WEB BASED METHODOLOGIES AND TECHNIQUES TO MONITOR ELECTRONIC RESOURCES USE IN UNIVERSITY LIBRARIES

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INTRODUCTION

Electronic resources, as defined by the *International Standard Bibliographic Description for Electronic Resources* (ISBD(ER)) are all those materials codified for computer elaboration, including material which requires the use of a peripheral. (IFLA, 1999; Saur, 1997). They constitute a constantly growing patrimony within the bibliographic resources of the university library system (Snowhill, 2001; Rowland, 1995; Woodward, 1997).

Searches (or consultation) within electronic resources can be carried out by the user on small or large portions of text taken from the consulted document. The information can then be classified as *primary*, or *full text*, often the case with e-magazines, *secondary*, when they are made up of bibliographical references or summaries (*abstracts*), (ex. Bibliographical databases), or *factual* (ex. numerical databases) (Lyman and Varian, 2000; Woodward, 1998).

At present, both the importance that these resources are assuming in library budgets, and the transition process from paper formats to digital formats, make it particularly interesting to analyze and monitor the process of offering and using this type of service, not only in quantitative terms but also regarding qualitative aspects and user satisfaction (Frazier, 2001; Chen , 2001; Montgomery, 2000).

The aim of this paper is to measure user satisfaction and the quality of the electronic resource consultation services offered by the Milano-Bicocca library.

MEASUREMENT OF RESOURCES

The process of evaluating remote access services in order to determine how close the results obtained come to the objectives implicates distinguishing the determining factors in user satisfaction. This presupposes familiarity with and correct usage of the information available regarding the means and the resources used (International Coalition Of Library Consortia (ICOLC), 2001; Luther, 2001). The fine-tuning of the methodology and the analysis techniques can also be used as a basis for monitoring these services, as well as being an important tool in understanding the evolution of the

phenomena involved. This is especially true if we consider the elevated heterogeneity of the electronic resource market with regard to both the types of products available (e-journals available for a fee, on-line databases, CD-ROM collections, etc.) as well as the ways the services are offered to the user by publishers or distributors (Bell, 2001).

Despite the fact that the investment required for the acquisition and the maintenance of subscriptions is high, the possibility to share the resources via remote access, based on the client/server structure, guarantees that the costs are contained (Bekhrandnia, 1995). In purchasing electronic material, the creation of consortiums among different libraries, in order to pool remote access resources, does not require the physical presence of support within the library, and this can offer all libraries the possibility of expanding their bibliographical patrimony exponentially (Dixon, 2001).

The data furnished by editors or distributors of electronic resources (Mogge, 2001), Mercer, 2000) are usually quantitative (frequency of access and number of information and documents requested), even if in the case of a remote access service, data regarding use and access are more difficult to obtain due to a series of reasons which stem from the client/server communication structure, as well as the technology on which the communication interface is based. There are striking differences in the types of data gathered by the service suppliers. Electronic service suppliers periodically (ex. every month) make reports available to library systems which contain information and statistics regarding the usage of the service. However, since the term electronic resource defines various types of products, a comparison between data from different types of resources is often very difficult. It follows that it is easier for the library system to collect data on certain aspects, for example regarding costs, rather than data regarding the use by the users. Defining guidelines for these reports regarding access to resources shared by diverse library systems seems to be complex. The study of a standard model of reference has to be based on the development of agreements between remote access service suppliers, in order to obtain uniform and comparable data. It is also necessary to develop tools which give libraries the possibility of carrying out an analysis and monitoring process regarding the services offered to the users, as well as making comparisons between one university system and another (Stewart, 1996; Shakel, 1991).

USER IDENTIFICATION

In the process of organizing, managing and measuring the use of the services offered by the library, one of the most important aspects is doubtlessly the definition of the potential users. Defining the potential users for a university library can present difficulties if university libraries promote the diffusion and the sales of their services to external users, like research organizations and private companies. In these cases, the population referred to becomes much larger and includes subjects defined as secondary users. The primary users of a university library are generally considered to be members that belonged to the same institution (students, researchers, professors, staff).

