



Technology Services Reports

Analysis of the Journal of Research of the National Institute of Standards and Technology

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Executive Summary

The *Journal of Research of the National Institute of Standards and Technology* (NIST) has been published under various titles and in various forms since 1904. Today it is both an electronic and print publication published six times a year. It continues to serve as a major mechanism for NIST scientists to report on their research in metrology and related fields of physical science, engineering, applied mathematics, biotechnology, statistics, and information technology. This report is the result of a fact gathering effort to assess where the *Journal* is now in order to identify its strengths as a valuable marketing and communications vehicle for NIST as well as areas where it can improve in this role. This fact gathering effort is not exhaustive; it is simply a first look at the available data.

Impact Factor and Citation Analysis

The most recent (2003) impact factor rating for the *Journal* is 0.580. This rating is calculated based on *Journal of Research* articles published in 2001 and 2002. Most journals have an impact factor of less than 1.000. Whether an impact factor for a given title is considered high or not is best determined by comparing it to other titles in the same subject area. In 2003, the *Journal* ranked 18 out of 61 Engineering, Multidisciplinary journals, 19 out of 46 among journals in Multidisciplinary Sciences, and 28 out of 50 among journals addressing Instruments and Instrumentation. The *Journal* compares favorably with its peer journals, including *Measurement*, *Measurement Science and Technology*, and *Metrologia*, all of which have similar impact factor values when compared across a six-year period.

Results of an online computer search in *Science Citation Index* for the period 1990 to June 2004 show that the *Journal of Research* was cited over 22,000 times. Over the past fifteen years, researchers around the world have cited *Journal of Research* articles approximately 1,500 times annually. Although not grouped with the most highly cited physical sciences journals, such as *Physical Review Letters*, this is a respectable number of cites for a specialized research journal. In comparison, peer journals, such as *Metrologia* and *Measurement Science and Technology*, have only been cited about 300 times and 800 times, respectively.

The top ten most highly cited *Journal of Research* papers were published between 1948 and 1977. Five of the top ten papers were published in a relatively short time period from 1948 to 1956, perhaps reflecting important NIST research being done during this period. The three most frequently cited papers were published during this time. The citation frequency for articles published during this time period is quite high, suggesting that these papers are considered classics in their fields. Since older papers may have an advantage over newer papers in citation analysis studies, the Information Services Division (ISD) looked at the citation rates of more recently published (1975 to the present) *Journal of Research* papers as a separate group. Five of the top ten more recent papers were published in the relatively short time period from 1995-1998.

With the exception of three special issues published in the 1990s, the *Journal of Research* special issues have not been cited very frequently. The most frequently cited special issue is v.101(4) 1996 (Bose-Einstein Condensation). Excluding the top three most frequently cited special issues, the average citation rate for *Journal of Research* special issue articles is less than 6 cites per article. It appears that the greater the number of special issue articles, the lower the impact factor, particularly for special issues that have articles with low citation rates, such as conference papers.

Journal of Research Authors

There were 654 authors of 205 articles published between 2000 and 2004, with approximately 43% of the authors having no direct affiliation with NIST. The Information Technology Lab (ITL) has the largest representation among *Journal of Research* authors at 14% (93), with Materials Science and Engineering Lab (MSEL) at 13% (87), and Physics at 11% (71).

Over one third (36%) of NIST authors, who have authored or co-authored at least one *Journal of Research* paper, published 0 or 1 paper in a *Web of Science*¹ journal from 2000 to 2004. Almost two thirds (65%) of NIST authors who published in the *Journal* published 5 or fewer papers in *Web of Science* journals from 2000 to 2004. These percentages would seem to suggest that the *Journal* is an important publishing venue for some NIST scientists. While very few prolific authors publish in the *Journal*, the *Journal* does seem to offer a viable publishing venue for some NIST researchers who might not publish their research elsewhere.

Journal of Research Customers

There are currently 330 subscribers (229 domestic and 101 foreign) through the Government Printing Office (GPO) subscription program. Based on the organization names listed on the subscriber list provided by GPO, ISD can determine that approximately, 45% (147) of the subscribers are academic and corporate libraries.²

In July 2004 ISD contacted a small sample (n=20) of library subscribers to gauge the potential impact of the *Journal* becoming electronic-only. Most of the respondents had no concerns about the possible ceasing of the print *Journal*. They indicated that most library users prefer to use electronic journals. The only concerns expressed had to do with archiving and perpetual access. ISD was able to address these concerns by explaining that it is continuing to digitize and make available current and back issues of the *Journal*.

Of the over 1,200 federal depository libraries nationwide, over 700 include the *NIST Journal of Research* in their electronic collections. Customers can locate a link to the electronic *Journal* and find information about the print version from the online version of the *GPO Catalog of U.S. Government Publications* at <http://www.gpoaccess.gov/libraries.html>. Access to the electronic version of the *Journal* through the Federal Depository Library Program gives it more visibility than it had as a print only publication since readers no longer need to request access to the physical depository library to read the *Journal*.

¹ *Web of Science* is the Web version of the *Science Citation Index* produced by the Institute for Scientific Information (ISI).

² These library subscribers are considered ISD/NIST's customers. The readers who use the *Journal* at these libraries are the customers of those libraries. ISD does not know who those customers are and does not have access to those customers.

Indexing Coverage

The *Journal* enjoys wide exposure with coverage in over 25 major journal indexes and abstracting services. The indexing of a journal in established, reputable indexing and abstracting services is considered to be a measure of impact and quality. The *Journal's* extensive coverage in major indexing and abstracting services indicates that it is considered a high quality research publication.

Printing and Printing Costs

ISD is allocated \$34K in institutional support funds each year to cover costs for the printing of the *Journal*. These funds pay for the printing of copies that are disseminated by ISD. The funds also pay for multiple copies of “separates” (reprints) of each article for contributing authors. GPO pays for the copies distributed to subscribers through the sales program through a “distribution rider” on NIST’s contract with the printer. These copies go directly from the printer to GPO and GPO is invoiced for the costs.

Color issues significantly increase the printing costs. In fiscal year 2004, the color issue (v109, n2) cost approximately \$12,000 to print, representing over half of the funds expended for all six issues printed in that year. There are no additional costs to produce color images for the electronic versions of *Journal* articles.

Changes at GPO

In 2001, the Federal Depository Library Program (FDLP) of the GPO was directed by the U.S. Congress to make “online dissemination” the primary method for making federal publications available to the public. The guidelines provided by the GPO Superintendent of Documents indicate that when an agency information product is available in both electronic and print formats, only the electronic format is to be disseminated to the federal depository libraries. Beginning in fiscal year 2005, GPO will also be implementing new print procurement and dissemination models in recognition of the government-wide decline in printing needs due to the increase in electronic dissemination of agency publications. For those customers still desiring print versions of agency publications, GPO is planning to offer a “Print-on-Demand” service. GPO has recognized that electronic format is quickly becoming the norm for the majority of federal documents.

Changes in Scientific/Technical Scholarly Publishing

The environment in which traditional journals operate is changing drastically. Almost every print journal has an electronic counterpart that is available through the Internet. The digital networked environment is changing journal usage patterns and enhancing their visibility. Recent studies of researchers at universities nationwide have revealed an overwhelming preference for using journals in electronic format. In fact, nearly half of all faculties in most disciplines (with over 60 percent in the biological and physical sciences) reported that they use online resources for the majority of their work.

Preliminary results from a number of recent studies are indicating that electronic access improves both readership and citation impact. In April 2004, ISI released information on its first study of the impact of open access (electronic) journals. (Open access refers to the free availability of scholarly publications through the Internet.) ISI found that while open access journals have a similar citation pattern to other journals, they may have a tendency to earlier citation than their print counterparts.

On the basis of the data collected from interviews with journal editors and publishers, some overall conclusions about trends in scientific journal publishing can be drawn that are consistent with what ISD is hearing at professional meetings and seeing in the trade/professional literature. The data indicates that most journal publishers are struggling with production cost issues. Those journals that have surveyed their customers report that, in general, libraries or institutional subscribers prefer electronic journals to their print counterparts. The decision to eliminate print journal formats will increasingly be considered by many journals as a serious and likely alternative, rather than as a hypothetical exercise in cost analysis.

Value of Electronic Only

A printed issue of the *Journal* requires a minimum number of pages. In order to produce a paper product that has “back strip” binding, there must be at least 64 pages in the issue to be printed. An electronic version has no similar packaging or size restrictions or requirements and therefore can be produced and disseminated much more rapidly than the print version.

In a digital world, information can be packaged, re-packaged, and distributed in a variety of ways. For example, articles can be posted to the Web as soon as they are ready. There are no size constraints as in the print model of journal publishing. Furthermore, users have a variety of ways of accessing electronic articles that are well organized and tagged with a good mark-up language (such as XML). Articles can be enhanced through a rich integration of links to and from related material.

Web Statistics

Between January 1, 2004 and August 31, 2004 (244 days), there were almost 450,000 hits by external customers on the *Journal's* Web pages on the NIST Virtual Library (NVL). Nearly 300,000 files of articles and 80,000 files of images were downloaded during this same time period. These high numbers and pattern of use seem to indicate that readers of the electronic version of the *Journal* are frequently taking advantage of what the digital medium has to offer.

Issues

During the last few years, there have been considerable delays in the production and publishing of the *Journal*, with publication running two issues behind schedule. Delays have occurred most often as a result of time spent on large, special issues; authors and editors of special issues not adhering to manuscript submission requirements and deadlines; problems with clarity of figures and graphs, requiring additional work with the authors to obtain files in the correct format; and

difficulties over producing the artwork for the covers.³ The Board of Editors has taken on some of the responsibilities normally held by a journal publisher. This overlap in editorial and publishing duties between ISD and the Board of Editors contributes too many of the delays in production. In its role as the *Journal's* publisher, ISD intends to work with the Board of Editors to clearly define roles and responsibilities to ensure that the *Journal* is produced on time.

Delays in publishing can adversely affect a journal's impact factor. Furthermore, subscribers or readers who become impatient waiting for the next issue of the journal or are uncertain about its reliability will turn to other sources of information. For the *Journal* to be successfully produced on time, the Board must agree to abide by scheduled deadlines and the defined roles and responsibilities.

Conclusion and Recommendations

The *Journal of Research* has an established reputation as a premier publication for articles on federally funded research results in metrology and related sciences. Recent data show that the *Journal* compares favorably with its peer journals and is considered a high quality research publication based on its impact factor and extensive coverage in major indexing and abstracting services. The *Journal* continues to be cited frequently with very high citation rates for articles published in the 1950's and 1960's. It is clearly a worthy publishing venue for NIST researchers and has the potential to become a valuable communication vehicle for NIST's leadership role in the U.S. Measurement System.

ISD is addressing some of the causes of delays in production through improving communication with the Board of Editors and authors regarding manuscript preparation and production deadlines. ISD proposes the selection and use of a single cover design for all issues in a volume year to reduce the time and effort spent on the cover, which has little or no impact on article citation patterns. In addition, the Board should consider eliminating large, special issues, especially those devoted to conference papers; and reducing the number of *Journal* issues produced each year to four to help address the delays in production. By eliminating large, special issues consisting of conference papers, the Board will also be addressing the *Journal's* declining impact factor since most of the *Journal's* special issues are not cited very frequently.

As the publisher of the *Journal*, ISD continues to look at ways to be fiscally responsible by controlling costs while producing a valuable information product in a timely manner. ISD intends to focus on applying the new emerging models of electronic publishing to the production of the *Journal*. *Journal* articles can be enhanced through a strong integration of links to and from related material. Flexibility in publishing an electronic-only journal removes the constraints found in the print model of journal publishing. Since the *Journal* fits into the open access model of publishing, NIST can take a leading role in the open access publishing forum, thereby increasing NIST's visibility within the scientific/technical scholarly publishing community. Open access publishing of scientific literature is fast becoming of increasing interest among scientists around the world, including those at NIST.

³ Images first became part of the cover design with Volume 105 (2000).

To strengthen the *Journal's* reputation among scholarly research journals, ISD recommends that the *Journal* place more emphasis on review articles⁴ and less emphasis on conference and workshop papers, which appear to have low citation patterns. Further analysis of highly cited *Journal* papers by subject experts within the NIST research community will help guide editorial decisions for future issues of the *Journal*.

