Semantic Web. The article defines the Semantic Web, identifies similarities between the library institution and the Semantic Web, and presents research questions guiding the inquiry. The article addresses each library function and demonstrates the applicability of each function's polices to Semantic Web development. Results indicate that library functions are applicable to Semantic Web, with "collection development" translating to "Semantic Web selection;" "cataloging" translating to "Semantic Web 'semantic' representation;" "reference" translating to "Semantic Web service," and circulation translating to "Semantic Web resource use." The last part of this article includes a discussion about the lack of embrace between the library and the Semantic Web communities, recommendations for reducing this gap, and conclusions.

KEYWORDS

Semantic Web, library functions, collection development, cataloging, reference, library outreach, circulation, Semantic Web planning and policies.

1. Introduction

The modern library of today, in all its shapes, forms, and constituent services, is often defined by the following primary functions: *collection development, cataloging, reference,* and *circulation*. The size of a library generally dictates if these functions are carried out in separate departments, or combined with other library operations. For example, cataloging generally forms a separate unit or division in large academic libraries, while it is often outsourced or combined with other function in smaller public or corporate libraries. The library functions, identified here, are supported by protocols that have developed over time, and they are applicable to both physical and digital libraries.

Most important, these library functions fulfill patent objectives that are integral to a successful library operation.

Primary library functions may also be valuable for developing the Semantic Web. This hypothesis is put forth because there are many similarities between the Semantic Web and the library. This hypothesis is also put forth because the Semantic Web community and the library community have *not* fully embraced one another, despite the similarities and pertinent connections. History tells us that solutions to past challenges are often useful for solving new, similar problems. For example, computer simulation techniques historically developed for training air force pilots have proved useful for training commercial pilots, and these techniques have improved flight safety in both realms (Rolfe & Staples, 1986). Given that the library and the Semantic Web are cultures devoted to increasing information access and knowledge discovery, it makes sense to explore the foundations of the library (the more established institution) and consider what primary functions may help advance the Semantic Web initiative. Said more forcefully, the library has been society's chief information custodian for the last several hundred years; and, if the Semantic Web is to evolve into a chief and trusted information network, affording services and performing tasks for both humans and machines, we need to examine the applicability of the library's primary functions to the Semantic Web.

This paper addresses this need and explores the applicability of library functions to the Semantic Web. This inquiry is a discussion based on rudimentary deduction, which is supported by an analysis of various library guidelines and policies. The article begins by defining the Semantic Web and identifying similarities between the library institution and the Semantic Web. The article then presents research questions guiding the inquiry, followed by a discussion of each function and how each function's polices can assist Semantic Web development. The last part of the article includes a discussion about the lack of embrace between the library and the Semantic Web communities and recommendations for improving this gap, followed by research conclusions.

2. The Semantic Web: Status and Planning

The Semantic Web, representing Berners-Lee's initial vision of the World Wide Web (Web), is an extension of the Web where "information is given well-defined

meaning, better enabling computers and people to work in cooperation" (Berners-Lee, et al, 2001). The goal is to construct a *network* of structured, sharable semantics that is accessible, understandable, and manipulable by computer agents. Computer agents (Semantic Web agents), acting on behalf of people or other computer agents, will traverse the semantic network, find and manipulate information, perform desired tasks, and offer services. A high level example is that a Semantic Web agent should be able to plan your family vacation to Las Vegas (e.g., purchase the airline tickets, book your hotel, and purchase tickets to a performance for a night-on-the-town) (McIlraith, et al, 2001).

As with many significant developments, Berners-Lee's vision of the Semantic Web has been shaped by historical developments and ideas, such as Vannevar Bush's conceptualization of the Memex; J.C.R. Licklider's work at ARPA that led to ARPANET; and Ted Nelson's coining of hypertext and project Xanadu—(Greenberg, et al, 2003). Berners-Lee's conception of the Semantic Web was developed amidst technological capabilities stemming from ARPA and the Internet, an infrastructure *realistic* for contemplating an environ where "machines become capable of analyzing all the data on the Web…the content, links, and transactions between people and computers" (Berners-Lee, 1999). The information infrastructure in which Berners-Lee's ideas evolved is remarkably different than the environment available to earlier visionaries having similar ideas. For example, the state-of-the-art technology was microform (film and fiche) when Vannevar Bush conceived his idea of the Memex (Bush, 1945).