Even though electronic services are available to everyone within the university institution, it is not always so easy to establish which users use the electronic resources, especially if the aim is to develop valid, uniform and comparable service indicators. In the case of electronic resources, in particular it is necessary to understand who reads the e-journals or who does a bibliographical search on a database, that is who is interested

in accessing the information content of the electronic resources. To reach this aim it is crucial to know the nature and the contents of the products published in electronic form (remote access e-journals, bibliographic and factual databases). Notwithstanding the large variety, their contents are principally aimed at satisfying the needs of the primary users of a university library, professors and researchers. They are thus considered to be real, active users.

EVALUATING THE EFFICIENCY AND THE EFFICTIVENESS OF THE ELECTRONIC RESOURCES OF THE MILANO-BICOCCA UNIVERSITY LIBRARY.

To measure the satisfaction level of users and to evaluate, both in terms of efficiency and effectiveness, whether the services offered satisfy the needs of the electronic resource users (on-line databases and e-journals) available, during the year 2001, at the Università degli Studi di Milano – Bicocca, an on-line questionnaire was sent out.

As is known, the measurement of the efficiency, defined as the correct usage of the available resources, can be carried out by measuring the use of the resources in terms of success in reaching objectives. In this sense, an activity is efficient if it minimizes the use of the resource, or if it produces better service with the same resources (ISO 11620, 1998).

Effectiveness, on the other hand, can be determined as the result obtained with respect to the objective to be reached. Often the concept of effectiveness is used as a synonym for quality, as defined by the ISO 9000 standards, on the basis of which the comparison is carried out with predetermined results (standard values).

During the process of evaluating the supply and the use of a service via remote access, both the concept of effectiveness (with reference to the reaching of the preset goals and thus satisfying the user's needs), as well as effectiveness expressed as a relationship between both real and potential users, becomes particularly important (Petretto, 1983).

SURVEY CHARACTERISTICS

As stated above, the instrument studied and realized in order to discover the characteristics, level of satisfaction and behavior of the electronic resources users via remote access **(RER)** of the library system at the University of Milano-Bicocca, was an on-line questionnaire.

Following what has been set out above, the survey population included the professors and researchers present in 2001 at the Universita' degli Studi di Milano-Bicocca. There were 508 subjects (306 professors and 202 researchers). Only 480 of the 508 subjects had been assigned e-mail addresses, thus over 94% of the population was contacted via e-mail during all of the phases of the survey[1].

The survey began on 22.11.2001 and ended on 21.12.2001. The period of reference for the survey was 2001, and the questions included in the survey pertained precisely to that year, or when this was not possible, to the 12 months preceding the filling out of the questionnaire.

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[1] For the 28 subjects without electronic addresses, we sent the questionnaire by post.

The on-line questionnaire was published on a temporary site, whose URL was communicated to the participants, where they were able to fill out the questionnaire directly on the Internet. This technique was chosen for various reasons:
- it was much easier to collect data if each participant filled in the data individually;
- the questionnaire was short and easy to fill out;
- economic advantage: no mailing costs;
- the population, made up of professors and researchers (considering the uniform cultural level) was perfectly capable of filling out the forms;
- the remarkable advantage of sending out the questionnaire to all the people to be interviewed simultaneously. The use of the Internet allowed us to carry out a single mailing to the entire population (the URL for accessing the questionnaire was communicated to everyone at the same time);
- the possibility, offered by web technology, to add a few checks which were generated dynamically, which served to signal errors or missing responses for the questions considered to be the most important;
- the strong analogy with the same phenomena that was being analyzed (using forms which were the same as those available for the consultation of the remote electronic resources);
- absolute anonymity of those who participated.

To minimize the risk of intrusion by people outside the survey population (one of the drawbacks of choosing an on-line questionnaire), we informed each professor and researcher of the URL via e-mail.

We were able to draw up a questionnaire that could be filled out in max. 10-15 minutes and this was pre-tested on a sample of 15 professors, considered to be "experts", in order to evaluate the validity[2] and reliability[3] of the measurement tool we had adopted. During the pretest phase, the questionnaire was made up of 21 questions and in order to evaluate the validity of the content, we added a section for feedback regarding the wording of the questions. The pretest results showed that:
- the questions were easy to understand;
- filling in was easy;
- the length of the questionnaire was acceptable to the "experts";
- two questions needed to be reworded (4.1 and 4.5) to make them more appropriate for inclusion in the survey.

