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# Using Google Search Appliance (GSA) to search digital library collections: A Case Study of the INIS Collection Search

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## 1 Introduction

The world of library, information and knowledge management is facing many challenges. Besides diminished funding and increased user expectations, the use of classic search tools, such as library catalogues, is becoming an additional stumbling block and imminent challenge. Library users require fast and easy access to full-text information resources, regardless of whether the original format is paper or electronic. Practice shows that users demand reliable and immediate access to the results of their queries, which should be performed through a simplified, non-complex user interface. However, most libraries still offer complex Boolean searches made through each individual library-specific interface, the results of which are displayed in a highly technical, standardized, professional library format, usually bearing no relevance to end users. Google Search, with its huge coverage, high retrieval speed, and appealing simplicity, has established a new standard of information retrieval, which

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was not possible with the previous generation of library search solutions. Put in a position of David versus Goliath, many small, and even larger libraries, are losing the battle and letting many of its users use Google rather than library catalogues. Statistics back this up. In 2013, over two trillion searches were made using Google, or around six billion searches a day[1]. At the same time, the Library of Congress, USA, one of the world's largest libraries, had a total of 2 billion searches since the establishment of its ILS in August 1999[2]. A question for the library community and practicing librarians is whether Google can be used to improve user satisfaction when visiting classic libraries, and if it can increase the number of visits and visitors. If so, then how can it be done? This was the question faced by theIAEA's INIS when it decided to replace its aging search engine. In other words, the question and the challenge for INIS was how to revamp the on-line database catalogue with 3.6 million bibliographic records and full-text nuclear documents, while increasing its use, accessibility, usability, and expandability. INIS, one of the world's largest collections of published information on the peaceful uses of nuclear science and technology, offers on-line access to a unique collection of 3.6 million bibliographic records and 483,000 full texts of non-conventional (grey) literature (INIS). However, searching was complex and complicated, and required training in using Boolean logic, while full-text searching was not an option, and response time was slow. An opportune moment came to upgrade the system with the retirement of the previous catalogue software and the adoption of GSA as an organization-wide search engine standard. INIS was quick to realize the potential of using such a well-known application as a replacement for its on-line catalogue. This paper presents the advantages and disadvantages encountered during the last three

[1]Google Annual Search Statistics. http://www.statisticbrain.com/google-searches/.

[2]http://www.loc.gov/ils/.

years of GSA use. Based on specific INIS-based practices, this paper shares experiences on ways to improve classic library catalogues, while reaping multiple benefits, such as increased use, better accessibility, easier usability, expandability and improved user search and retrieval experiences.

## 2 IAEA NIS

The IAEA is regarded as the world's centre of cooperation in the field of safe, secure and peaceful uses of nuclear technologies. It was set up in 1957 as the world's "Atoms for Peace"[3] organization within the United Nations system. As of January 2014, the IAEA has 161 Member States. The IAEA Secretariat is headquartered at the Vienna International Centre in Vienna, Austria. It also operates liaison and regional offices in Geneva, Switzerland; New York, USA; Toronto, Canada; and Tokyo, Japan. The IAEA runs or supports research centres and scientific laboratories in Vienna and Seibersdorf, Austria; Monaco; and Trieste, Italy. The IAEA Secretariat is a team of 2300 multi-disciplinary professional and support staff from more than 100 countries. The IAEA's mission is guided by the interests and needs of Member States, strategic plans and the vision embodied in the IAEA Statute. Three main pillars — or areas of work — underpin the IAEA's mission: Safety and Security; Science and Technology; and Safeguards and Verification. The work of the IAEA is carried out through six departments[4]: Nuclear Energy, Nuclear Safety and Security, Nuclear Science and Applications, Safeguards, Technical Cooperation, and the Department of Management. Although supporting the entire Agency, the NIS is organizationally part of the Department of Nuclear Energy. The Department's main tasks are