Although technological infrastructure is a significant factor underlying the conceptualization and potential of the Semantic Web, *technological infrastructure* alone is not sufficient for rapid and robust growth. In some respects, we can argue that the Semantic Web is evolving slowly compared to many other fast paced developments in our technologically intensive, highly connective, and increasingly wireless world. Consider the pace at which cell phone technology and functionalities have developed. A probable factor, contributing to this slowness, is the fact that requirements for building a fully functional Semantic Web have not been articulated in a detailed strategic plan or policy. Rather, Semantic Web development is being guided by the famous layer-cake graphic that appears in nearly every article that defines the Semantic Web,[1] several key

documents outlining underlying principles (Koivunen & Miller, 2001), and the *top of the mountain view* of what the Semantic Web will or can be (e.g., Berners-Lee, et al, 2001).

One reason for this predicament (the absence of a detailed plan) is that the original design of the Web—as the Semantic Web—was initially derailed, due to the rapacity with which Hypertext Markup Language (HTML) was adopted for Web development. HTML primarily focuses on tagging documents for appearance and format display; it is relatively simple compared to the intellectual task of the tagging required for the Semantic Web; and it has enabled the Web to mushroom at an unpredictable and exponential rate. Another reason for the absence of a detailed plan is that most Semantic Web efforts have focused on infrastructure and enabling technology development (e.g., Resource Description Framework (RDF) and the Web Ontology Language (OWL)) (Greenberg & Roberson, 2002). Building a network of shared semantics that is understandable and accessible by agents (people and machines) requires time and thinking.

This paper demonstrates that the library institution and the Semantic Web have many similarities, and that greater attention to functional planning and policies, as evidence in the library community, may accelerate Semantic Web development and contribute to its sustainability. In presenting this thesis it is important to acknowledge that there is, indeed, interest in semantic tagging, and it appears to be increasing via folksonomies and social tagging projects (e.g., Flickr,[2] Del.icio.us,[3] and Facebook[4]). One may add to this recent partnerships between academic and research libraries and information industry leaders (Google, Yahoo! and Microsoft), where digital content and associated metadata are key commodities. These developments are unprecedented and represent aspects of Miller's "Library 2.0" (2006), including a move toward a more *semantic* Web.

Despite these recent developments, there is still an absence of plans and policies guiding Semantic Web development. It is possible that members of the Semantic Web community view planning and policy development as an impediment to the open spirit of the Semantic Web or considered too labor intensive to produce, although literature and discussion does not reveal this opinion. Another more likely reason is that members of the Semantic Web initiative have not had the time to consider the benefits of shared

planning and policy development, due to other pressing foci and activities. Regardless of the reason for the absence of Semantic Web plans and polices, I firmly believe that librarians have a responsibility to share, with all information communities, including the Semantic Web, their knowledge of library practices and functions that have allowed the modern library operate successfully over the last century. One way to do this is through sharing policies and practices. I also believe that it is the responsibility of those wanting to build a Semantic Web to look beyond modern library limitations, and inquire about the functions that have sustained and allowed this chief custodian of information to thrive for the last few centuries. Helping to validate this inquiry, it seems prudent to first consider the similarities between the library and the Semantic Web.

3. Similarities between the Library and the Semantic Web

Many clichés defining the Web either distinguish it from the library or point to similarities. For example, the "Internet [Web] has been described as a library with all the books tossed on the floor" (Wilson, 2000) or "the Web is like a virtual library"—the latter statement marshals little support when considering the full scope and anarchy of the Web. The Semantic Web part of the larger Web is, however, quite similar to the library for the following reasons:

- The library and the Semantic Web have each developed, in part, as a response to an abundance of information.
- The library and the Semantic Web have mission statements grounded in service, information access, and knowledge discovery.
- The library and the Semantic Web have advanced as result of international and national standards.
- The library and the Semantic Web have grown due to a collaborative spirit.
- The library and the Semantic Web have become a part of society's fabric—although less so for the Semantic Web.

The following discussion shows these similarities to be quite strong, further justifying the need for an inquiry on the applicability of library functions for developing the Semantic Web.

- *Response to information abundance*

Today's familiar modern physical library has it roots in the Renaissance. It grew, in part, to accommodate the enormous number of publications produced with the development of the printing press (Miksa, 1996). The digital library also developed in response to the increase in digital information (Chepesuik, 1997). Similar to the development of the modern library, the idea of the Semantic Web was initiated as a means to more effectively manage and take advantage of the increased amount of digital data.

- *Missions grounded in service, information access, and knowledge discovery*

Most libraries have some form of a *mission statement* articulating their goal to provide high quality library services, enhance access to information of "enduring and contemporary value," and support research and communication.[5] These goals are evident in both physical and digital library initiatives; and, in the academic world, they are integrated with the larger institutional mission (Snow, 2004). The library's definitive goal is to support knowledge discovery for advancement of citizens and society.