The reliability of the results regarding the opinions of the interviewees, measured on an ordinal scale with 5 ways to respond, was carried out using the calculation of the ? Cronbach coefficient (Cronbach et al., (1955)), which obtained a result of 0.485, considered to be acceptable. The degree of satisfaction was calculated on 3 items[4] regarding: the completeness of the resources, the service performance and the usefulness.

During the pretest phase, the measurement of the behavior and the perceptions of the users regarding our electronic resources presented quite a few difficulties: the opinions

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[2] Validity is the level by which an instrument measures exactly what it was supposed to measure (Anastasi, 1959).

[3] Reliability is the level by which a measuring instrument gives a result with no error (Nunnally, 1994).

[4] In this survey the items referring to the level of customer satisfaction were introduced in questions 5.3, 5.4, 6. The other items of the survey about the satisfaction tested aspects that could not be examined by experienced men's sample.

of the interviewees, in fact, were not always the result of a only positive or negative evaluations, but probably they derived from a synthesis of aspects perceived as positive associated with aspects perceived as negative. For example, during the pretest phase, a neutral judgement (3 on a scale of 1-5) could have reflected the synthesis of contrasting judgements (simultaneous presence of both satisfying and non-satisfying aspects), which resulted in this type of judgement. A 3 could be an expression of the presence of positive and negative components which created a balance between user "satisfaction" and "non-satisfaction" [5].

We also noted that in those questions regarding opinions accompanies by an open question (asking why one had formulated a negative opinion (1 or 2=0, often the interviewee, to clarify the aspects which stopped him from expressing an oriented judgement, responded to the open question even in the event that he had given a 3, ignoring the instructions given. [6]

During the pretest phase we also decided to add a final question, in which we asked the user to make any type of comment about electronic resources. The verification of the reliability of the final results of the questionnaire given to the target population was also carried out through the calculation of the ?' Cronbach coefficient, which gave the acceptable result of ? = 0,663, confirming the appropriateness of the choices made during the initial planning stage.

The Structure of the Questionnaire

The questionnaire was divided into 7 areas with a total of 20 questions.

After filling out the form and submitting it, the data sent flowed in two text files (one for professors and one for researchers) to be filed and conserved by the server, which published the questionnaire.

The first three questions were aimed at gathering information about the population being studied. Question 1 was designed to ascertain the subject's collocation in one of the 22 scientific-disciplinary sectors currently provided for. It was obligatory to respond, and constructed by inserting 22 single choice buttons.

The next two questions, which became more specific in a graduated manner, was meant to identify the real electronic resource users: both question 2 (Are you aware of the existence of electronic resources (on-line data bases and e-journals) in our university library?) and question 3 (Have you ever used these resources?) had two buttons for responding (YES , NO). Automatic codification of the replies associated the value 1 for YES answers and the value 0 for NO answers. While the second question was equipped with a dynamic check in that it was obligatory, the third was posed only to those who had answered affirmatively to the preceding question. The filling-in instructions, inserted in each question, directed the user to the other sections depending on the answers given.

The fourth question introduced the section designed to gather information about the quantitative use during 2001 of the electronic resources in the university library (questions 4.1, 4.2, 4.3 and 4.4). They were questions regarding the frequency and intensity of the use of electronic resources, question 4.4 gave the user the chance to

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[5] These considerations are purely intuitive and are based on the opinions, gathered from the open-ended questions, obtained during the pre-test phase.
[6] This brought about a rewording of the open questions in the final version (Appendix A2).

indicate which resources he had used in the 12 months preceding the interview, using multiple choice pop-up menus.

Areas 5, 6 and 7 were developed to gather information about the perceptions and attitudes of the users in relation to the remote access services made available by the library. In particular, in order to evaluate the degree of satisfaction of the interviewees, both the ordinal scale of 5 degrees and open questions were used.

