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## **Refereed Paper**

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#### **Biography**

For the last 25 years Dr Balnaves has worked as a technologist, researcher and academic in the area of Information Systems technology and Library Information Systems. His recent doctoral research focused on systematic methods for content reuse. The software "Inter-Search" developed by Dr Balnaves to support the Gratis group of libraries is now used by over 300 libraries in Australia/New Zealand for inter-library loan exchange and full text database access. He developed the unit of study "Information Systems in the Arts & Humanities" at University of Sydney as part of the Bachelor of Arts Informatics. His interests lie in Information Retrieval systems and electronic journal management.

## **Demand balancing in inter-library loan networks**

### **Abstract**

In the face of burgeoning subscription costs, special libraries face particular challenges in gaining access to resources to support their clients. The cost and complexity of participating in electronic consortia deals, and even in national ILL networks can also be problematic. Special libraries in Australia have responded to this difficulty by forming networks of similar libraries and undertaking inter-library loans at no charge and with no specific reciprocity. Such resource sharing would present difficulties to many special libraries if they were subject to excessive request on their specialist collections. The active involvement of the participating libraries relies on a dynamic approach to load sharing which balances workload across participating members. This paper describes the resource sharing approach and its contribution to ensuring equitable participation in the free resources sharing network.

### **Collections in transition**

Libraries face many resource challenges with the ever expanding corpus of published journals. In 2003 Libraries in Australian universities subscribed to over 1,300,000 journals of which 974,000 were in aggregate digital collections. This represented over 273,000 new serial titles and over 150,000 cancellations (Council of Australian University Libraries, 2005). One of the principle solutions to this problem is to reduce the unit cost of subscriptions through consortia deals with publishers. While such an approach has proven effective for larger libraries, smaller special libraries are often not in a position to be able to participate in consortia deals. Similarly, the transition to electronic delivery has seen the gradual attrition of subscriptions to the traditional print format (Fox & Marchionini, 1998; Weiderhold, 1995). This cost saving is offset by the substantial increase in the number digital resources available and the increasing displacement of collection building in other areas to address the subscription cost for Scientific journals (Barbera, 2006).

Special libraries have generally depended on national union lists to complement their collections. Such inter-library loan (ILL) resource sharing networks are generally fee-based. Two problems detract from participation of smaller research centres and special libraries in national ILL networks:

- They may have specialist collections not covered by larger institutions and therefore be a net focus for requests rather than a net borrower.

- Some are so small the paperwork in redeeming ILL credits from other libraries may not be practical.
- They may not be able to afford the participation costs of a fee-based ILL network.

This paper presents a transactional study of ILL transactions over a four-year period in order to contribute to the understanding of the decision processes in ILL fulfilment and how they may be affected by different workload distribution approaches.

Special libraries have an acute need for access to the electronic resources but are ill-equipped to develop comprehensive research collections. There are numerous such libraries distributed across health institutions, government organisations and commercial businesses. Unlike large university, state and national libraries these special libraries are not in a strong bargaining position relative to large digital database suppliers. Yet these institutions often have unique collection profiles and specialist information research needs, both of which demand some form of networked collaboration.

The *GratisNet* service represents an interesting innovation in distributed collection management of journal resources among health libraries in Australia. Over two hundred small special libraries have joined in a network to provide distributed intelligent-agent ILL services optimised for lowest-cost provision of health journals that are otherwise expensively or poorly supported in traditional ILL services. They achieve this at an annual cost per

library of \$110 in 2001 (National Resource Sharing Working Group, 2001) rising to no more than \$130 in 2005. This annual fee funds the operation of an inter-library network that shares print and electronic holdings. The low service cost (per library) illustrates the potential for low cost models of operation for distributed networks of special libraries. The networks are also important in illustrating approaches to resource balancing in such a fee-free transaction environment. Such ILL transactions are GST free as long as all inter-library transactions are themselves free and done with no specific reciprocity.

The transactionally fee-free approach to ILL resource sharing started by the *Gratis* group of health-related special libraries has been adopted by five other networks including government, semi-governmental and law libraries, comprising over 350 libraries. The collaborating, resource sharing networks in a fee-free environment face several risks that are common to voluntary and collaborating communities. There is the “free-loader” phenomenon, or those who take the benefit of membership of a collaborating community but do not contribute resources. Without a fee, factors other than supply and demand determine the economy of journal supply in these communities. Imbalanced resource distribution, if unmanaged, can also create imperfect resource management through inequitable distribution of demand resulting in a reluctance to supply (a form of compliance failure), and through inequitable distribution of demand resulting in a delay in supply (a

queuing problem). A longer term issue in the management of distributed resource collections is the potential for degradation of individual resource collections through reliance on networked collections (a collection building problem).

### **Managing the workload in a fee-free environment**

The Inter-Search software which supports the *GratisNet* and *GLASS* library networks applies a combination of computer-facilitated encouragement of compliance monitoring and dynamic ranking to achieve an equitable load balancing in an otherwise unequal resource network. Collaborating network members may search for and request resources. Resources are ranked on a geographical basis first and then on an inverse basis of workload using ILL statistics. Voluntary compliance rules for network members encourage selection of those network members ranked first in the resource list.