ISD recommends marketing the *Journal* internally as a vehicle for NIST authors to share the results of their research. To identify ways to market the *Journal* to potential NIST authors, ISD proposes soliciting NIST researchers' opinions through a survey or through focus groups to learn how they view the *Journal* as a potential publishing avenue.

ISD recommends exploring the concept of splitting the *Journal* into two parts. One part would keep the *Journal's* established technical focus targeted to scientists and researchers, while the second part could become a vehicle for disseminating information about NIST's research activities to a non-scientific audience. The *Journal* can be used as a vehicle for helping NIST reaffirm its role and communicating a 21st century view of the U.S. measurement system.

ISD believes that assessing the potential of the *Journal* is critical, especially as NIST looks for ways to communicate its relevance to policy-makers, industry, and others. The question is not should there be a *Journal*, but what content should the *Journal* contain to make it a valuable marketing/communications vehicle for NIST.

⁴ Review articles can be defined as critical analyses of recent developments in a field of study that brings together information about previously published research.

1. Introduction

The *Journal of Research of the National Institute of Standards and Technology* (NIST) has been published under various titles and in various forms since 1904. It had its roots as *Scientific Papers* issued as the *Bulletin of the Bureau of Standards*. In 1928, the *Scientific Papers*, which reported results of work in science and technology, were combined with *Technologic Papers*, which reported results of investigations of material and methods of testing. This new publication was titled the *Bureau of Standards Journal of Research*. Beginning in 1959, the *Journal* was published in four separate sections, A, B, C, and D. Section A covered physical and chemical research, Section B covered studies in mathematics and mathematical physics, Section C covered engineering and instrumentation, and Section D covered research in radio propagation, communications, and atmospheric physics. In 1977 Sections A and B were combined and published as the *Journal of Research of the National Bureau of Standards*.⁵

Today the *Journal* is published six times a year and it continues to serve as a major mechanism for NIST scientists to report on their research in metrology and related fields of physical science, engineering, applied mathematics, biotechnology, statistics, and information technology. In 1997, the *Journal* became both a print and electronic publication. Articles published in the *Journal* since 1982, volume 87 (with the exception of volume 99 and five issues of volume 92) are currently available on the NIST Virtual Library (NVL) at http://nvl-i.nist.gov/nvl3.cfm?doc_id=89&s_id=117#jr.

Periodically, over the last seven years, NIST Management has raised questions in connection with continued financial support of the *Journal* as well as the future of the *Journal* in the context of scientific and technical publishing. In light of the budget cuts in Institutional Support over the last three fiscal years and the significant changes taking place at the Government Printing Office (GPO), which disseminates the *Journal* through its sales and Federal Depository Library programs, this is a good opportunity to take a critical look at the *Journal* to begin charting a new course for its future.

This report is the result of a fact gathering effort to assess where the *Journal* is now in order to identify its strengths as a valuable marketing and communications vehicle for NIST as well as areas where it can improve in this role. This fact gathering effort is not exhaustive; it is simply a first look at the available data. The report begins by examining the *Journal's* impact factor and citation frequency. It looks at the characteristics of the *Journal's* authors and customers and briefly touches on some production issues, including costs for printing. The report also addresses the changes underway at GPO as well as a few of the developments in the scientific and technical publishing arena that will inevitably have an impact on the *Journal's* future. The report concludes with some recommendations for the *Journal* to remain relevant and viable in the future.

⁵ Schooley, J.F., *Responding to National Needs: The National Bureau of Standards Becomes the National Institute of Standards and Technology, 1969-1993*. Appendix J. Section C of the *Journal* ceased publication in 1972 and Section D continued to be published by the Environmental Science Services Administration beginning in 1966.

2. Impact Factor and Citation Analysis

2.1 Journal of Research Impact Factor

In order to determine the *Journal of Research*'s position in relation to its peer journals and to assess the collective performance of the *Journal* over the last several years, ISD looked at the *Journal*'s impact factors and highly cited issues and papers.

The most recent impact factor rating for the *Journal* is 0.580⁶. Defined by the Institute for Scientific Information (ISI), the producer of *Science Citation Index* and the inventor of the journal impact factor, the ISI impact factor is the average number of times recent articles in a specific journal were cited in the *Journal Citation Reports (JCR)*⁷ cover year. Recent articles are those published in the two years proceeding the *JCR* cover year.

Based on the definition above, the 0.580 impact factor for the *Journal of Research* in 2003 is calculated based on *Journal of Research* articles published in 2001 and 2002. The impact factor is calculated by dividing the total number of cites to articles published in 2001 and 2002 by the total number of articles for that time period.

The impact factor is useful in understanding the significance of absolute citation frequencies. It tends to discount the advantage of large journals over small ones, of frequently issued journals over less frequently issued ones, and of older journals over newer ones. Impact factor values can range from 0.000 to over 30.000. Most journals have an impact factor of less than 1.000. Whether an impact factor for a given title is considered high or not is best determined by comparing it to other titles in the same subject area. According to ISI, "citation and publication patterns differ between disciplines, so the impact factor is only meaningful when it is used to compare journals within a discipline."⁸

ISI currently categorizes and ranks the *Journal* in two subject categories – Engineering, Multidisciplinary and Multidisciplinary Sciences. The Engineering, Multidisciplinary category covers resources having a general or interdisciplinary approach to engineering. Specific topics include computer science and mathematics in engineering, engineering education, reliability studies, and audio engineering. The Multidisciplinary Sciences category covers the spectrum of major scientific disciplines such as Physics, Chemistry, Mathematics, Biology, etc. *Nature* and *Science* are the preeminent journals in this category.⁹ Prior to 1997 the *Journal* was categorized only in the Engineering category. Table 2.1 shows the *Journal*'s impact factor and rank within its ISI subject categories for the years 1991-2003. It is not clear why the *Journal* is not categorized in the Instruments and Instrumentation category with the other metrology journals, such as *Metrologia* and *Measurement Science and Technology*. To show how the *Journal* would compare with such journals as *Metrologia* and *Measurement Science and Technology* had ISI included it in the Instruments and Instrumentation category, this category ranking is provided in Table 2.1, shown in italics.

⁶ Based on 2003 ISI *Journal Citation Reports* data.

⁷ *Journal Citation Reports* is an ISI product that provides quantitative tools to evaluate and compare journals. One of those tools is the impact factor.

⁸ The impact of open access journals: A citation study from Thomson ISI, 2004.
<http://www.thomsonisi.com/media/presentrep/acropdf/impact-oa-journals.pdf>

⁹ Scope notes for Science Citation Index and Science Citation Index Expanded,
http://www.isinet.com/journals/scope/scope_scie.html

Table 2.1: Journal of Research Subject Category Ranking and Impact Factor, 1991-2003

Year	Impact Factor	Rank with ISI Subject Category
1991	0.414	11 out of 66 (Engineering) <i>20 out of 42 (Instruments and Instrumentation)</i>
1992	0.753	4 out of 68 (Engineering) <i>12 out of 39 (Instruments and Instrumentation)</i>
1993	0.328	13 out of 45 (Engineering) <i>19 out of 35 (Instruments and Instrumentation)</i>
1994	0.732	4 out of 44 (Engineering) <i>11 out of 35 (Instruments and Instrumentation)</i>
1995	0.778	3 out of 49 (Engineering) <i>9 out of 38 (Instruments and Instrumentation)</i>
1996	0.613	7 out of 53 (Engineering) <i>13 out of 38 (Instruments and Instrumentation)</i>
1997	1.187	1 out of 56 (Engineering) 12 out of 56 (Multidisciplinary Sciences) <i>7 out of 47 (Instruments and Instrumentation)</i>
1998	1.889	1 out of 59 (Engineering) 7 out of 62 (Multidisciplinary Sciences) <i>3 out of 53 (Instruments and Instrumentation)</i>
1999	2.400	1 out of 60 (Engineering) 4 out of 51 (Multidisciplinary Sciences) <i>1 out of 53 (Instruments and Instrumentation)</i>
2000	1.611	1 out of 58 (Engineering, Multidisciplinary) 6 out of 49 (Multidisciplinary Sciences) <i>2 out of 53 (Instruments and Instrumentation)</i>
2001	0.605	13 out of 58 (Engineering, Multidisciplinary) 17 out of 45 (Multidisciplinary Sciences) <i>21 out of 49 (Instruments and Instrumentation)</i>
2002	0.766	10 out of 61 (Engineering, Multidisciplinary) 14 out of 48 (Multidisciplinary Sciences) <i>19 out of 53 (Instruments and Instrumentation)</i>
2003	0.580	18 out of 61 (Engineering, Multidisciplinary) 19 out of 46 (Multidisciplinary Sciences) <i>28 out of 50 (Instruments and Instrumentation)</i>

The ISI impact factors for the *Journal* remained roughly the same from 1991 through 1996. The impact factor then jumped to 1.187 in 1997 and rose steadily in 1998 and 1999. The Bose-Einstein special issue published in 1996, which is the most highly cited *Journal of Research* special issue, is likely to have contributed to the increase in the impact factor for 1997 and 1998. The high impact factor in 1999 may be attributed to two or three 1997 and 1998 papers with high citation rates (see Table 2.5) and the relatively lower total number of articles published in the 1997 and 1998 *Journal* issues (see Table 2.6b). The higher the citation rate and the fewer number of articles result in a higher impact factor. It is also possible that there may have been an overall increase in citation rates in 1997 and 1998 due to the debut of the electronic version of the *Journal* in 1997. As a full-text online publication, the *Journal of Research* gained even greater visibility and offered broader access to readers at a time when e-journals were just emerging on the market.

In July of this year ISD contacted ISI to find out why the *Journal* was not categorized and ranked with other metrology journals. While no explanation was offered, ISI informed us, that upon review of recent issues of the *Journal*, they had decided to include it in the Instruments and Instrumentation category from this point forward. Therefore, the *Journal* will now be ranked and listed in three subject categories in ISI's *Journal Citation Reports*. This is significant because the *Journal* will be ranked with other metrology journals and will have additional subject coverage in ISI indexes and databases.

2.2 Impact Factor Comparison

To give some additional context for and understanding of the *Journal's* impact factors, ISD looked at the impact factors of other metrology journals, as well as journals in the physical sciences with broader subject coverage, over a six year period. See Table 2.2. In looking at these data however, it is important to keep in mind that meaningful comparisons should only be made within a discipline and not across disciplines.

Table 2.2: Impact Factor Comparison, 1998-2003

Journal	Impact Factors					
	1998	1999	2000	2001	2002	2003
NIST Journals						
Journal of Research of the National Institute of Standards and Technology	1.889	2.400	1.611	0.605	0.766	0.580
Journal of Physical and Chemical Reference Data	6.229	9.892	8.756	4.488	3.333	4.000
Journals of other research institutions						
PTB-Mitteilungen (Germany)	0.130	0.200	0.074	-	0.050	0.029
Johns Hopkins APL Technical Digest	0.174	0.230	0.232	0.556	0.310	0.099
IBM Journal of Research and Development	0.930	1.425	1.944	2.560	3.700	3.606
Bell Labs Technical Journal	0.329	0.779	1.048	1.175	0.694	0.673
Other measurement journals						
Measurement (Elsevier)	-	-	-	-	0.486	0.434
Measurement Science and Technology (IoP)	0.659	0.857	0.796	0.859	0.845	0.822
Metrologia (IoP, BIPM)	0.420	1.055	0.820	0.945	0.842	0.983
Review of Scientific Instruments	1.177	1.293	1.239	1.352	1.437	1.343
Other physical science journals						
Physical Review Letters	6.017	6.095	6.462	6.668	7.323	7.035
Physical Review B	2.842	3.008	3.065	3.070	3.327	2.962
Macromolecules	3.440	3.534	3.697	3.733	3.751	3.621
Journal of Applied Physics	1.729	2.275	2.180	2.128	2.281	2.171

Specialized journals, such as the *Journal of Research and Metrologia*, generally have lower impact factors than journals with broader coverage such as *Physical Review Letters* and the *Journal of Physical and Chemical Reference Data*. This seems to be typical of specialized journals. *Review of Scientific Instruments*, specializing in instrumentation, is as reputable a journal as any of the most prestigious physical sciences journals, but its impact factor (1.343 in 2003) does not approach that of *Physical Review Letters* (7.035 in 2003), which is much broader in its coverage. The *Journal of Research* does compare favorably with its peer journals, including *Measurement*, *Measurement Science and Technology*, and *Metrologia*, all of which have similar impact factor values when compared across the six-year period.