As is practice in studies which aim at measuring the attitude of individuals, it is assumed that a latent recognizable continuum exists, for which it is possible to construct a monotonous ordinal scale which grows as the favorable predisposition of the interviewee grows in relation to the object of the question. The type of scale was chosen on the basis of the indications of the International ISO 11620 standards (1988), used in the Equinox project (program "Telematics for Libraries" for the European Commission, for the development of methodologies for measuring the performance of library systems) (EQUINOX, 2001).

These documents suggest using a scale of 5 values which correspond to 5 numeric scores with a semantic differential at the two scale extremes. Each question of this type was always followed by an open question, posed only to those who had expressed a negative or neutral opinion (a score of 3, already discussed above), as to why they had given that score.

Characteristics of the Interviewees

270 subjects participated (150 professors and 117 researchers) equal to 53,1% of the target population. The response rate differed depending on the scientific disciplinary sector: from 37,5% (Law) to 77,8% (Ancient Civilization Studies, Art History, Philology and Literature), and it was a little higher for the researchers (57,9%).

Almost all the interviewees stated they were aware of the existence of RER provided by the university. 71,1% (that is 69,3% of the professors and 73,5% of the researchers) claimed to have used RER. The division by disciplinary sector shows a variation between 41,7% (Law Studies) and 100% (Chemistry and Agricultural Science).

On the basis of these results, it is reasonable to assume that during year 2001 the percentage of real users fluctuated between a minimum value of 37,4%, assuming that all those who did not answer were all non-users, to a maximum value of 70,4% (the same percentage of participants that stated they used remote access electronic resources at least once in 2001), assuming that the population of non-participants (those who did not reply to the questionnaire) is characterized by the same percentage of usage as that of those who participated. Substantial similarities between the division among the disciplinary scientific sectors of the target population and the participants seems to confirm the assumption that the percentage of real users is not far from the maximum value hypothesized (70.4%).

Among those who claimed to use electronic resources, hereinafter called **real users,** almost all (98,9%) stated that they had used them at least once during year 2001. The average number of times users accessed the electronic resources was 29 times in 12 moths and, slightly higher for researchers (32 times). The analysis divided by disciplinary sector shows the highest values in Natural Sciences and Physics (Chemistry, Biology, etc.), Mathematics, Computer Science. 92,2% of the participants stated they used the RER once in the period September - November 2001, 76,6% twice and 48,4% three times.

Table 1.

Distribution of the respondents according to the frequency of RER use in 12 months.

	1-5	*6-10*	*11-20*	*21-50*	*More than 50*	*Total*
Frequency	35	27	37	36	55	190
%	18.4	14.2	19.5	18.9	28.9	100.0

The distribution of the scores assigned to the items referring to customer satisfaction and perceptions are described in Table 2.

Table 2.

Effectiveness gauge: distribution of the scores and average values

ITEM	*1*	*2*	*3*	*4*	*5*	*Average Judgement*[(*)]
(5.1.1) RER help on line	1	8	40	22	6	**3.312**
(5.2.1) Librarian assistance	0	4	7	17	24	**4.173**
(5.3) RER completeness	6	26	56	90	11	**3.387**
(5.4) RER performance	0	18	40	114	17	**3.686**
(6) RER utility	3	4	17	41	205	**4.633**

[(*)] *Estimated as an arithmetic mean of the assigned scores*

Item (5.1.1) measured the opinions regarding the effectiveness of on-line help accessed by users who consulted the academic library's RER resources; item (5.2.1) estimated the satisfaction level of the assistance provided by the library for RER use. Average scores associated with the first indicator show a situation of non-complete satisfaction. For the second indicator, 27,1% of the participants claimed to have requested librarian assistance and the average satisfaction score was 4,173. This value shows quite a good level of satisfaction, both in terms of the efficiency of the library staff as well as the assistance supplied. Indicator (5.3) concerns the completeness of the patrimony available on electronic resources, while indicator (5.4) supplies a general opinion on the performance of the electronic resources provided by the library system; both these questions were asked only to the real users of the resources.