Detailed statistics on requests have been tracked for the last five years on the Inter-Search system. Table 1 shows the progressive behavioural impact of the ranking of search results among participating libraries in the *GratisNet* and *GLASS* networks (both networks are included because of the considerable overlap of libraries in the two networks).

Table 1 also shows the percentage of transactions selected outside the recommended ranking order for the years 2002 to 2005.

	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>
NSW	32.1%	28.8%	24.2%	26.7%
QLD	23.4%	17.9%	14.2%	13.0%
SA	21.6%	25.8%	16.6%	20.0%
VIC	26.7%	21.6%	18.6%	15.0%
WA	11.6%	11.9%	11.8%	5.8%
TOTAL	26.0%	22.7%	18.7%	17.8%

Table 1: Compliance of libraries in selecting based on ranking 2002-2005

While by network policy libraries are expected to select from the first three ranked libraries, libraries do exercise a measure of discretion in selecting strictly according to the ranking rules. There is considerable variance from year to year, and state by state. Compliance cannot be expected in all transactions, because in many cases the library must apply discretion in choosing out of ranking order due to either specific holdings gaps (which do not factor in the ranking), or issues of timeliness in supply. However compliance with the ranking recommendations has progressively improved with trust of the ranking process. It is likely that the efficiency curve will "flatten" at a level that reflects the practical limits of compliance through the ranking-based approach. The ability to monitor compliance on a state-by-state basis may facilitate publicity campaigns among the library members to explain the ranking methodology and encourage compliance where there appears to be a reduction in compliance (such as in NSW and SA in 2005). Changes introduced in 2006 to record electronic

collections held by libraries may affect the compliance trend if libraries select out of ranking to prefer libraries that declare electronic holdings.

The obvious question arises as to whether ranking compliance actually has an impact on the workload of participating membership. A logical choice for the requesting library is to consider only the factor of timeliness of supply, rather than extraneous factors such as workload of the library to which requests are directed. In order to examine this question, the actual transactions for 2003 and 2004 were reprocessed according to a "game scenario" in which all ILL requests were processed against a rational choice for supply based on proximity and holdings alone. The objective of this scenario was to contrast a load-based ranking with a utility-based ranking. The distribution of transactions based on the load-based ranking approach and those based on a utility basis are contrasted in

Table 2 contrasts the number of requests to the smallest and largest twenty libraries that occur with a

ranking-based and utility-based approach for the years 2003 and 2004. It is evident that a utility-based ranking considerably increases the transactional load on larger participating libraries, while tending to distribute the

transactions more evenly across the union list, including smaller participating libraries. Such a workload skew would inevitably discourage participation by these libraries in the network.

	2003	2004
Transactions	150155	128365
Distribution of transactions to the top 20 largest libraries ( <b>ranking-based</b> )	39003	33212
Distribution of transactions to the top 20 largest libraries ( <b>utility-based</b> )	56815	46760
Distribution of transactions to the 20 smallest libraries ( <b>ranking-based</b> )	1454	1154
Distribution of transactions to the 20 smallest libraries ( <b>utility-based</b> )	779	754

Table 2: Contrasting load-based ranking with utility-based ranking.

The *GLASS* and *GratisNet* library communities collaborate to achieve a cooperative benefit – where all community members gain access to a larger resource by sharing their own resources and committing to the additional workload in ILL fulfilment. The challenge is to avoid excesses in requests on those libraries with the largest collections, a scenario that would ultimately discourage membership. Participating libraries commit to supplying ILL requests at no charge and with no specific reciprocity, on the basis that they can be confident that an increase in demand on their library will be balanced progressively with a lower ranking in future ILL search results.

The approach taken by these library communities illustrates the benefits that

arise from effective collaboration among small libraries as they face the challenge of cost-efficient resource sharing. The model chosen in the Inter-Search networks is a variant of a "relative egalitarianism" viewed not at the individual transaction level, but at the cumulative level of transactions over time. Each individual transaction represents a win/lose in the sense that a resource request represents effort on the part of one library to the benefit of another with no immediate return. Egalitarianism would indicate the selection over time of the approach that give the highest combined utility to participating libraries. However, with unequal resource distribution, *relative* egalitarianism models the utility that each participant will derive relative to the overall utility aiming to achieve the utility benefit for each participation that

has the lowest level of frustration (Moulin, 1988).

### **Conclusion**

Statistics on inter-library loans in a fee-free environment are analysed to determine the effect of ranking of search results on the selection of the library to supply. Ranking based on workload is contrasted with a selection based on collection size and proximity. The fee-free model described in this paper relies

an annually revised load-based ranking to encourage an effective resource distribution in an environment where collection sizes vary widely. The Inter-Search example demonstrates the effectiveness of formal approaches to resource distribution in a fee-free ILL model and the benefits of an analysis of library resource usage. Such workload balancing approaches also have relevance to other communities that share resources on a fee-free basis.

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