> *…by creating a setting conducive to learning, discovery, and cultural excitement, we help community members meet academic and personal goals that extend knowledge and promote achievement in the individual and in the community*.[6]

> *We strive to inform, enrich and empower every person in our community by creating and promoting easy access to a vast array of ideas and information, and by supporting an informed citizenry, lifelong learning and love of reading*.[7]

The Semantic Web's homepage provides a succinct definition of the Semantic Web that is characteristic of a mission statement.

> The Semantic Web provides a common framework that allows data to be shared and reused across application, enterprise, and community boundaries. It is a collaborative effort led by W3C with participation from a large number of

> researchers and industrial partners. It is based on the Resource Description Framework (RDF).[8]

This statement highlights such components as a common framework, shared data (information), and collaboration; and it parallels the library's standardization and sharing of bibliographic data, resource circulation, and collaborative activities. The Semantic Web Activity Statement[9] provides a more in-depth view of the Semantic Web's mission by stating its goal to "to create a universal medium for the exchange of data…global sharing of commercial, scientific and cultural data." The Semantic Web's overriding goal to imbue computer and human agents with *intelligence*, which is very similar to the library's goal of *advancing knowledge*.

Advancement via international and national standards

The library community's response to the increased amount of information has also led to development of cataloging codes; formalized classificatory and verbal systems; and encoding/communication standards (International Bibliographic Description (ISBD) and MAchine Readable Cataloging (MARC)). The Web and digital library growth has also motivated rethinking and revision of cataloging standards, models, and codes, as evidenced by the development of the many metadata schemes, Functional Requirements for Bibliographic Records (1998), and Resource Description and Access (RDA) drafts.[10]

The Semantic Web has followed a similar path as evidenced by a collection of information standards: eXtensible Markup Language (XML), RDF, OWL, Friend Of A Friend (FOAF), and Simple Knowledge Organizations System (SKOS). The word "standard" is used loosely here, because these developments do not have standard numbers, rather they exists as W3C formal recommendations.

Collaborative spirit

Collaboration has been, and continues to be, necessary for library and the Semantic Web development. Library standards, primarily cataloging standards, have developed via national and international collaboration. For example, the American

Library Association, Association of Library Collections and Technical Services, Cataloging and Classification Section (ALA/ALCTS/CCS), includes many committees that propose and review cataloging polices and standards, and which interact with international organizations (e.g, IFLA and the Dublin Core Metadata Initiative). Collaboration extends to all library functions, such as collection building and collection use/access via consortiums and cooperative systems.

Collaboration is a key part of Semantic Web development, as indicated on the Semantic Web's homepage referenced above (…"a collaborative effort…"). All of the enabling technologies/standards listed above (RDF, OWL, FOAF, and SKOS) have been developed through working groups and public calls for comment. Additionally, the Semantic Web supports a number of working groups exploring a variety of topics, such as Semantic Web Best Practices and Deployment Working Group,[11] which offers hands-on guidance for Semantic Web application developers. The World Wide Web Consortium (W3C), the home of the Semantic Web, is, itself, a collaborative effort involving academic, research, and industry members, and it has set a path of collaboration underlying the Semantic Web initiative

A part of society's fabric

The library is an institution, an operation, and a part of society's fabric. That is, the library (*all* types combined—public, academic, corporate, and special) is made available to all economic classes and strata of society. The library touches millions of people everyday in their daily activities in the work place, after work, and in the comfort of their home, as they connect to the library virtually, or physically interact with library materials by reading, listening, and/or viewing. The Semantic Web intends to be a part of society's fabric, although it is less so than the library at this point because it is relatively small. It has already permeated society through the popular press and high impact articles such as Berners-Lee, et al, (2001) piece in *Scientific American.* If the current Web is any indication of the extent of the Semantic Web's reach, which seems quite logical, the Semantic Web (or what ever the Semantic Web morphs into) will surely impact millions of people's lives daily, and become a major thread of society's fabric.[12]

4. Inquiry

This article explores the applicability of four primary library functions (collection development, cataloging, reference, and circulation) to the development of the Semantic Web. The inquiry is a discussion based on rudimentary deductive reasoning (without formal logic), and supported by an analysis of various library guidelines and policies. The deductive analysis is supported by the "library and Semantic Web similarities" presented above. The analysis was undertaken because of these obvious similarities and because it has been hypothesized that primary library functions may also be valuable for developing the Semantic Web. As a first step in testing this hypothesis, the inquiry presented here asks the following two questions:

- Which basic library functions of c*ollection development*, *cataloging*, *reference*, and *circulation* apply to the development of the Semantic Web?
- If these basic library functions are applicable to the Semantic Web, how can they guide Semantic Web development?