As can be seen, the opinions regarding the general performance levels of the remote access service indicate good levels of satisfaction. Indeed almost nobody had problems

with remote access connections or the communication infrastructure (speed of the net, etc.). A lot of negative opinions regard the incompleteness of electronic resources, as shown by indicator (5.3).

The opinion expressed by the entire population regarding the utility of electronic resources (item 6) received a high average (4,633); in this specific case 75,93% of the participants selected the maximum score (5). It is interesting to underline that non-use of electronic resources is due to lack of experience and time for learning the procedure for consulting these resources, thereby even the opinion regarding the utility expressed by non-users was quite high (4,529).

3.4. COST PERFORMANCE INDICATORS

Indications regarding the efficiency of the services can be obtained by using performance indicators based on electronic resource costs. This kind of indicator gives information on how to allocate the financial resources of the library for the purchase of remote access services (Gardois (2001)). In creating these indicators we used data regarding the absolute cost of the resources offered to the users during year 2001, as well as data regarding the population made up of professors and researchers of the Università degli Studi Milano? Bicocca[7]. Thus the indicators calculated in this way allow us to monitor the use of the financial resources employed to increase the bibliographic patrimony already available via Internet. The performance indicators and their numeric values are:

$$\frac{?cost(on\ line\ database\ ?\ e\text{-}journals)?}{?professors\ ?\ researchers?} ?\ 492.62\ \text{€}$$

$$\frac{?on\ line\ database\ cost?}{?professors\ ?\ researchers?} ?\ 277.34\ \text{€}$$

$$\frac{e\text{-}journals\ cost}{?professors\ ?\ researchers?} ?\ 218.28\ \text{€}$$

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[7] We did not consider free electronic resources and those offered as part of paper subscription.

3.4.1. INVESTMENT AND REMOTE ELECTRONIC RESOURCE ACCESS ANALYSIS

Indications regarding the balance between the investment quotas made by each disciplinary sector and the corresponding number of electronic resource accesses can be calculated by comparing the investments in electronic resources and their use.

In order to divide on-line electronic resources and their cost among the different disciplinary sectors, we proceeded to count the number of titles connected to each discipline in each editorial electronic resource package[8]. In each package, we estimated the proportion of electronic resource titles belonging to the different disciplinary sectors. The whole cost of each package was then divided among the disciplines according to this proportion. The investments made for the purchase of electronic reviews was thus split up in proportion to the total sum of the cost of each journal according to the total cost of each e-journal attributable to each single disciplinary area.

For databases in used by several different disciplines, it was impossible to divide their content among disciplinary sectors as we did for journal packages (the number of titles connected to a discipline). We thus considered the product combination bought by the library as a single interdisciplinary resource (database) whose aim was to provide information to all the users, regardless of their specific disciplinary sector. If this hypothesis is acceptable, then the cost sustained for the construction of this electronic patrimony can be divided equally between all of the disciplinary sectors.

The comparison between the cost division of all electronic resources (electronic reviews and database information), for year 2001 per disciplinary sector, and the number of times each resource was accessed is described by the graph of Figure 1. The x axis outlines the access percentages for each disciplinary sector: as those values depend on the "intensity of use" and on the population size of the disciplinary sector, they can not be considered an index of high or low service efficiency, but they can help to verify the balance between the access percentage and the matching investment percentage which is described by y axis. The main diagonal indicates equilibrium and it divides the quadrant into two regions. This graphic description allows us to evaluate whether there is equilibrium among the different disciplinary sectors. This happens when all the points (all disciplinary sectors) are on the diagonal, depicting a situation in which the investment percentage for each discipline produces the same proportion of RER access. A disciplinary sector indicated by a point on the equilibrium line or above it shows an access percentage similar to or greater than the investment percentage for the purchase of resources and therefore, in terms of the access percentage, the result is higher than the proportion of the financial resources used. A point situated below the main diagonal shows that the investment percentage is higher than the percentage of access. The results for the year 2001 outline a general balance between the access percentage and the investment percentage for each disciplinary sector.