Table 2.2 shows that the impact factor for the *Journal of Research* peaked in 1999. This is also true of several other comparable titles, including *Metrologia*, the *Journal of Physical and Chemical Reference Data*, *PTB- Mitteilungen*, and the *Journal of Applied Physics*. Although this is an interesting pattern, it is difficult to determine if it is significant or not. The pattern of high citation rates for 1999 might indicate that some important research results published in 1997 and 1998 were being cited more frequently than research in the years immediately preceding and following this time period. The question of why the *Journal* citation rate peaked in 1999 is further explored later in this report.

There are a number of factors that can influence the rise or decline of a journal's impact factor. ISI suggests that "careful attention to the many phenomena that influence citation rates" be made when looking at a journal's impact factor. In addition to looking at a journal's ranking within its peer group, one should also examine the citation frequency of a journal as a whole as well as the frequency of citations of individual articles to get a complete picture of its standing in its field and to assess its overall performance.

2.3 Citation Frequency

Citation frequency is an indicator of how often a paper has been cited in the literature. To get a general idea of how frequently the *Journal of Research* has been cited in recent years, ISD conducted an online computer search in *Science Citation Index*. The search was conducted in June 2004, in Dialog File 34, SciSearch 1990-2004. NBS/NIST papers being cited include papers back to 1934. The date of 1934 was chosen because this is when the *Journal* began being published under the title *Journal of Research*. Prior to 1934, the *Journal* was known as *Bulletin of the Bureau of Standards* (1904-1919); *Scientific Papers of the Bureau of Standards* (1919-1928); *Technologic Papers of the Bureau of Standards* (1910-1928); and *Bureau of Standards Journal of Research* (1928-1934). Citing paper coverage is from 1990 to the present. The citing paper coverage of 1990 to the present was determined by the coverage of the file being searched.

During the period from 1990 to June 2004, the *Journal of Research* was cited over 22,000 times. This citation count is an estimate and took into account the various title changes of the *Journal* since 1934. In addition, it includes many variations in citing the *Journal*, such as misspellings (i.e., J RES NATL VUR STAND) and a variety of abbreviations (i.e., J RES NBS PAP). Including the variations, misspellings, etc., the *Journal* was cited almost 200 different ways.

Over the past fifteen years, researchers around the world have cited *Journal of Research* articles approximately 1,500 times annually. Although not grouped with the most highly cited physical sciences journals, such as *Physical Review Letters*, this is a respectable number of cites for a specialized research journal. In comparison, peer journals, such as, *Metrologia* and *Measurement Science and Technology* have been cited about 300 times and 800 times, respectively.

In addition to this general overview, ISD studied the citation frequency of the *Journal* from several more specific perspectives, including an historical look at the *Journal* during two specific time periods: 1934-2004 and 1975-2004. ISD also looked at the citation frequency of special issues published from 1985 to 2003. The effect that special issues have on the *Journal's* impact factor deserves special attention and is addressed later in section 2.6.

2.4 Citation Frequency of Articles Published Since 1934

The most highly cited *Journal of Research* papers published since 1934 are listed in Table 2.4. Coverage of citing papers is from 1975 to the present, which was determined by ISD's subscription to the *Web of Science* database, which includes files from 1975 to the present.

Publication years for the “top ten” papers ranged from 1948 to 1977. Five of the “top ten” papers were published in a relatively short time period from 1948 to 1956, perhaps reflecting important NIST research being done during this period. The three most frequently cited papers were published during this time.

The citation frequency for articles published during this time period is quite high. It would suggest that these papers are classics in their fields. This high citation rate also suggests that the *Journal of Research* was a reputable, well-respected journal. Many researchers were aware of the *Journal* and cited it frequently.

Why were these specific papers cited so frequently? Was it because the research discussed in the papers was so significant, or because the research had not been published elsewhere? What makes a *Journal of Research* paper get cited frequently? These are questions that cannot be answered without further analysis of the specific articles. The answers to these questions will help guide editorial decisions for future issues of the *Journal* and could ultimately have a positive effect on the *Journal's* impact factor. ISD recommends exploring the answers to these questions and studying the most highly cited *Journal of Research* papers with help and input from subject experts within the NIST research community.

Table 2.4: Top Ten Most Frequently Cited Articles Since 1934

Citation Frequency	Article Author, Title, Volume, Issue, Date
1117 times	Lanczos, C., <i>Journal of Research</i> 45:255, 1950 (Iteration method for the solution of the eigenvalue problem of linear differential and integral operators)
1104 times	Hestenes, M.R., <i>Journal of Research</i> 49:409, 1952 (Methods of conjugate gradients for solving linear systems)
801 times	Kissinger, H.E., <i>Journal of Research</i> 57:217, 1956 (Variation of peak temperature with heating rate in differential thermal analysis)
697 times	Hoffman, J.D., <i>Journal of Research</i> 66A:13, 1962 (Melting process and the equilibrium melting temperature of polychlorotrifluoroethylene)
620 times	Greenspan, L., <i>Journal of Research</i> 81:89, 1977 (Humidity fixed points of binary saturated aqueous solutions)
507 times	Broadhurst, M.G., <i>Journal of Research</i> 66A:241, 1962 (Analysis of the solid phase behavior of the normal paraffins)
466 times	Flynn, J.H., <i>Journal of Research</i> 70A:487, 1966 (General treatment of the thermogravimetry of polymers)
437 times	McCrackin, F.L., <i>Journal of Research</i> 67A:363, 1963 (Measurement of the thickness and refractive index of very thin films)
386 times	Woolley, H.W., <i>Journal of Research</i> 41:379, 1948 (Compilation of thermal properties of hydrogen in its various isotopic and ortho-para modifications)
361 times	Haupt, G.W., <i>Journal of Research</i> 48:414, 1952 (An alkaline solution of potassium chromate as a transmittance standard in the ultraviolet)

2.5 Citation Frequency of Articles Published Since 1975

The data in Table 2.4 shows that several papers during the 1950's and early 1960's are widely read and cited. Since older papers may have an advantage over newer papers in citation analysis studies, ISD looked at the citation rates of more recently published *Journal of Research* papers as a separate group. Table 2.5 lists the most frequently cited papers published in the last 30 years. The most frequently cited "recent" paper (Hoffman, J.D., 1975) was cited 294 times, which is less than the least cited paper among the "top ten" papers since 1934 (Haupt, G.W., 1952).

Five of the "top ten" more recent papers were published in the relatively short time period from 1995-1998. This likely accounts for the higher ISI impact factors for the *Journal of Research* for 1997 to 2000.

The lower citation frequency of *Journal* papers published in the last thirty years might suggest that the *Journal* has lost some of its influence and prestige. One way to determine if this is actually the case would be to study the citation patterns of the most highly cited “classic” papers that were published in the 1950s and 1960s. Do these papers continue to be cited, or were they cited frequently only in the years immediately following their publication? If the papers continue to be cited, then these older papers do indeed have an advantage over more recent papers, leading to higher and higher citation rates as the paper gets older. It then becomes more difficult to make the argument that the *Journal*’s influence might be on the decline. The more recent, less frequently cited papers may very well approach the higher citation rates of the 1950s and 1960s papers 40 to 50 years from now.

Table 2.5: Top ten most frequently cited articles published since 1975

Citation Frequency	Article Author, Title, Volume, Issue, Date
294 times	Hoffman, J.D., Journal of Research 79:671, 1975 (Growth-Rate of Spherulites and Axialites from Melt in Polyethylene Fractions - Regime-1 and Regime-2 Crystallization)
213 times	Wineland, D.J., Journal of Research 103:259, 1998 (Experimental issues in coherent quantum-state manipulation of trapped atomic ions)
119 times	Tiesinga, E., Journal of Research 101:505, 1996 (A spectroscopic determination of scattering lengths for sodium atom collisions)
110 times	Miller, P.A., Journal of Research 100:427, 1995 (An Inductively-Coupled Plasma Source for the Gaseous Electronics Conference Rf Reference Cell)
95 times	Roth, R.S., Journal of Research 95:291, 1990 (Phase-Equilibria and Crystal-Chemistry in Portions of the System SrO-CaO-Bi ₂ O ₃ -CuO, .2. The System SrO-Bi ₂ O ₃ -CuO)
88 times	Angell, C.A., Journal of Research 102:171, 1997 (Entropy and fragility in supercooling liquids)
77 times	Drexhage, K.H., Journal of Research 80:421, 1976 (Fluorescence efficiency of laser-dyes)
61 times	Hammouda, B., Journal of Research 98:31, 1993 (Small-angle neutron-scattering at the National Institute of Standards and Technology)
58 times	Villarrubia, J.S., Journal of Research 102:425, 1997 (Algorithms for scanned probe microscope image simulation, surface reconstruction, and tip estimation)
53 times	Devoe, H., Journal of Research 86:361, 1981 (Generator columns and high-pressure liquid-chromatography for determining aqueous solubilities and octanol-water partition-coefficients of hydrophobic substances)
53 times	Goldberg, R.N., Journal of Research 90:341, 1985 (Thermodynamics of solution of SO ₂ (g) in water and of aqueous sulfur-dioxide solutions)

2.6 Citation Frequency of Special Issues

With the exception of three special issues published in the 1990s, the *Journal of Research* special issues have not been cited very frequently. Table 2.6a shows the citation frequency of special issues published since 1985. Excluding the top three most frequently cited special issues, the average citation rate for *Journal of Research* special issue articles is less than 6 cites per article. A total of 17 special issues were published from 1985 to 2003. One special issue published in 2004 is not included in Table 2.6a because it had not been indexed in *Web of Science* at the time ISD collected the data, and it would not have been available to researchers long enough to have a significant citation history.

Special issues typically include more articles than regular *Journal* issues, which average about six articles per issue. If a special issue is cited infrequently, the ISI impact factor for the *Journal* can be adversely affected in the two years after an infrequently cited special issue appears. The fewer the number of times papers are cited in a given year and the greater the number of articles published in that year, the lower the ISI impact factor.

Table 2.6a: Citation Frequency of Special Issues Published Since 1985

Citation frequency	Journal of Research Volume, Issue, Date, Special Issue Title	Number of articles
419 times	v.101(4) 1996 (Bose-Einstein Condensation)	15
194 times	v.98(1) 1993 (NIST Cold Neutron Research Facility)	10
162 times	v.102(2) 1997 (40 Years of Entropy & the Glass Transition)	8
96 times	v.99(4) 1994 (Extreme Value Theory)	28
93 times	v.101(3) 1996 (Crystallographic Databases)	21
77 times	v.90(6) 1985 (Chemometrics Conference Proceedings)	12
46 times	v.93(3) 1988 (Accuracy in Trace Analysis)	130
44 times	v.97(1) 1992 (Platinum/Neon Spectrum)	3
42 times	v.94(1) 1989 (Role of Numeric Databases in Materials and Biological Sciences)	10
40 times	v.95(2) 1990 (Radon Measurement Standards and Calibration)	11
35 times	v.105(1) 2000 (Applications of High Precision γ -Spectroscopy)	24
26 times	v.91(1) 1986 (pH Measurements in Rainwater)	5
14 times	v.106(1) 2001 (Centennial Issue: NBS/NIST 100 Years of Measurement)	12
14 times	v.106(6) 2001 (Crystallography at NBS/NIST)	18
12 times	v.91(2) 1986 (Biomedical Sampling)	7
11 times	v.107(6) 2002 (Accuracy Barriers of Quantitative Electron Beam X-ray Microanalysis)	19

Table 2.6b compares the number of *Journal of Research* special issue articles to the total number of *Journal* articles published from 1996 to 2002, and demonstrates how this relationship can affect the impact factor of the *Journal*.