5. Applicability of Library Functions to the Semantic Web

This section discusses the goals and objectives of the four primary functions underlying the modern library. The discussion also explores the applicability of each function to the Semantic Web, based on the above analysis of library and Semantic Web similarities.

5.1 Collection Development

Collection development in the library

The goal of collection development is to build and maintain a coherent collection that services a designated constituent/patron population. Collection development activities are generally guided by a written collection development policy that may be viewed as a contract between the library and its users. Collection development policies document the library's intent to grow the collection, identify collection strengths and limitations, and guide library staff, particularly bibliographers, in their collection

development work. Guidelines also include selection criteria about preferred subjects and formats.

Collection development policies are not permanent, rather they need to be reviewed and revised, as user populations change and present new demands. Consider how inner city populations change, with new immigrant population influxes, and more established immigrant populations migrating to the suburbs. New areas of study and emerging disciplines also have a major impact on collection development polices, particularly for university and college libraries. Finally, collection development can help libraries with administrative activities by including procedures for acquisitions, gifts, weeding, replacing lost items, and collection evaluation.[13]

Semantic Web selection

The Semantic Web initiative, as a whole, does not identify a specific type of user, although individual Semantic Web projects are often initiated to service specific populations or topics. (The word "project/s" is used hereafter for refer to Semantic Web undertakings and initiatives that are part of the larger Semantic Web.) For example, MusicBrainz,[14] a community music metadatabase, is for people interested in both music resources and building a comprehensive music information site; and the Semantic Web Environmental Directory,[15] a distributed directory, is for environmental organizations wanting to disseminate and maintain organizational and project information.

A useful question to ask, as part of this current analysis, is: *Can library collection development policies inform Semantic Web development?* Inquiry into this topic indicates that a *Semantic Web selection policy* may help a Semantic Web project carry out the following:

- Articulate the intent of a project; and, in turn, a policy could help a project determine the degree to which Web resources and data need to be semantically encoded.
- Clarify the type of format(s) that will be tagged and made accessible for a project.
- Identify the strengths and limitations of a project.
- Guide managers with project development and evaluation, including the acquisition and removing (weeding) of project resources or data.

- Guide project employees (e.g., collection developers and metadata creators) in their selection and tagging of resources.
- Provide information useful to vendors who want to develop effective Semantic Web tools.
- Assist related projects with their selection and develop policies.
- Explain factors and means by which a project's scope may change.

Following this last point, it is likely that Semantic Web selection policies will require review and revision for the following key reasons: the development of new and related projects—some of which may be competitors; the identification of new user agents (computer and human); and the development of new technologies and machine capabilities.

Based on knowledge about the library community's experience developing library collection development policies, it is likely that Semantic Web selection policy development will require time and patience, particularly given the absence of examples specific to the Semantic Web. The wide availability of library collection development guidelines and resources, such as *Guidelines for Writing Collection Development Policies* (Dartmouth College, 2000) provide a useful framework for developing Semantic Web selection polices. And, if Semantic Web selection policies were to develop at any noticeable rate, a master guideline specific to writing a Semantic Web selection policies could be developed to assist future projects.

5.2 Cataloging

Library cataloging

The goal of cataloging is to make library collection materials findable and discoverable so they can be used. Charles A. Cutter's (1904) objectives for a library catalog, printed in the 4th edition of his *Rules for a Dictionary Catalog*, are among the most influential statements impacting cataloging. Cutter's objectives state that a library should:

1. Enable a person to find a book when the author, title, or subject is known;
2. Show what the library has by author, subject, and literature genre; and

3. Assist in the selection of a book by its edition and literary or topical composition.

Written a century before the development of the Web, Cutter's objectives are still applicable to library operations today, and thus influence current cataloging activities. Cutters' *Rules for a Dictionary Catalog* also includes principles to meet the stated objectives. For example, subject specificity is expressed by informing catalogers to "enter a work under its subject-heading, not under the heading of a class which includes that subject (e.g., "Put Lady Cust's book on the cat under Cat, not under Zoology or Mammals, or Domestic animals."). Throughout cataloging history, there are other principles such as the "Statement of Principles," (Paris Principles) (International Federation…, 1963) that have had a major impact on cataloging policy and practice.