The next step is to integrate the instrument described above with an objective analysis of the accesses carried out directly by the servers that publish the resources and that collect these data. Thanks to the integration of these elements, it will actually be possible to analyze and monitor the use of electronic resources and to guarantee further improvement in adapting the service to the real needs of the users.

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[8] An editorial package of reviews is a product, made up of a certain number of journals, bought from an individual supplier (for example Kluwer supplies 737 reviews.).

Figure 1.

Equlibrium level between RER investments and RER access (database and electronic resources) for each disciplinary sector (2001).
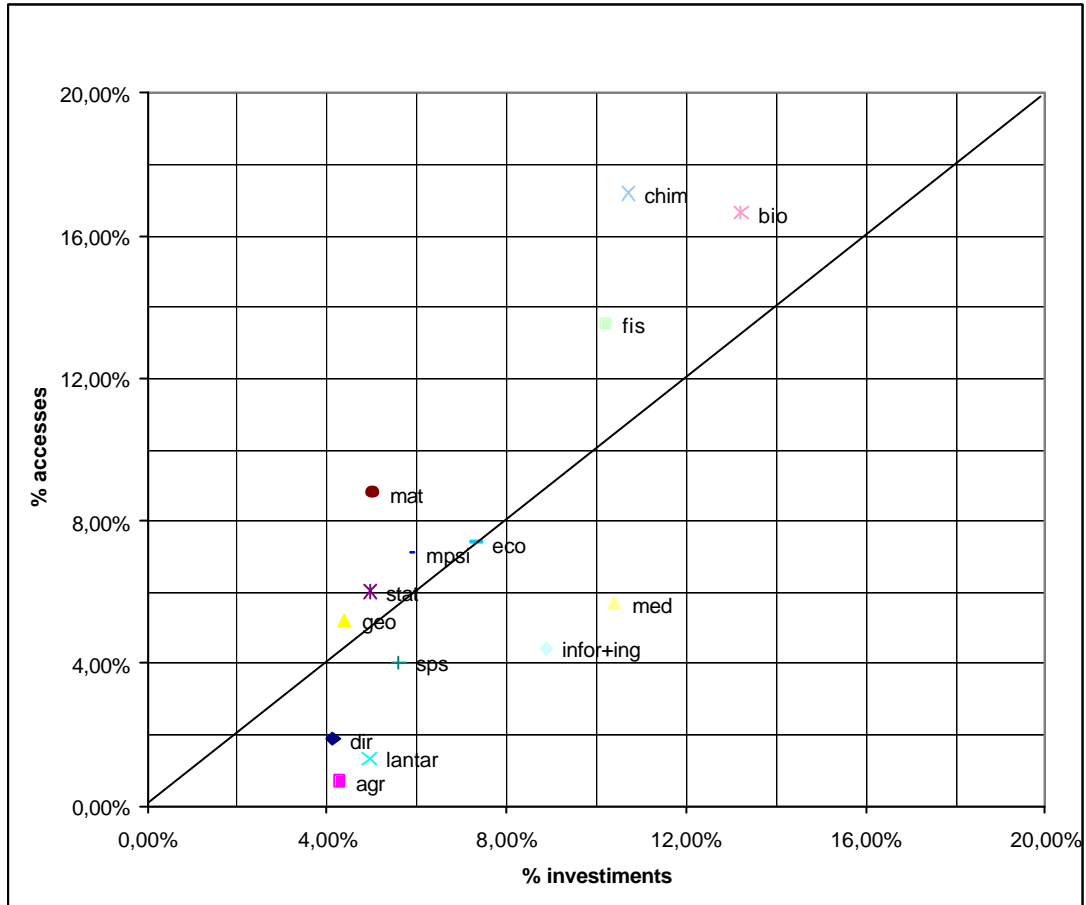
legenda:

agr=*Agricultural Science*; bio=*Sc. Biology*; chim=*Sc. Chemistry*; dir=*law*;
eco=*Sc. Economics*; fis=*Physics*; geo=*Geology*; info+ing=*Computer Science and Engineering*; lantar= *Art History, Literature, Phililogy*; mat=*Sc. Matematics*; med=*Sc. Medicine*; mpsi=*History, Psychology, Education*; sps=*Sc. Political and Social Science*

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