Table 2.6b: Journal of Research Special Issues and the ISI Impact Factor

	Total # of articles	Special issue articles	# of articles used to calculate <u>IF</u>	# of special issue articles affecting <u>IF</u>	Impact Factor
1996	55	36			0.613
1997	34	8			1.187
1998	28	0	89	44	1.889
1999	26	0	62	8	2.400
2000	60	24	54	0	1.611
2001	55	30	86	24	0.605
2002	49	19	115	54	0.766
2003	33	0	104	49	0.580

Table 2.6b shows that the impact factors for the three most recent years (2001, 2002, and 2003) are the lowest since 1997. At the same time, the number of articles used to calculate the impact factors for these years is greater than the number of articles used in the impact factor calculations for the two previous years, 1999 and 2000, which have higher impact factors. The greater number of articles in 2001, 2002, and 2003 is due, in part to special issues that typically contain well over the average number of articles per issue, which is about 6 articles per issue. For both 1999 and 2000, when the impact factor was well above 1.0, a total of only 8 special issue articles were published.

Generally speaking, it appears that the greater the number of special issue articles, the lower the impact factor, particularly for special issues that have articles with low citation rates. The special issues of the *Journal* typically contain conference papers. Citation analysis shows that these papers have lower citation rates than other types of articles. This is most evident with the 2003 impact factor, which is calculated based on a total of 104 articles, 49 of which are special issue articles, which on average were cited less than 1 time per article. The low citation frequency of special issues, which often require a great deal of time and effort to produce, indicates that some editorial decisions about continuing special issues may be warranted. It appears that the *Journal* may have higher citation rates and higher impacts by publishing a few excellent metrology articles that highlight NIST's most important research.

The one exception to the pattern described above is the 1998 impact factor of 1.889, which is calculated based on a fairly high number of articles (89), published in the years 1996 and 1997. Two of the most highly cited special issues were published during this time, including the Bose Einstein special issue, which has been cited 419 times since it was published. This citation count is twice that of any other special issue. So, even though the number of articles increased - in large part due to the 44 special issue articles - the number of times 1996 and 1997 papers were cited was also high leading to a fairly high impact factor of 1.889 for 1998.

As another way to test this theory, ISD calculated the impact factors for regular *Journal of Research* articles and for special issue articles separately using data collected from the *Web of Science* database. Table 2.6c shows these impact factor calculations for the years 2001, 2002, and 2003. The calculated impact factor values for the *Journal* may differ somewhat from the *Journal Citation Reports* impact factor values because ISI may have made their calculations with fewer issues of the *Journal*. Due to publication delays of the *Journal*, ISI may not have received the last one or two issues of the *Journal* in time to calculate the impact factor for a given year using all of the issues actually published for that year. Table 2.6c shows that the impact factors based solely on special issue articles are lower than the impact factors based only on regular issue articles.

Table 2.6c: Impact Factor Comparison of Regular Journal of Research Articles and Special Issue Articles (2001-2003)*

	Impact factor based on regular issue articles only	Impact factor based on special issue articles only
2001	0.532	0.292
2002	0.869	0.278
2003	0.527	0.388

*based on results of Web of Science search

3. Journal of Research Authors

3.1 NIST Lab Affiliation (2000-2004)

Table 3.1 shows the *Journal of Research* author affiliation by NIST laboratory for the issues published between 2000 and 2004. There were 654 authors of 205 articles during this time period with approximately 43% of the authors having no direct affiliation with NIST. The Information Technology Lab (ITL) has the largest representation among *Journal of Research* authors at 14% (93), with Materials Science and Engineering Lab (MSEL) at 13% (87), and Physics at 11% (71). Almost one quarter of the 205 total articles produced during this time period have no NIST affiliated author. This is due to the three Special Issues that were produced during this time period that were dedicated to papers from two workshops and one conference; only one of the workshops was hosted by NIST.

The number and percentage of collaborative articles published in a journal is one indicator of quality¹⁰ and it is not unusual for NIST authored papers to include authors from other organizations. However, when funds for producing the *Journal* are in jeopardy it may be difficult to justify the publishing of such a large portion of conference and workshop papers that have no NIST authors when there are other venues available, such as the NIST Special Publications series, for this purpose.

Table 3.1: Journal of Research Authors by NIST Laboratory, 2000-2004

Volume/Issue	Total # of Articles	# of articles with no NIST author	EEEL	MEL	CSTL	PL	MSEL	BFRL	ITL	TS	ADMIN	RETIRED NIST	NON NIST
2004: 109/1	11	9					3						27
109/2	7		4	3	4		1	1	2				4
2003: 108/1	6				7		5		1				5
108/2	6		3		2	8	4						5
108/3	6		1		1	3	10	2	2				10
108/4	5			3		5		1	7				
108/5	5		4	1		10							3
108/6	5	1				4			3				2

¹⁰ Clyde, L.A. Evaluating the quality of research publications: A pilot study of school librarianship. *Journal of the American Society for Information Science and Technology*, 55(13):1119-1130, 2004.

Volume/Issue	Total # of Articles	# of articles with no NIST author	EEEL	MEL	CSTL	PL	MSEL	BFRL	ITL	TS	ADMIN	RETIRED NIST	NON NIST
2002: 107/1	6		1		4		2		6				23
107/2	5	2			10			3	8				14
107/6	19	13			8							1	45
2001: 106/1	12		1	2	1	2	1	2	2	1			
106/2	7				2			1	2				7
106/3	2		1			2			7				1
106/4	6		7			1	8						4
106/5	6					4					1		6
106/6	18			3	2	1	39		2				2
2000: 105/1	24	22				3							81
105/2	7				7	5	2						2
105/3	3		2						4				
105/4	11	1	1		1	3	4	4	13				1
105/5	5				2	7	1		1				2
105/6	5		3	1		5	2	1	14				5
Totals	205	49	29	16	58	71	87	16	93	1	1	1	281

3.2 Publishing Patterns of NIST Authors Publishing in the Journal of Research (2000-2004)

A search for NIST-authored *Journal of Research* papers in the *Web of Science* from 2000 to 2004 resulted in 154 papers with at least one NIST author. Due to database search parameters, this count did not include 2004 *Journal* issues because these issues were published mid-2004 and had not yet been indexed in the *Web of Science*. The count did include some late 1999 issues, again due to the timing of when the issue was actually published.

A total of 325 NIST staff members published in the *Journal* during this time period. Of the 325 NIST authors, 247 authors (76%) published in journals other than the *Journal of Research* during this time. It is important to remember that this universe of “other” journals is defined by those journals indexed in *Web of Science*. A total of 78 authors (24%) published in the *Journal of Research* but did not publish in any other journal indexed in the *Web of Science*. Of the 247 NIST authors who published in the *Journal* and in at least one other *Web of Science* journal, 39 authors published only one outside paper. A further breakdown is given in Table 3.2.

Table 3.2: Number of non-Journal of Research papers published by NIST authors who publish in the Journal of Research (2000-2004)*

Number of non-JRes papers	Number of NIST authors
0	78
1	39
2-5	94
6-10	54
11-15	24
16-20	10
21-30	12
31-40	9
41-50	2
>50	3

*based on results of Web of Science Search

Table 3.2 shows that over one third (36%) of NIST authors, who have authored or co-authored at least one *Journal of Research* paper, published 0 or 1 paper in a *Web of Science* journal from 2000 to 2004. Almost two thirds (65%) of NIST authors who published in the *Journal* published 5 or fewer papers in *Web of Science* journals from 2000 to 2004. These percentages would seem to suggest that the *Journal* is an important publishing venue for some NIST scientists. While very few prolific authors publish in the *Journal*, the *Journal* does seem to offer a viable publishing venue for some NIST researchers who might not publish their research elsewhere. It should be noted that the *Journal* is indexed in *Web of Science*, which means that ISI deems it a worthy research publication. ISD recommends soliciting NIST researchers’ opinions through a survey or through focus groups to learn how they view the *Journal* as a potential publishing avenue. This information will help the Board of Editors and ISD determine ways to market the *Journal* to potential authors.

To put the data in Table 3.2 into perspective, according to a search in the *Web of Science*, NIST authors publishing in the *Journal* from 2000 to 2004 authored or co-authored 1584 non-*Journal* papers in 360 different journals during that same time period. Below is a list of the “top ten” journals in which *Journal of Research* authors published most frequently from 2000-2004. This list excludes the *Journal of Research*.

Table 3.3: “Top Ten” Journals in which Journal of Research Authors Publish Most Frequently (NIST Authors Only)

Journal title	Number of NIST-authored papers (2000-2004)
Physical Review B	91
Journal of Applied Physics	79
Physical Review Letters	53
Metrologia	50
Physical Review A	35
IEEE Transactions on Instrumentation and Measurement	33
Journal of Dental Research	32
Journal of Solid State Chemistry	27
Langmuir	26
Applied Optics	21
Applied Physics Letters	21

A search for all NIST-authored papers indexed in the *Web of Science* from 2000 to 2004 resulted in 5,794 non-*Journal of Research* papers published in a total of 822 different journals. The “top ten” journals in which NIST authors publish most frequently are shown in Table 3.4. The two lists share seven journal titles indicating that NIST authors who publish in the *Journal of Research* publish in many of the same journals as the overall NIST author population.

Table 3.4: “Top Ten” Journals in which NIST Authors Publish Most Frequently

Journal Title	Number of NIST authored papers (2000-2004)
Physical Review B	216
Physical Review Letters	204
Physical Review A	187
Journal of Applied Physics	177
Journal of Chemical Physics	128
Applied Physics Letters	92
Macromolecules	82
Langmuir	79
Metrologia	76
Journal of Physical Chemistry A	74

4. Journal of Research Customers

4.1 Subscribers

Paid subscriptions to the print version of the *Journal* are made available to external customers through the Government Printing Office (GPO) sales program. There are currently 330 subscribers (229 domestic and 101 foreign). Based on the organization names listed on the subscriber list provided by GPO, ISD can determine that approximately, 45% (147) of the subscribers are academic and corporate libraries. In addition, the domestic subscriber list includes several subscription agents, which typically serve library clients, representing approximately 20% of the total 370 subscriptions.¹¹ Other customers of note include several of the U.S. Department of Energy Laboratories (Argonne, Brookhaven, Los Alamos, and Sandia) and the editorial departments of publishers and indexing services (American Scientific Publications, Engineering Elsevier, Gale Group, H.W. Wilson, and Institute for Scientific Information (ISI)).

ISD disseminates print issues of the *Journal* to NIST staff (in Gaithersburg and Boulder)¹² and to the eight organizations that are part of the Research Library's gift & exchange program.¹³

4.1.1 Survey of Subscribers

In anticipation of the possible ceasing of the print version of the *Journal* in fiscal year 2005, ISD conducted a mini-survey in July 2004 of a small sample of subscribers to gauge the potential impact of this decision. The list of subscribers to the print version was obtained from GPO, and twenty libraries on the list were contacted by phone.

The breakdown of the libraries contacted by library type is as follows:

- 10 academic libraries
- 3 corporate/special libraries
- 7 other libraries, most of which were federal research libraries

The subscribers were asked the following two questions:

1. Are you aware that the *NIST Journal of Research* is available free, electronically?
2. Do you have any concerns if NIST ceases the print version of the *Journal*? If yes, please tell us what those concerns are.

¹¹ There are more subscriptions than subscribers because in some cases subscribers have purchased more than one subscription.

¹² As of June 2004, this list includes 46 individuals at Gaithersburg, 39 individuals at Boulder, the Public Inquiries Unit of the Public & Business Affairs Division, the members of the *Journal's* editorial board, and the Research Library (for the collection and for give-aways).

¹³ The NIST Research Library provides complimentary copies of selected NIST publications to foreign institutions, which in turn provide complimentary copies of their publications to the Library.

While most of the individuals we spoke with were not personally aware that the *Journal of Research* is available free, electronically, they did respond “yes” to question #1 after verifying the availability of the *Journal* in their library catalog or on their Web site. Almost all of the 20 libraries contacted already had a link either from their catalog or their Web site to the electronic *Journal* on the NVL. Those libraries that did not link to the *Journal* asked how to link to it and were given the URL. It is interesting to note that several libraries had found access to the electronic version of the *Journal* through the *Directory of Open Access Journals* (DOAJ).¹⁴ This is significant because the *Journal* is included in this major tool used by researchers to locate scholarly electronic journals.