Jumping a century beyond Cutter to today, digital resource cataloging (metadata creation) is being guided by principles and objectives documented in a variety of metadata schemes (Greenberg, 2005). Under development is the *Rules for Description and Access (RDA*), which includes a draft statement of objectives (RDA…, 2005). RDA may have the most impact on cataloging in the 21st century, although it is far too early to tell. Part 2 of RDA's draft statement of objectives includes a series of statements about the catalog record's responsiveness to user needs. For example, descriptive data (metadata) created using RDA should enable a user to "identify the resource described" and select appropriate resources "with respect to content, format, etc." Additional objectives address access points, representation of entities identified in Functional Requirements for Bibliographic Records (FRBR) (1998), and cataloging quality criteria (e.g. data flexibility, sufficiency, and accuracy). Describing RDA in more detail is well beyond the scope of this paper, but it is important to recognize that RDA intends to provide cataloging guidance well beyond what is presented in communication and encoding standards (e.g., MARC and XM). Moreover, RDA's objectives may help with the development of the Semantic Web.

Semantic Web "semantic" representation

Similarities between library cataloging and producing metadata for the Semantic Web are obvious, in that both deal with representation. In fact, the boundary between the employ of representation standards in these two environments (libraries and the Semantic Web) is artificial. Rather, the representation activity takes place along a continuum, with simple bibliographic representation for search and retrieval on one end, and the implementation of formal ontologies and machine supported deductive reasoning on the other (McGuinness, 2003, p. 175). What are missing in the context of the Semantic Web are principles and objectives for using metadata schemes and ontological system. *How should a Semantic Web project decide which metadata schema or ontology to use? What level of representation is required to properly represent the information entity so that an agent can successfully manipulate the information and provide a useful service?* Similar to the library's community extensive MARC documentation,[16] the Semantic Web provides comprehensive documentation for working with enabling technologies, such as XML, RDF, and OWL. However, the Semantic Web community falls short, currently, in providing documentation to guide the use of metadata standards and ontologies.

Plans, guidelines, and policies are needed stating principles and objectives for Semantic Web representation to ensure good quality "semantics" (e.g., coherent, consistent, accurate semantic representation). A *semantic representation policy* would help secure a robust framework for effective Semantic Web operations. There are many examples cataloging policies[17] that document and detail principles and objectives, and could serve as a model for developing useful policies for the Semantic Web. Similar to the development of a Semantic Web selection policy, the development of a *Semantic Web "semantic" representation policy* would require time, but as more examples are created, a general framework might also be developed to assist future projects feeding into the overall Semantic Web initiative.

5.3 Reference

Reference and outreach

The goal of reference is to provide the library community with effective information services. Reference services include personal interaction; dissemination of

documentation (e.g., pathfinders, bibliographies, and guides on collection resources or technology use); signs identifying location and directions; and educative and outreach activities, such as bibliographic instruction (RUSA Access to Information Committee, 2000; University of Texas at Arlington, 2006). The library has an obligation "to provide information service to support the educational, recreational, personal and economic endeavors of the members of their respective communities" (RUSA Access to Information Committee, 2000). In meeting these needs, libraries uphold the American Library Association's Library Bill of Rights,[18] Freedom to Read Statement[19], and Code of Ethics.[20] Reference services are generally supported by guidelines stating service goals, which are integrated into library access policies, collection development polices, or the library's mission statement (e.g., Office of the Associate University Librarian, 2006).

An extension of reference is *outreach.* Libraries plan services that are of value to their users. Consider a library centrally located in a retirement community, where the majority of the user population over the age 65. For this library, it makes sense to conduct bibliographic instruction/outreach sessions highlighting collection holdings that address retirement challenges, healthy living for the elderly, and health issues impacting seniors. Whereas conducting outreach to highlight collection resources that help with finding a first professional job would not be that practical, unless, of course, the grandchildren of the retirees frequent the library to such an extent that is would be a useful service to provide. Outreach extends to *community outreach*, generally in public through the offering of classes and other services (e.g., English as a second language classes, story time for youngsters, reader advisory services, even cooking and art classes). These items extend beyond reference, but deal with overall access and use of the library facility, and often promote collection use.

Semantic Web service

How, we may ask, is reference applicable to the development of the Semantic Web? The tie is with "service"—the central pillar of Semantic Web. The Semantic Web depends on standardized structured metadata and Semantic Web algorithms capable of reading and manipulating such data, but the overriding goal is to provide service, to free humans from mundane tasks that computers can perform—and can perform effectively.

Current Semantic Web services facilitate knowledge and service discovery, and more sophisticated forecasted activities include automatic purchasing of an airline ticket—even an airline ticket from your preferred carrier (McIlraith, et al, 2001).

To learn and benefit from the experience of reference services, Semantic Web projects might look to RUSA's *Guideline for Information Services* (RUSA Access to Information Committee, 2000) as a template for developing *Semantic Web service* guidelines and statements that could facilitate Semantic Web development. Table 1 and Table 2 pull examples from Section 1.0 Services and Section 5.0, Evaluation respectively and demonstrate how the statements could be modified to guild Semantic Web development.

Table 1: Library Reference and Semantic Web Project Service Policy Statements

Library Reference Service Statements*	**Semantic Web Project Service (SWPS) Statements**
RUSA Statement 1.1	SWPS Statement 1
The goal of information services is to provide the information sought by the user. Information service should anticipate as well as meet user needs. It should encourage user awareness of the potential of information resources to fulfill individual information needs.	The goal of Semantic Web project *x* is to provide the information sought by agents (computer and human). The Semantic Web service should anticipate agent needs. It should facilitate agent awareness of the potential the services' its information resources can fulfill to individual needs.
RUSA Statement 1.3	SWPS Statement 2
The library should strive to provide users with complete, accurate answers to information queries regardless of the complexity of those queries.	Semantic Web project *x* should strive to provide agents (computer and human) with complete, accurate answers to information queries regardless of the complexity of those queries.
RUSA Statement 1.6	SWPS Statement 3
The library should actively publicize the scope, nature, and availability of the information services it offers. It should employ those media most effective in reaching its entire clientele or selected segments of that clientele, as appropriate.	Semantic Web project *x* should actively publicize the scope, nature, and availability of the information services it offers. It should employ those media most effective in reaching its entire clientele or selected segments of that clientele, as appropriate.
RUSA Statement 1.7	SWPS Statement 3
The library should survey and assess the information needs of its community and create local information products to fulfill those needs not met by existing materials.	Semantic Web project *x* should survey and assess the information needs of its community and create local information products to fulfill those needs not met by existing materials.

*RUSA's *Guideline for Information Services* (2000).

Table 2: Library Reference and Semantic Web Project Evaluation Policy Statements

Library Reference Service Statements*	Semantic Web Project Evaluation (SWPE) Statements
RUSA Statement 5.1	SWPE Statement 1
The library should regularly evaluate its information services to ensure that the service furthers the institution's goals and that the goals reflect the needs and interests of the community served.	Semantic Web project *x* should regularly evaluate its information services to ensure that the service furthers the initiatives goals and that the goals reflect the needs and interests of the community served.
RUSA Statement 5.2	SWPE Statement 2
The library should integrate the perspectives of staff and community in the overall evaluation procedure for information service.	Semantic Web project *x* should integrate the perspectives of managers, staff, and user agents (computer and human) in the overall evaluation procedure for Semantic Web service.

*RUSA's *Guideline for Information Services* (2000).

The reference function, like all library functions, has taken advantage of technological advances, including those associated with the Web. One of the most obvious changes is virtual reference—often labeled as "Chat-Reference" or "Ask-a-Librarian." Digital technology and the Web have had an impact on the overall reference activity, leading to the development of "digital reference," which includes new challenges, such as interface and architecture design, and requires new ways of marketing, evaluation, and collaboration. IFLA's Digital Reference Guidelines (2005) provides guidance for addressing these new digital reference challenges. The IFLA guidelines and other resources on digital reference (e.g., Lipow, 2005) may prove useful for articulating more detailed *Semantic Web service* plans. Finally, these resources may also assist with *Semantic Web outreach projects* promoting community events and use of a Semantic Web service. For example, the creation of a community bulletin board listing local concerts as explored by Graves (2003).

5.4 Circulation

Library circulation

Circulation is the last primary library function to explore in this inquiry of the applicability of library functions to Semantic Web development. Circulation policies document collection access and use procedures. These policies are created to promote healthy collection use and protect library collection holdings. Users often want access to

the same collection materials, of which there may be limited copies, or rare materials that are fragile. Circulation polices identify who may use a collection and who has borrowing privileges; they define loan time periods and present renewal polices so that all interested users can have access to library materials. Circulation polices generally state fines and procedures for late returns, lost and damaged items, and other problems associated with delinquent use. Circulation policies also identify non-circulating materials, such as very costly collection holdings, resources needed daily (e.g., a reference resource), or fragile and rare materials. For an example of a thorough policy see the University of Rochester's circulation policy.[21]

Semantic Web resource use

In examining circulation in the context of the Semantic Web, it is important to point out that digital libraries have eliminated basic circulation challenges tied to physical collections. For example, multiple users can access a digital resource at any time, and for extended time periods, eliminating the need for a loan period. Notwithstanding these developments, basic circulations challenges are still applicable to Semantic Web projects on a fundamental level. Table 3 indicates how several basic circulation issues may translate to a *Semantic Web resource use policy*.