In response to question #2, most of the libraries (16) did not have concerns about the possible ceasing of the print *Journal*. However, several of the libraries offered additional comments qualifying their response that are in keeping with concerns in general about electronic journals. The following types of comments were provided:

- no concerns “as long as we have access online; students prefer electronic”
- “absolutely yes” in favor of electronic only; already cancelled 95% of print collection starting in 1999, with the bulk of cancellations in 2001; be sure to address archival issue
- NIST should make all back issues available full text electronically
- main concern - being aware that there’s a new issue; otherwise, electronic is more convenient and “the way to go”
- no concerns “as long as there is a guarantee that there will be a perpetual electronic archive” or “as long as it’s available electronically and will always be there”
- no concerns as long as NIST keeps archives
- no concerns, but copy in Reading Room will not be available for browsing
- “delighted and enthusiastic supporter” of electronic only; electronic only access helps address space problems; electronic will become the copy of record; but “need bases covered for archiving”

Two libraries appeared unsure or gave conflicting answers:

- need to check with their users; leaning toward electronic due to space savings; users tend to prefer electronic
- two answers from one institution: 1) one librarian had personal concerns about long-term stability of electronic access; 2) another said it was okay to go electronic only, and “someone needs to take the first step”

Of the 20 libraries contacted only two indicated that they had concerns with the possibility of the *Journal* becoming an electronic-only journal. They expressed the following concerns:

- major concerns about archiving; “archiving is still a major issue with open access”
- worried about “image problem” [prestige] of an electronic only journal; worried about guarantee of archive; from library perspective, it’s okay

¹⁴ The *Directory of Open Access Journals* provides information on over 350 scientific and scholarly journals that are widely available at no cost through the Internet. <http://www.doaj.org>.

While this survey is only a statistically small sample of the current print subscribers, it does reveal that most libraries surveyed do not feel that they or their customers will be adversely affected by the ceasing of the print *Journal*. The concerns expressed by the twenty libraries with regard to perpetual access were not surprising. This is an issue of great concern among libraries with regard to electronic journals, in general. ISD was able to address these concerns by explaining that it is continuing to digitize back issues of the *Journal* and intends to make them available on the NVL for the foreseeable future. Furthermore, since the *NIST Journal of Research* is a federal publication, the GPO will ensure its perpetual access should NIST decide at some point in the future to cease making it available.

4.2 How Customers Locate and Access the Journal

Of the over 1,200 federal depository libraries nationwide, over 700 include the *NIST Journal of Research* in their electronic collections. The Federal Depository Library Program (FDLP) began making the transition to an electronic depository library program in 2001. As directed by Congress, effective January 2001, “the primary method of making publications available to the FDLP is online dissemination.”¹⁵ The guidelines provided by the GPO Superintendent of Documents indicated that when an agency information product is available in both electronic and print formats, only the electronic format would be disseminated to the federal depository libraries. Therefore, in 2001, NIST was informed that only the electronic version of the *Journal* would be made available to the federal depository libraries. It should be noted that only the 50 regional federal depository libraries are required to have all federal publications in their collections. This means that at least 650 federal depository libraries choose to have the *Journal* in their collections. The Federal Depository Libraries that make the electronic version of the *Journal* available to their customers, access it from the NVL. Customers can also locate a link to the electronic *Journal* and find information about the print version from the online version of the *GPO Catalog of U.S. Government Publications* at <http://www.gpoaccess.gov/libraries.html>. Access to the electronic version of the *Journal* through the Federal Depository Library Program actually gives it more visibility than it had as a print only publication. Customers no longer need to visit the physical library to use the *Journal*.

The *Journal* also enjoys wide exposure with coverage in over 25 journal indexes and abstracting services. The list of indexes is provided in Appendix A. This broad exposure makes it easy for customers to identify citations to *Journal of Research* articles when doing subject-based searches in libraries throughout the world. Noteworthy indexes include major scientific research tools such as *Science Citation Index*, *Chemical Abstracts*, *INSPEC*, and *Engineering Monthly Index (Compendex)*. The indexing of a journal in established, reputable indexing and abstracting services is considered to be a measure of impact and quality.¹⁶ The *Journal's* extensive coverage in major indexing and abstracting services indicates that it is considered a high quality research publication.

¹⁵ “Dissemination/Distribution Policy for the Federal Depository Library Program,” Superintendent of Documents Policy Statement No. SOD-71, January 2, 2001.

¹⁶ Clyde, A.L. (2004)

It is unlikely that the *Journal* would be dropped from these indexing services if it should become an electronic-only journal. *Chemical Abstracts*, the premiere chemical sciences abstracting service, monitors over 164 online-only journals, including *Acta Crystallographica Section E: Structure Reports Online*, *New Journal of Physics*, *Optics Express*, *Physical Review Special Topics-Accelerators and Beams*, and *PloS Biology*. If the *Journal* becomes an electronic-only publication, ISD will carefully monitor its continuing coverage in the indexing and abstracting services to ensure that researchers can continue to easily locate *Journal* articles through these services.

4.3 Web Usage Statistics

Web usage statistics for the *Journal of Research* can be a useful indicator of the *Journal's* impact and influence on the world's scientific research community. Tables 4.3a and 4.3b show Web usage statistics for *Journal* external and internal customers. The usage statistics are based on NIST Virtual Library (NVL) external (nvl.nist.gov) and internal (nvl-i.nist.gov) Web log files. The external log files are particularly valuable since the *Journal's* primary audience is not NIST scientists and researchers, but rather NIST's external customers in industry, government, and academia.

As an aid to understanding the tables below, it is useful to define "hits," "visits," and "pageviews" within the parameters of the Web log analyzer software used to derive the statistics. Access of a Web page or file generates a "hit." Hits include .htm files, .pdf files and images, which include *Journal* front cover, index, and tables of contents pages, as well as the full text of articles. If a visitor leaves the Web site and returns 30 minutes later, the Web log analyzer software generates two visits. If a visitor returns within 30 minutes, the software reports one visit. A "pageview" is a hit of a Web page. A file download is a capture of a .pdf file.

Table 4.3a shows that total hits increased for all categories from 2003 to 2004, which is significant since the total number of Web logs (total number of days) for 2004 is less than the total number for 2003. The total numbers of hits may include hits by Web crawlers accessing the *Journal of Research* Web pages. While this may not give a true picture of the actual electronic usage of the *Journal* by individual users, it is desirable to have Web crawlers searching the *Journal* Web pages. To be located by Web crawlers ensures that users can easily find links to the *Journal's* issues and articles via search engines such as Google and Yahoo.

The high total numbers of hits in Table 4.3a is significant indicating that the *Journal* Web pages are hit quite frequently. Also, the total number of images downloaded is very high, which is likewise significant and desirable since a lot of time and effort is invested in creating Web-viewable images within the *Journal's* issues and articles. This pattern of use seems to indicate that readers of the electronic version of the *Journal* are taking advantage of what the digital medium has to offer. While this shows use, only citation frequency is an indicator of impact and that *Journal* articles are being read.

Table 4.3a: Journal of Research Usage Statistics for External Customers

	2003*	2004**	2003 Projections***	2004 Projections***	Projected % Increase (2003-2004)
Hits	320,245	449,814	384,294	674,721	76
Visitors	73,589	90,225	88,307	135,338	53
Unique IPs	41,228	48,047	49,474	72,071	46
Pageviews	58,873	70,930	70,648	106,395	51
File Downloads	213,034	288,905	255,641	433,358	70
Images	40,769	79,448	48,923	119,172	144

*February 28, 2003 – December 31, 2003 (307 days)

**January 1, 2004 – August 31, 2004 (244 days)

***Projected totals were calculated by dividing the actual total counts by the number of months for which ISD has statistics and multiplying this result by the number of months for which there is missing data. These results were then added to the actual total counts to get the projected totals for a given year.

Although usage statistics are incomplete for 2002 and 2004 in Table 4.3b, if the complete stats for these years were projected based on the available statistics, the trend for the three-year period would show a progressive annual increase in internal NIST usage of the electronic version *Journal of Research*. This would suggest that electronic access to the *Journal* has given it greater visibility and accessibility even within the NIST community.

Table 4.3b: Journal of Research Usage Statistics for Internal Customers (NIST Staff)

	2002*	2003	2004**	2004 Projections***	Projected % Increase (2003-2004)
Hits	1677	6815	4281	7339	8
Visitors	282	798	780	1337	68
Unique IPs	170	434	445	763	76
Total pageviews	499	1584	534	915	-42
File Downloads	448	3466	3242	5557	60
Images	728	1752	492	843	-52

*May 16, 2002 – December 31, 2002 (230 days)

**January 1, 2004 – July 30, 2004 (211 days)

***Projected totals for 2004 were calculated by dividing the actual total counts by the number of months for which ISD has statistics (7) and multiplying this result by the number of months for which there is missing data (5). These resulting amounts were then added to the actual total counts to get the projected totals for 2004.

Assessing the internal Web usage statistics in Table 4.3b, it was easy to identify some unusual patterns of hits, which in most cases were likely due to internal Web crawlers. The IP addresses of Web crawlers, as well as the IP addresses of ISD staff that load *Journal of Research* files onto the server and analyze *Journal* issues and articles on the Web, were easy to identify. These easily identified IP addresses were excluded from the analyses performed on the internal Web log files. Because such unusual usage patterns were impossible to discern in the external log files, no IP addresses were excluded when analyzing the external Web log files.

Using Web log analyzer software, ISD identified the most frequently viewed *Journal of Research* papers (.pdf files) for internal users for 2002 and for external and internal users for 2003 and 2004. These most frequently viewed papers are listed in Appendix B. The “top ten” *Journal of Research* papers among external readers - the papers viewed most frequently by NIST’s external customers - are listed for the years 2003 and 2004. Following the external usage tables are the “top ten” papers viewed internally by NIST staff for the years 2002, 2003, and 2004. Years of coverage were determined by the availability of internal and external Web log files, which are located on two different NIST servers. Gaps in coverage existed in the external Web log files.

The progressive increase in usage over time is demonstrated by both sets of tables showing external and internal usage. In both cases, 2004 papers show the highest usage despite the incomplete statistics for 2004.

5. Publication Production

The production of a journal publication involves multiple and time sensitive processes. The steps of these processes include obtaining article files from the authors and distributing them to the readers/referees, collecting comments from readers and sharing them with the authors, tracking the status of each paper through the process, technical and copy editing, and performing electronic composition (page layout). For an electronic journal, the text is coded, links are checked, and the files posted to a Website; for a print journal, files are prepared for printing and sent to a printer with the appropriate specifications.

While most of the production activities for the *Journal of Research* are handled by ISD, the *Journal's* Board of Editors handles a few of them. The Editor in Chief identifies and selects prospective authors and articles. The Editor in Chief, with some assistance from the Board members, does the technical editing of articles and chooses the design for the cover of each issue. Prior to the start of FY05, the NIST Visual Arts department did the actual artwork for the covers. Since the services of Visual Arts became a cost reimbursable activity, a member of the Board has elected to do the cover artwork. Members of the ISD staff handle the remaining production activities.

This overlap in editorial and publishing duties contributes to many of the delays in production. In its role as the *Journal's* publisher, ISD intends to work with the Board of Editors to clearly define roles and responsibilities to ensure that the *Journal* is produced on time. The *Journal* risks losing its audience if it cannot be produced, whether in print or electronic, on a predictable schedule.

5.1 Printing and Printing Costs

ISD is allocated institutional support funds each year to cover costs for the printing of the *Journal*. In fiscal years 2000 and 2001 ISD was allocated \$30K. In fiscal year 2002, this amount was increased to \$34K. These funds pay for the printing of copies that are disseminated by ISD. The funds also pay for multiple copies of “separates” (reprints) of each article for contributing authors. GPO pays for the copies distributed to subscribers through the sales program using a “distribution rider” on NIST’s contract with the printer. These copies go directly from the printer to GPO and GPO is invoiced for the costs.