Library Circulation Policy Issues	**Semantic Web Resource Use Policy (for computer and human agents)**
Who has access	A policy could state agent access procedures. A policy might involve an application procedure, where an agent would be given an access code. Agent status could then be verified via an identification number of digital signature.
Borrowing privilege	A policy could state if agents, with privileges, can borrow (or harvest) metadata/semantics to integrate with other applications to perform a task.
Loan period, Renewing loans	A policy could indicate how long an agent can access the project resources and how access privileges can be renewed.
Recalling checked out items	A policy might include a procedure for informing agents of new resources and semantic data updates, given the potential impact on ongoing, or previously conducted operations.
Recommending a library purchase	A policy could provide a venue for agents to request additional resources or semantics.
Locating items	A policy could indicate explain the arrangement of resources within a project.
Fines policy, Borrower blocks	A policy could state instances in which agents would be fined. For example, tampering with semantic data would results in fines or blocking agent use.
Record of use	A policy should inform agents of any tracking or recording of data use.

On one hand, much of the sprit of the Semantic Web is open—open access, open information, and open source—and it seems a bit restrictive to consider something like a Semantic Web resource use policy. On the other hand, it is important to recognize that a "use policy" can promote resource use and protect the integrity of a project's resources, including semantics. It is important to point out that not all libraries are "open," and not all user services are free. A user fee is generally required for access and searching certain online databases (e.g., Dialog and LexisNexis), and corporate and private libraries are not open to just anyone. Additionally, there are general operational and collection development and maintenance costs with any library that are related to all the functions addressed in this article. Similarly, the Semantic Web initiative includes a range of partners from both the academic/research and industry sectors, and there already are Semantic Web services that have been initiated due to financial incentives. Despite financial motivation, the implementation of Semantic Web projects requiring fees need to be reasonable (and worthy of their cost) if they are to be as successful at the library.

7. The Semantic Web/library gap

The Semantic Web and library communities are far from being healthfully integrated. On one side of this gap, the members of the Semantic Web community are not fully aware of the skills, talent, and knowledge that librarians (primarily catalogers) have, and which can help advance the Semantic Web.[22] This is evident by the absence of a metadata representation working group within the World Wide Web Consortium (W3C), and the severely limited participation of professional librarians on various W3C working groups. Granted, the W3C's Semantic Web activity has focused more on the development of enabling technologies, rather than processes or activities. Clearly, librarians could become Semantic Web advocates by engaging in W3C discussion groups and participating in Semantic Web conferences, if they want to be involved in this initiative. Even so, I am able to confirm only one professional librarian active and chairing a W3C task force that has relevancy to the Semantic Web.

On the library side of the gap, librarians have been slow to embrace the Semantic Web and work with Semantic Web enabling technologies and standards (e.g., RDF, OWL,

etc.) in comparison to the way in which computer scientists, engineers, and ontologists (who are often formerly trained as linguists, psychologists, or scientists) have. *Slowness* here is calculated in relation to today's fast paced and highly connected world with real time and instant processes for creating and disseminating information (e.g., blogs, email, podcasting, Web sites, and instant messaging). Additional factors interfering with librarian participation in the Semantic Web are:

- Communication barriers stemming from the different languages used by members of the Semantic Web initiative and the library community.
- An absence of user-friendly applications for making digital information (documents to data sets) operative for the Semantic Web (although this is changing, with more user friendly tools, like Protégé for ontologies[23]).
- Heavy and demanding daily workloads for library operations, resulting in limited time to read and digest Semantic Web developments.
- Limited documentation on the processes, plans, and policies for building the Semantic Web.

Following on this last point, it is worth reiterating that the majority of Semantic Web documentation presents technical standards or hypothetical scenarios (e.g., Berners-Lee, et al, 2001) currently not possible, which makes it difficult for librarians to determine where their skills and knowledge can aid Semantic Web development. True, examples can be found to counter each of the above listed obstacles. For example, Brooks (2002) reviews cataloging and information retrieval developments and presents *lessons of librarianship* that are applicable to the Semantic Web. A more recent development is the increase in panels and workshops addressing the Semantic Web at library and information science at professional conferences (e.g., American Society of Information Science and Technology (ASIST) and the Joint Conference on Digital Libraries (JCDL) have both offered workshops on ontologies and Semantic Web technology). Additionally, blogs and e-lists frequented by librarian show limited attention to the Semantic Web. Despite these examples, the link between the library and the Semantic Web is still limited.

The Semantic Web/library "gap," it seems, could be reduced if the Semantic Web initiative more heavily recruited librarians to participate in current projects, and if librarians could explore beyond their current enclaves and consider how their skills were

applicable to the Semantic Web. This current article focused on one possible path by exploring the applicability of library functions and policies to the Semantic Web. There are other means of reducing the Semantic Web/library gap as alluded to here, and exploration is required if we are advance and accelerate Semantic Web development.

8. Conclusion and Future Research

This paper explored the applicability primary library functions to the Semantic Web. The inquiry was a discussion based on rudimentary deduction and was supported by an analysis of various library guidelines and policies. An exploration of similarities between the library institution and the Semantic Web served as a base. All four of the primary library functions proved applicable to the Semantic Web. Each library function translates to a Semantic Web function. The translation (or redefinition) of each library function for the Semantic Web follows:

- *Collection development → Semantic Web selection.*
- *Cataloging → Semantic Web "semantic" representation.*
- *Reference → Semantic Web service.*
- *Circulation → Semantic Web resource use.*

This paper is an initial inquiry, and the results illustrate that primary library functions are applicable to the Semantic Web. The functions, redefined in the context of the Semantic Web, may improve and accelerate Semantic Web development. Development, implementation, and evaluation of Semantic Web policies, underscoring these functions, is required if we are to determine the true impact of library functions on Semantic Web development. As a first step, the results presented in this article indicate that the functions are applicable to the Semantic Web, and invite more research. In conclusion, continued efforts may bridge the Semantic Web/library gap and lead to new opportunities for both communities.

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NOTES

[1] Semantic Web layer cake: http://www.w3.org/2004/Talks/0412-RDF-functions/slide4-0.html.
[2] Flickr: http://www.flickr.com/.
[3] Del.icio.us: http://del.icio.us/.
[4] Facebook: http://www.facebook.com/.
[5] South Western State University: http://www.gsw.edu/~library/Libmission.htm, Georgetown Law Library: http://www.ll.georgetown.edu/about/mission.cfm, and Seattle Public Library: http://www.spl.org/default.asp?pageID=about_mission.
[6] Madeleine Clark Wallace Library, Wheaton College: http://www.wheatonma.edu/Library/Info/home.html.
[7] Seattle Public Library: http://www.spl.org/default.asp?pageID=about_mission.
[8] Semantic Web homepage: http://www.w3.org/2001/sw/.
[9] Semantic Web Activity Statement: http://www.w3.org/2001/sw/Activity.
[10] Resource Description and Access (RDA): http://www.collectionscanada.ca/jsc/rda.html.
[11] Semantic Web Best Practices and Deployment Working Group: http://www.w3.org/2001/sw/BestPractices/.
[12] It is important to note that the Internet has penetrated less than 10% of the populations in African and the Middle East, and less than 15% of the population in Asia and Latin America/Caribbean [viewed Sept. 1, 2006]: http://www.internetworldstats.com/stats.htm.
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[14] MusicBrainz: http://musicbrainz.org/.
[15] Semantic Web Environmental Directory: http://www.swed.org.uk/swed/index.html.
[16] MARC Standards Website: http://www.loc.gov/marc/.

[17] Cataloging Documentation: Yale University: http://www.library.yale.edu/cataloging/ccc/catpol/catpolhome.htm#documents; University of Illinois at Urbana Champaign: http://www.library.uiuc.edu/committee/charges/cataloging%20policy.htm.
[18] American Library Association, Library Bill of Rights: http://www.ala.org/ala/oif/statementspols/statementsif/librarybillrights.htm.
[19] American Library Association, The Freedom to Read Statement: http://www.ala.org/ala/oif/statementspols/ftrstatement/freedomreadstatement.htm.
[20] Code of Ethics of the American Library Association: http://www.ala.org/ala/oif/statementspols/codeofethics/codeethics.htm.
[21] University of Rochester, Circulation Policies, "Who Can Borrow,": http://www.lib.rochester.edu/index.cfm?PAGE=1324.
[22] Librarians is used loosely in this article to refer to information professionals working in custodial agencies or institutions that is identified as a library, or includes similar functions (e.g., museum, archives, or data centers).
[23] Protégé homepage: http://protege.stanford.edu/.