Table 5.1 shows the printing costs incurred by ISD on behalf of NIST for fiscal years 2000-2004. To provide a context for these costs, the table includes information on the total number of issues and pages produced in each fiscal year and the total number of bound copies and separates printed in each fiscal year. The printing of color issues significantly increases the printing costs. In fiscal year 2004, the color issue (v109, n2) cost approximately \$12,000 to print, representing over half of the funds expended for all six issues printed in that year. There are no additional costs to produce the electronic (Web) versions in color and as such all *Journal* articles on the NVL include color illustrations, making the electronic version more desirable.

Table 5.1: Journal of Research Printing Costs for Fiscal Years 2000-2004

Fiscal Year	Costs	# of Issues Printed	# of pages	# of Bound Copies Printed	# of Separates Printed
2000	\$33,087	5	745	2,540	9,000
2001	\$34,415	7*	1,288	3,450	10,800
2002	\$29,515	6	848	2,800	5,500
2003	\$14,729	5	636	2,000	2,500
2004	\$22,644	6	668	1,200	1,900

*Includes a 380-page special issue for the Centennial.

In fiscal years 2000 and 2001, two hundred separates were printed for each author and the number of bound copies printed for each issue ranged from 450 to 650. In all four years (2000-2003), ten “untrimmed” copies of each article were printed. At the end of the volume year, the untrimmed copies were sent to the bindery contractor to produce bound volumes for each member of the *Journal’s* editorial board. As a cost-savings measure, in fiscal year 2002 ISD reduced the number of bound copies printed to 400 and the number of separates printed to 100 per author. The printing of “untrimmed” copies and subsequent binding was eliminated in fiscal year 2004. Also in fiscal year 2004, ISD further reduced the number of bound copies printed to 200 and the number of separates to 50 per author as a way of controlling costs. Contractual requirements do not permit any further printing reductions until a new contract is in place for fiscal year 2006.

5.2 Production Schedules

During the last few years, there have been considerable delays in the production and publishing of the *Journal*, with publication running two issues behind schedule. Delays have occurred most often as a result of time spent on large, special issues; authors and editors of special issues not adhering to manuscript submission requirements and deadlines; problems with clarity of figures and graphs, requiring additional work with the authors to obtain files in the correct format; and difficulties over producing the artwork for the covers.¹⁷ The Board of Editors has taken on some of the responsibilities normally held by a journal publisher, making it difficult for ISD to manage the *Journal’s* production effectively.

Delays in publishing can adversely affect a journal’s impact factor.¹⁸ Furthermore, subscribers or readers who become impatient waiting for the next issue of the journal or are uncertain about its reliability will turn to other sources of information.

¹⁷ Images first became part of the cover design with Volume 105 (2000).

¹⁸ Garfield, E. Journal impact factor: A brief review. *CMAJ* 161:979-80, 1999.

In an attempt to rectify the delays in production and publishing, ISD Management has had several discussions with the *Journal's* Editor in Chief and has begun to implement changes to those processes that are within ISD's purview. A key component to improving production is increasing author awareness of deadlines and manuscript submission requirements. ISD will work closely with the Board of Editors to set clear deadlines for authors and this information will be made more visible on the NVL. Publishing schedules and manuscript preparation information will also be shared with authors when their manuscripts are accepted for publication. Since the amount of time and effort devoted to the design of each issue's cover outweighs their value, ISD recommends that a single cover design be selected and used for all six issues in each volume year. ISD will work with the Board to develop a new cover design that will be used beginning with Volume 111, January 2006.

5.3 Value of Electronic Only

A printed issue of the *Journal* requires a minimum number of pages. In order to produce a paper product that has "back strip" binding, there must be at least 64 pages in the issue to be printed. An electronic version has no similar packaging or size restrictions or requirements and therefore can be produced and disseminated much more rapidly than the print version.

In a digital world, information can be packaged, re-packaged, and distributed in a variety of ways. For example, articles can be posted to the Web as soon as they are ready. There are no size constraints as in the print model of journal publishing. Furthermore, users have a variety of ways of accessing electronic articles that are well organized and tagged with a good mark-up language (such as XML). Articles can be enhanced through a rich integration of links to and from related material.

ISD intends to focus its energies on applying the new emerging models for electronic journals to the *Journal*, providing value added services to the electronic content. ISD plans to establish relationships with publishers that are allowing cross-reference linking from citations within journal articles. This will significantly enrich the content in the *Journal* and give the content greater visibility to and access by researchers. In the event that NIST Management determines that the print version of the *Journal* should cease, ISD will ensure that the *Journal* maintains its distinct identity as it makes the transition to an electronic-only journal.

6. Changes at the Government Printing Office (GPO)

6.1 Federal Depository Library Program

Under Title 44 of the United States Code, the Government Printing Office (GPO) provides permanent public access to federal publications through the Federal Depository Library Program (FDLP). In 2001, the FDLP was directed by the U.S. Congress to make “online dissemination” the primary method for making federal publications available to the public. The guidelines provided by the GPO Superintendent of Documents indicate that when an agency information product is available in both electronic and print formats, only the electronic format is to be disseminated to the federal depository libraries. This direction by Congress and the Superintendent of Documents comes in recognition that federal agencies are printing fewer publications and that the GPO printing mechanisms are no longer the primary source of publications for the FDLP.

The electronic environment allows the federal depository libraries to provide increased access to federal publications. Electronic publications are accessible through hyperlinks contained in the bibliographic records of the Catalog of U.S. Government Publications (CGP) available at <http://www.gpoaccess.gov/cgp/index.html>. Catalog records for Web publications in the CGP include persistent links using Persistent Uniform Resource Locators (PURLs) which ensures that the online content is always accessible. Any researcher looking for the NIST *Journal of Research* no longer needs to use a physical federal depository library collection at a nearby federal depository library. They need only to search the electronic CGP to link directly to the *Journal* on the NIST Virtual Library via the GPO catalog records.

6.2 GPO Printing and Sales Programs

The GPO Printing and Sales programs have also been making a similar transition, relying on electronic information technology to create and disseminate federal agency information products. Beginning in fiscal year 2005, GPO will be implementing new print procurement and dissemination models in recognition of the government-wide decline in printing needs due to the increase in electronic dissemination of agency publications. GPO will be issuing guidance to federal agencies on the new print procurement procedures in Spring 2005.

The Public Printer of the United States, Bruce James, recently stated that, -- “More than 50% of our [federal] documents are born digital and will never be printed, except on demand and as needed. This calls for a different type of information dissemination system, one that can deal with versioning, authentication and preservation of the digital record of the American Government in perpetuity.”¹⁹

¹⁹ U.S. Government Printing Office, News Release. March 4, 2004.

As PDF documents increasingly become the norm for government agencies, concerns about how these documents will be maintained over time have taken on greater importance. GPO is pursuing a number of initiatives to digitize the entire legacy collection of U.S. government documents (approximately 2.2 million publications) to increase the accessibility of these publications to the public and to ensure that the entire collection is preserved.

ISD has been in discussions with GPO since March 2004, on the transition of all NIST printed publications to the new GPO models. GPO is planning to offer its customers print versions of agency publications through a “Print-on-Demand” service. GPO is still in the planning stages for this new service, looking at costs, developing its infrastructure, designing workflows, and determining which publications are most suitable for this service. If GPO determines that any of NIST’s publications will be made available through the “Print-on-Demand” service, ISD already has the mechanisms and processes in place to participate. Participation in the “Print-on-Demand” service will require that agencies prepare and send to GPO press optimized PDF files for each publication. ISD is already doing this with the *Journal* and other selected publications under a pilot arrangement with GPO.

In addition, ISD electronic publication production staff regularly attend GPO-sponsored meetings to keep abreast of the decisions made by GPO regarding digital preservation, authentication, and versioning of federal documents.

7. Changes in Scientific/Technical Scholarly Publishing

Scientific/technical scholarly publishing is undergoing a profound transformation. The current debate among the stakeholders (scientists/authors, publishers, and librarians) centers on journals. The environment in which traditional journals operate is changing drastically. Almost every print journal has an electronic counterpart that is available through the Internet. As the Internet expanded the reach and versatility of these journals, various publication models have emerged.

7.1 Open Access

Open access is a publishing model that has been made possible with the emergence of new digital technologies and networked communications. It is an alternative to the traditional print model that focused on subscriptions paid for by libraries or individuals. There are a number of open access models, but at its simplest, open access refers to the availability of scholarly publications through the Internet at no cost to the reader or library. Open access does not mean that peer-review or quality is bypassed. Peer review is not medium dependent; it is as necessary for electronic scholarly journals as it is for print scholarly journals.

Although the models of open access are still evolving, the digital environment is changing journal usage patterns and enhancing their visibility. Recent studies of researchers at universities nationwide have revealed an overwhelming preference for using journals in electronic format. In fact, nearly half of all faculties in most disciplines (with over 60 percent in the biological and physical sciences) reported that they use online resources for the majority of their work.²⁰ Preliminary results from a number of recent studies on open access are indicating that electronic access improves both readership and citation impact. In April 2004, ISI released information on its first study of the impact of open access journals. ISI found that while open access journals have a similar citation pattern to other journals, they may have a tendency to earlier citation than their print counterparts.

While the *Journal of Research* does not fit some definitions of open access, it is available electronically on the Web at no cost to readers. Therefore, its citation patterns should be similar to open access journals, indicating that efforts to enhance and market the electronic version of the *Journal* are warranted.

Open access and electronic publishing were subjects of a special technical program at the 228th American Chemical Society (ACS) Annual Meeting held in August of 2004, in Philadelphia. One of the most interesting discussions revolved around how the different disciplines of chemistry, physics, and the biomedical sciences view the issues of preprints and open access publishing. These differing viewpoints and the varying degrees of acceptance among disciplines will likely mean that open access publishing will thrive in some scientific disciplines and never go beyond experimentation in others. The differences across disciplines are likely due to concerns over proprietary information, which is of particular concern in the chemical and pharmaceutical industries. Proprietary information is of less concern for physicists and astronomers, which is probably why physics preprint archives like LANL's *arXiv* have thrived.

²⁰ Electronic Scientific, Technical, and Medical Journal Publishing and Its Implications: Proceedings of a Symposium. National Academy of Sciences, 2004.

7.2 Survey of Journal Editors and Publishers

ISD conducted interviews with editors from eight comparable peer journals in order to gain some additional insights into the digital publishing arena. The journals were selected from the list of 52 journals from the “Instruments & Instrumentation” category of the *Journal Citation Report*, published by ISI. The eight journals selected were ranked in the upper one third of the impact factor values for this category. In particular, ISD talked with editors from the following journals:

- *Applied Spectroscopy*
- *IEEE Circuits and Devices*
- *Journal of Guidance Control and Dynamics*
- *Journal of Micromechanics and Microengineering*
- *Journal of Synchrotron Radiation*
- *Measurement Science and Technology*
- *Nuclear Instruments and Methods in Physics Research, Section B*
- *Sensors and Actuators – A (Physical)*

ISD also interviewed the editor from the *Journal of Turbulence*. Although this is not a comparable peer title, this particular journal is published only in electronic format. As such, it was beneficial to collect data from this electronic only perspective to complement what ISD learned from the other journal publishers.

In addition, ISD interviewed publishers and those involved with the publishing field in order to collect data on their perspectives. In this area, ISD spoke with representatives from the following publishers and organizations:

- Institute of Physics Press (IOP), specifically the publishing representative assigned to *Journal of Micromechanics and Microengineering* and *Measurement Science and Technology*
- The current President of the Society for Scholarly Publishing (SSP)
- Elsevier Press

The questions posed to the editors from the nine journals covered four areas: customers, budget/costs, printing, and electronic format. The questions included:

Customer issues:

- Who are your primary customers? What is the estimated ratio of individual to institutional subscribers?
- What percentages of your customers get the electronic version of your journal?
- Have you formally asked your customers about their preferences for print vs. electronic journals? What did you learn?

Budget/costs issues:

- Do you have any budgetary issues in publishing your journal? How have your publishing costs changed in the last few years?
- How is the journal printing budget derived – membership dues/fees, etc.?
- Is the journal printing/production budget considered to be an overhead function?
- How do you control printing and publication costs?
- What type of business model does your journal implement in publication and distribution?

Printing issues:

- Is printing performed in-house or using an outsourced contractor?
- Have you considered a “print on demand” model?

Electronic format issues:

- How are electronic journal formats distributed and archived?
- Have you considered publishing in a purely electronic format or as an Open Access journal (OAJ)?
- What is your perception of electronic journals as compared to print?

7.2.1 Summary of Customer Issues

In terms of the subscriber demographics, eight out of nine journals had a significantly higher customer base (nominally 66-80%) stemming from libraries or institutional subscribers. Only one journal editor (*Applied Spectroscopy*) indicated that individual members or subscribers made up the largest portion of their customer base. Only two journals have collected formal survey data on print vs. electronic preferences: one journal surveyed their customers/subscribers (*Applied Spectroscopy*), while the second journal participated in a formal query of all journals published by its governing society (IEEE).

With the exception of the *Journal of Turbulence*, none of the nine journals provide their customers/subscribers with an “electronic only” option in their subscription selections. The reasons for this are varied and are not necessarily related to customer preference or demand. In some cases, advertising is accepted in the print format, creating a source of revenue for the journal or organization. In these situations, eliminating the option for receipt of the print format would reduce circulation statistics, thereby lowering advertising rates and revenue generated. In other situations, large publishers such as Institute of Physics Press or Elsevier produce the journals. For these vendors, retaining both print and electronic formats for each journal provides a greater range of sales and marketing options.

The nine journal editors who were interviewed largely quoted anecdotal data when assigning value to print vs. electronic customer preferences. However, their informal conclusions largely support the formal data gathered by the two surveys referenced above. All journal editors interviewed expressed their belief that purely electronic journals are the wave of the future, calling this trend “inevitable” or “only a matter of time.”

The publisher data largely echoed the observations from the journal editors. The publishers interviewed agreed with the notion that all-electronic journals are imminent and unavoidable. While no “silver bullet” archiving solution currently exists, there are any number of concrete steps that can be pursued to cover these bases and ensure preservation and access. The representative from the Institute of Physics (IOP) and the president of the Society for Scholarly Publishing (SSP) emphasized that archiving and preservation should not be viewed as impediments to pursuing all-electronic formats.

7.2.2 Summary of Budget/Cost Issues

Six out of nine journal editors indicated that they are faced with significant budgetary issues in publishing their journals. The remaining three journal editors work with commercial publishers and indicated that they are largely uninformed about such matters. This is not unusual since concerns for budgets and costs are more typically the purview of the publisher, not the editors. However, even these three editors were given instructions regarding techniques for curtailing the high cost of printing color and graphics. All eight print journal editors indicated that they regularly practice at least one, and often many, techniques for controlling printing costs. The editor from the all-electronic journal indicated that this was less of an issue, although length of submitted articles was still of concern. The publisher data confirms that it is indeed significantly more expensive to publish print journals than their electronic counterparts and that this differential is likely to increase rather than decrease over time.

7.2.3 Summary of Printing Issues

Only two of the nine editors surveyed had any knowledge regarding how their journals are actually printed, namely whether this function is accomplished via in-house or outsourced services. In addition, according to the nine editors interviewed, no journal represented in this analysis is considering a “print on demand” business model. When asked about this lack of option, seven of the nine editors independently expressed that it was their opinion that the next few years will likely bring all electronic journal variants, rendering any print alternative as obsolete, whether “on demand” or not.

Two journal editors specifically discussed an active and ongoing effort to develop alternatives to the “print on demand” business model. One editor (*Journal of Synchrotron Radiation*) indicated that his journal’s board has approved a two-tiered pricing scheme, whereby the electronic only subscription option will represent the baseline price, with the “electronic + print” variant offered at an increased cost.

7.2.4 Summary of Electronic Issues

All nine editors were unfamiliar with the concept of “open access journals.” In addition, they had little general knowledge about the mechanisms of the archival process for electronic content, with the exception of two editors who were well versed in the subject. The publisher representatives were more knowledgeable about the “open access” cost model and felt there was definite potential in this type of arrangement. Again, it is not unusual that the publishers would be more familiar with open access than the editors since this is an issue dealing with costs.

In response to the question regarding the perception that print journals are more highly valued than their electronic counterparts, all nine editors agreed that this is a common opinion within their customer bases as well. However, all nine also independently stated that they felt this viewpoint was largely inaccurate and would change over time due to a number of factors. The editor for the all-electronic *Journal of Turbulence* pointed out his journal’s high impact factor (1.172) as evidence that quality has not been compromised by the format.

The publisher representatives agreed that the comparison of quality between print and electronic is based in perception rather than fact. The president of the Society for Scholarly Publishing argued on behalf of tiered pricing formats that assume the base product is an electronic format, with print versions offered as an supplementary and, therefore, premium product. This could potentially be created on-demand and priced in a way that is commensurate with the costs of developing the print version. In this way, publishers could focus their efforts on developing the electronic content that meets the needs of the vast majority of their users, while still creating other products that address the demands of the smaller minority of users who still prefer print.

7.2.5 Overall Trends Based on Editor and Publisher Interviews

On the basis of the data collected from these interviews some overall conclusions about trends in scientific journal publishing can be drawn that are consistent with what ISD is hearing at professional meetings and seeing in the trade/professional literature. The data indicates that most journal publishers are struggling with production cost issues. It would appear that this is a fairly generic problem across the industry. While individual journal publishers and journal editorial boards are developing a myriad of techniques to handle these problems, this is a recurring theme that is unlikely to disappear or even diminish over the next several years.

Those journals that have surveyed their customers report that, in general, libraries or institutional subscribers prefer electronic journals to their print counterparts. This is due to the fact that many organizations are space-constrained, resulting in limited areas for storing large quantities of physical items, such as hard copy journals. In addition, libraries are responding to their users requests for more electronic, desktop-accessible information resources, such as e-journals. However, the one mitigating concern in all-electronic access remains the issue of archiving and maintaining access to back issues.

Nearly all the journal editors interviewed estimated that libraries and institutions are the largest component of their customer subscription base. If this demographic segment emphasizes the value of electronic resources, then they will increasingly demand electronic format journals, even at the expense of print counterparts. It seems reasonable to conclude that electronic journals will continue to increase in popularity.

Each journal editor interviewed mentioned, independently and without prompting, that they believe that all-electronic journals are the “wave of the future.” They consistently mentioned an expected timeframe of “3 to 5 years” before the bulk of journals are available only in electronic format. While individual editors may have also expressed their personal conflicting opinions on this trend, they all felt that it is an inescapable result of the increasing costs of publication as well as the pervasiveness of computer literacy across journal users. These comments, whether enthusiastic or resigned, suggest that many journals are currently facing similar issues with regard to continuing print production. The decision to eliminate print journal formats will increasingly be considered by many journals as a serious and likely alternative, rather than as a hypothetical exercise in cost analysis.

8. Conclusion and Recommendations

The *Journal of Research* has an established reputation as a premier publication for articles on federally funded research results in metrology and related sciences. Recent data show that the *Journal* compares favorably with its peer journals and is considered a high quality research publication based on its impact factor and extensive coverage in major indexing and abstracting services. The *Journal* continues to be cited frequently with very high citation rates for articles published in the 1950's and 1960's. It is clearly a worthy publishing venue for NIST researchers.

As the publisher of the *Journal*, ISD continues to look at ways to be fiscally responsible by controlling costs while producing a valuable information product in a timely manner. ISD intends to focus its energies on applying the new emerging models of electronic publishing to the production of the *Journal*, providing added services to the electronic content. *Journal* articles can be enhanced through a strong integration of links to and from related material. Establishing relationships with publishers will allow for cross-reference linking from citations within *Journal* articles. Flexibility in publishing an electronic-only journal removes the constraints found in the print model of journal publishing. The *Journal* fits into the open access model of publishing, which is fast becoming a topic of interest at NIST. ISD believes that NIST via the *Journal of Research* could take a leading role in the open access publishing forum thereby increasing NIST's visibility within the scientific/technical scholarly publishing community.

ISD's survey of subscribers indicated that most libraries do not feel that they or their customers will be adversely affected by the ceasing of the print *Journal*. Likewise, ISD's survey of journal editors and publishers showed a widespread belief that all-electronic journals are the "wave of the future" and are inevitable due to the added value the digital medium provides and in the face of escalating publication costs. Specific to the *Journal of Research*, print production issues, including delays in publication, make ceasing the print publication a more inviting option. Furthermore, federal publications in general are increasingly becoming electronic only. Taken together, these studies and trends point in the direction of an electronic-only future for the *Journal of Research*.

ISD is addressing delays in production through: (1) the definition of roles and responsibilities for the Board, authors, and ISD as the publisher; (2) the selection and use of a single cover design for all issues in a volume year; and (3) improved communication with authors and regarding manuscript preparation and production deadlines. The Board should consider eliminating large, special issues, especially those devoted to conference papers; and reducing the number of *Journal* issues produced each year to four to help address the delays in production. Both of these are actions that ISD is not in a position to make.

The *Journal's* special issues typically contain conference papers, which require more time and energy to produce than regular *Journal* issues and increase non-NIST authorship in the *Journal*. As the citation data shows, most of the *Journal's* special issues are not cited very frequently, which ultimately causes the *Journal's* impact factor to go down. While the *Journal* offered a no-

cost mechanism for the publication of conference papers, the more appropriate and established vehicle for conference papers is the NIST Special Publication series.²¹

To strengthen the *Journal's* reputation among scholarly research journals, ISD recommends that the *Journal* place more emphasis on review articles²² and less emphasis on conference and workshop papers, which appear to have low citation patterns. Further analysis of highly cited *Journal* papers by subject experts within the NIST research community will help guide editorial decisions for future issues of the *Journal*. ISD also recommends marketing the *Journal* internally as a vehicle for NIST authors to share the results of their research.

ISD recommends exploring the concept of splitting the *Journal* into two parts. One part would keep the *Journal's* established technical focus targeted to scientists and researchers, while the second part could become a vehicle for disseminating information about NIST's research activities to a non-scientific audience.

The NIST Senior Management Board (SMB) with support from the Visiting Committee on Advanced Technology (VCAT) has recommended that NIST reaffirm its leadership role in the Nation's measurement system and define how best to carry out that role to maximize its impact.²³ The *Journal* can be used as a vehicle for helping NIST reaffirm its role and communicating a 21st century view of the U.S. measurement system.

ISD believes that assessing the potential of the *Journal* is critical, especially as NIST looks for ways to communicate its relevance to policy-makers, industry, and others. The question is not should there be a *Journal*, but what content should the *Journal* contain to make it a valuable marketing/communications vehicle for NIST.

²¹ Costs for printing the *Journal* are supported by ISD while the costs for printing NIST series publications are incurred by the division authoring the publication.

²² Review articles can be defined as critical analyses of recent developments in a field of study that brings together information about previously published research.

²³ White Paper: Potential Roles for NIST in the Nation's Measurement System. June 11,2004. http://www-i.nist.gov/director/WP_MeasSystems.htm

Appendix A

INDEXING COVERAGE OF THE JOURNAL OF RESEARCH

Based on a search of ulrichsweb.com (Ulrich's Periodicals Directory), the Journal of Research is indexed in the following:

Aluminum Industry Abstracts
Analytical Abstracts
Applied Science and Technology Index (Nov. 1988-)
Cambridge Scientific Abstracts
 Civil Engineering
 Engineered Materials
 Mechanical & Transportation Engineering
Ceramic Abstracts
Chemical Abstracts
Chemical Engineering and Biotechnology Abstracts (Online edition)
Chemistry Citation Index
Computer and Information Systems Abstracts Journal
Corrosion Abstracts
Current Contents
Current Index to Statistics
Electronics and Communications Abstracts Journal
Engineering Index Monthly
Forestry Abstracts
INSPEC
International Aerospace Abstracts
METADEX
Nutrition Abstracts and Review
Personal Alert
Referativnyi Zhurnal
Science Citation Index
Solid State and Superconductivity Abstracts
U.S. Government Periodicals Index
World Ceramics Abstracts
World Surface Coating Abstracts
Zentralblatt MATH

Appendix B

Top ten most frequently downloaded papers in 2003 – External NVL

(based on external Web log files dated February 28, 2003 – December 31, 2003 with some gaps)

Hit frequency	Article Title, Author, Volume, Issue, Date
3407 hits	Measurement of the Rheological Properties of High Performance Concrete: State of the Art Report Chiara F. Ferraris <i>vol. 104, no. 5, 1999</i>
3021 hits	Amorphous Calcium Phosphate-Based Bioactive Polymeric Composites for Mineralized Tissue Regeneration D. Skrtic, J. M. Antonucci, and E. D. Eanes <i>vol. 108, no. 3, 2003</i>
2720 hits	Phase Equilibria and Crystallography of Ceramic Oxides W. Wong-Ng, R. S. Roth, T. A. Vanderah, and H. F. McMurdie <i>vol. 106, no. 6, 2001</i>
2662 hits	Coding and Modulation for LMDS and Analysis of the LMDS Channel Jan Erik Håkegård <i>vol. 105, no. 5, 2000</i>
2404 hits	Electron Diffraction Using Transmission Electron Microscopy Leonid A. Bendersky and Frank W. Gayle <i>vol. 106, no. 6, 2001</i>
1924 hits	Low-Temperature Properties of Silver David R. Smith and F. R. Fickett <i>vol. 100, no. 2, 1995</i>
1912 hits	Thermal-Conductivity Apparatus for Steady-State, Comparative Measurement of Ceramic Coatings A. J. Slifka <i>vol. 105, no. 4, 2000</i>
1856 hits	JCPDS-ICDD Research Associateship (Cooperative Program with NBS/NIST) W. Wong-Ng, H. F. McMurdie, C. R. Hubbard, and A. D. Mighell <i>vol. 106, no. 6, 2001</i>
1808 hits	Concrete Mixing Methods and Concrete Mixers: State of the Art Chiara F. Ferraris <i>vol. 106, no. 2, 2001</i>
1686 hits	A Natural Bone Cement—A Laboratory Novelty Led to the Development of Revolutionary New Biomaterials Laurence C. Chow and Shozo Takagi <i>vol. 106, no. 6, 2001</i>

Top ten most frequently downloaded papers in 2004 – External NVL

(based on external Web log files dated January 1, 2004 – August 31, 2004 with some gaps existing)

Hit frequency	Article Title, Author, Volume, Issue, Date
3364 hits	Electron Diffraction Using Transmission Electron Microscopy Leonid A. Bendersky and Frank W. Gayle <i>vol. 106, no. 6, 2001</i>
3272 hits	A Double-Primary Dead-Weight Tester for Pressures (35-175) kPa in Gage Mode Kamlesh Jain, Yueqin Cen, Walter J. Bowers, and James W. Schmidt <i>vol. 108, no. 1, 2003</i>
3237 hits	Measurement of the Rheological Properties of High Performance Concrete: State of the Art Report Chiara F. Ferraris <i>vol. 104, no. 5, 1999</i>
3022 hits	A Link-Level Simulator of the cdma2000 Reverse-Link Physical Layer H. Gharavi, F. Chin, K. Ban, and R. Wyatt-Millington <i>vol. 108, no. 41, 2003</i>
2864 hits	Amorphous Calcium Phosphate-Based Bioactive Polymeric Composites for Mineralized Tissue Regeneration D. Skrtic, J. M. Antonucci, and E. D. Eanes <i>vol. 108, no. 3, 2003</i>
2675 hits	JCPDS-ICDD Research Associateship (Cooperative Program with NBS/NIST) W. Wong-Ng, H. F. McMurdie, C. R. Hubbard, and A. D. Mighell <i>vol. 106, no. 6, 2001</i>
2382 hits	An Experimental Method for Measuring Mechanical Properties of Rat Pulmonary Arteries Verified With Latex E. S. Drexler, A. J. Slifka, J. E. Wright, C. N. McCowan, D. S. Finch, T. P. Quinn, J. D. McColskey, D. D. Ivy, and R. Shandas <i>vol. 108, no. 3, 2003</i>
2344 hits	Coding and Modulation for LMDS and Analysis of the LMDS Channel Jan Erik Håkegård <i>vol. 105, no. 5, 2000</i>
2258 hits	The State of the Art and Practice in Digital Preservation Kyong-Ho Lee, Oliver Slattery, Richang Lu, Xiao Tang, and Victor McCrary <i>vol. 107, no. 1, 2002</i>
2253 hits	A Primary Dead-Weight Tester for Pressures (0.05-1.0) MPa Kamlesh Jain, Walt Bowers, and James W. Schmidt <i>vol. 108, no. 2, 2003</i>

Top ten most frequently downloaded papers in 2002 – Internal NVL

(based on 2002 internal Web log files dated May 16, 2002– December 31, 2002)

Hit frequency	Article Title, Author, Volume, Issue, Date
38 hits	The Candela and Photometric and Radiometric Measurements Albert C. Parr <i>vol. 106, no. 1, 2001 (Centennial Issue)</i>
20 hits	The State of the Art and Practice in Digital Preservation Kyong-Ho Lee, Oliver Slattery, Richang Lu, Xiao Tang, and Victor McCrary <i>vol. 107, no. 1, 2002</i>
19 hits	The Ampere and Electrical Standards Randolph E. Elmquist, Marvin E. Cage, Yi-hua Tang, Anne-Marie Jeffery, Joseph R. Kinard, Jr., Ronald F. Dziuba, Nile M. Oldham, and Edwin R. Williams <i>vol. 106, no. 1, 2001 (Centennial Issue)</i>
18 hits	Algorithm for Scanned Probe Microscope Image Simulation, Surface Reconstruction, and Tip Estimation J. S. Villarrubia <i>vol. 102, no. 4, 1997</i>
14 hits	Very Cold Indeed: The Nanokelvin Physics of Bose-Einstein Condensation Eric Cornell <i>vol. 101, no. 4, 1996</i>
11 hits	A Careful Consideration of the Calibration Concept S. D. Phillips, W. T. Estler, T. Doiron, K. R. Eberhardt, and M. S. Levenson <i>vol. 106, no. 2, 2001</i>
8 hits	Through Measurement to Knowledge: The Inaugural Lecture of Heike Kamerlingh Onnes (1882) Arno Laesecke <i>vol. 107, no. 3, 2002</i>
6 hits	Information Technology Measurement and Testing Activities at NIST Michael D. Hogan, Lisa J. Carnahan, Robert J. Carpenter, David W. Flater, James E. Fowler, Simon P. Frechette, Martha M. Gray, L. Arnold Johnson, R. Michael McCabe, Douglas Montgomery, Shirley M. Radack, Robert Rosenthal, and Craig M. Shakarji <i>vol. 106, no. 1, 2001 (Centennial Issue)</i>
6 hits	Fraunhofer Diffraction Effects on Total Power for a Planckian Source Eric L. Shirley <i>vol. 106, no. 5, 2001</i>
6 hits	Length and Dimensional Measurements at NIST Dennis A. Swyt <i>vol. 106, no. 1, 2001 (Centennial Issue)</i>

Top ten most frequently downloaded papers in 2003 – Internal NVL

(based on 2003 internal Web log files)

Hit frequency	Article Title, Author, Volume, Issue, Date
100 hits	Amorphous Calcium Phosphate-Based Bioactive Polymeric Composites for Mineralized Tissue Regeneration D. Skrtic, J. M. Antonucci, and E. D. Eanes <i>vol. 108, no. 3, 2003</i>
84 hits	Accuracy of Nanoscale Pitch Standards Fabricated by Laser-Focused Atomic Deposition Jabez J. McClelland, William R. Anderson, Curtis C. Bradley, Mirek Walkiewicz, Robert J. Celotta, Erich Jurdik, and Richard D. Deslattes <i>vol. 108, no. 2, 2003</i>
73 hits	Mass Absorption Coefficient of Tungsten and Tantalum, 1450 eV to 2350 eV: Experiment, Theory, and Application Zachary H. Levine, Steven Grantham, Charles Tarrío, David J. Paterson, Ian McNulty, T. M. Levin, Alexei L. Ankudinov, and John J. Rehr <i>vol. 108, no. 1, 2003</i>
60 hits	Repeatability and Reproducibility Standard Deviations in the Measurement of Trace Moisture Generated Using Permeation Tubes Peter H. Huang and Raghu Kacker <i>vol. 108, no. 3, 2003</i>
59 hits	An Experimental Method for Measuring Mechanical Properties of Rat Pulmonary Arteries Verified With Latex E. S. Drexler, A. J. Slifka, J. E. Wright, C. N. McCowan, D. S. Finch, T. P. Quinn, J. D. McColskey, D. D. Ivy, and R. Shandas <i>vol. 108, no. 3, 2003</i>
57 hits	A Primary Dead-Weight Tester for Pressures (0.05-1.0) MPa Kamlesh Jain, Walt Bowers, and James W. Schmidt <i>vol. 108, no. 2, 2003</i>
53 hits	Design and Uncertainty Analysis for a PVTi Gas Flow Standard John D. Wright, Aaron N. Johnson, and Michael R. Moldover <i>vol. 108, no. 1, 2003</i>
44 hits	Characterization of an Ellipsoidal Radiometer Annageri V. Murthy, Ingrid Wetterlund, and David P. DeWitt <i>vol. 108, no. 2, 2003</i>
42 hits	Information Technology Measurement and Testing Activities at NIST Michael D. Hogan, Lisa J. Carnahan, Robert J. Carpenter, David W. Flater, James E. Fowler, Simon P. Frechette, Martha M. Gray, L. Arnold Johnson, R. Michael McCabe, Douglas Montgomery, Shirley M. Radack, Robert Rosenthal, and Craig M. Shakarji <i>vol. 106, no. 1, 2001 (Centennial Issue)</i>
42 hits	The Ampere and Electrical Standards Randolph E. Elmquist, Marvin E. Cage, Yi-hua Tang, Anne-Marie Jeffery, Joseph R. Kinard, Jr., Ronald F. Dziuba, Nile M. Oldham, and Edwin R. Williams <i>vol. 106, no. 1, 2001 (Centennial Issue)</i>

Top ten most frequently downloaded papers in 2004 – Internal NVL

(based on internal Web log files dated January 1, 2004 – July 31, 2004)

Hit frequency	Article Title, Author, Volume, Issue, Date
162 hits	Changes in the U.S. Primary Standards for the Air Kerma From Gamma-Ray Beams Stephen M. Seltzer and Paul M. Bergstrom, Jr. <i>vol. 108, no. 5, 2003</i>
95 hits	The Kelvin and Temperature Measurements B. W. Mangum, G. T. Furukawa, K. G. Kreider, C. W. Meyer, D. C. Ripple, G. F. Strouse, W. L. Tew, M. R. Moldover, B. Carol Johnson, H. W. Yoon, C. E. Gibson, and R. D. Saunders <i>vol. 106, no. 1, 2001 (Centennial Issue)</i>
80 hits	Statistical Interpretation of Key Comparison Reference Value and Degrees of Equivalence R. N. Kacker, R. U. Datla, and A. C. Parr <i>vol. 108, no. 6, 2003</i>
57 hits	The Kilogram and Measurements of Mass and Force Z. J. Jabbour and S. L. Yaniv <i>vol. 106, no. 1, 2001 (Centennial Issue)</i>
47 hits	The Candela and Photometric and Radiometric Measurements Albert C. Parr <i>vol. 106, no. 1, 2001 (Centennial Issue)</i>
47 hits	Statistics and Measurements M. Carroll Croarkin <i>vol. 106, no. 1, 2001 (Centennial Issue)</i>
46 hits	Optical-Fiber Power Meter Comparison Between NIST and PTB I. Vayshenker, H. Haars, X. Li, J. H. Lehman, and D. J. Livigni <i>vol. 108, no. 5, 2003</i>
46 hits	A Logical Model of Conceptual Integrity in Data Integration David Flater <i>vol. 108, no. 5, 2003</i>
45 hits	Virtual Environment for Manipulating Microscopic Particles With Optical Tweezers Yong-Gu Lee, Kevin W. Lyons, Thomas W. LeBrun <i>vol. 108, no. 4, 2003</i>
42 hits	Bayesian Inference of Nanoparticle-Broadened X-Ray Line Profiles Nicholas Armstrong, Walter Kalceff, James P. Cline, and John Bonevich <i>vol. 109, no. 1, 2004</i>
42 hits	Simulation of an Austenite-Twinned-Martensite Interface A. J. Kearsley and L. A. Melara, Jr. <i>vol. 108, no. 6, 2003</i>