[3] http://www.iaea.org/About/about-iaea.html.
[4] http://www.iaea.org/Publications/Reports/Anrep2012/orgchart.pdf.

to foster the efficient and safe use of nuclear power by supporting interested Member States in improving the performance of nuclear power plants, the nuclear fuel cycle, and the management of nuclear wastes; catalysing innovation in nuclear power and fuel cycle technologies; development of indigenous capabilities for national energy planning; the deployment of new nuclear power plants; and the advancement of science and industry through improved operation of research reactors. One of its tasks is also the preservation and dissemination of nuclear information and knowledge, which in turn is the responsibility of NIS. The Nuclear Information Section consists of the IAEA Library Unit, the INIS Unit, and the Systems Development and Support Group. The INIS Unit fosters the collection and exchange of scientific and technical information on the peaceful use of nuclear science and technology; maintains a unique nuclear related thesaurus, increases awareness in Member States of the importance of maintaining efficient and effective systems for managing such information; provides information services and support to Member States and to the IAEA; and assists with capacity building and training.

# 3 INIS

The Statute of the IAEA (IAEA), Article III, states that the Agency is authorized to foster the exchange of STI on peaceful uses of atomic energy. Article VIII, which is devoted to the exchange of information, states that the Agency's goal is to foster the exchange of STI on the peaceful uses of atomic energy, to encourage the exchange among its members of information relating to the nature and peaceful uses of atomic energy, and that it shall serve as an intermediary among its members for this purpose. Based on these Statute provisions, INIS was created in 1969 to provide computerized access to an ex-

tensive collection of references to the world's nuclear literature. It was designed as an international cooperative venture, requiring the active participation of its members. While it started with only 25 members, today there are 152 (128 countries and 24 international organizations[5]). INIS also represents the world's first truly international computerized information system. Under the INIS concept, each participating member undertakes to look through literature published within its boundaries and select those documents that fall within the agreed subject scope. The countries prepare a detailed description of each item selected and send it, in some cases together with a copy of the document, to the INIS Secretariat in Vienna. Here, the incoming information is checked and combined with input from other countries into a single database collection. INIS is a channel for information exchange that employs the very latest technology, thus, proving over the decades to be instrumental in bringing cutting edge technology to countries or geographical areas which lack such facilities or infrastructures. It is also the tool used by scientists, engineers, technicians, and managers in the nuclear industry to keep abreast of developments in the subject areas covered by the INIS Collection. From the perspective of "knowledge management and preservation", INIS is the repository for references to publications that contain cumulative scientific knowledge in the areas of peaceful applications of nuclear science and technology as recorded in scientific journals, as well as the repository for the full texts of NLC, also known as "grey literature", not easily available through regular commercial channels.

[5] http://www.iaea.org/inis/about-us/membership.html.

# 4 INIS Collection

INIS represents an extraordinary example of world cooperation, where 152 members allow access to their valuable nuclear information resources in order to preserve world peace and further increase the use of nuclear energy for peaceful purposes. Not only are more than 3.6 million bibliographic references to publications, documents, technical reports, non-copyrighted documentation, and other grey literature made available, but 483,000 full texts are also available. Overall, there are 700 GB of data in the INIS Collection. Besides being a source of information when searching, the availability of full-text gives INIS a special role — being the main custodian of this world information heritage and preserving this codified, specialized, scientific and technical knowledge. On average, INIS adds 120,000 bibliographic records and 13,000 full-text PDF documents to its collection annually. The complete collection is freely accessible from the INIS Search website[6]. The INIS Collection covers around 50 well defined subject categories which are regularly maintained by INIS and the ETDE. They also provide the scope descriptions used by national and regional centres to categorize nuclear literature for INIS input, and to categorize energy technology literature for ETDE input. The ETDE/INIS Joint Reference Series publications are also available on the INIS website[7]. The INIS Collection covers all aspects of the peaceful uses of nuclear science and technology such as nuclear reactors, reactor safety, nuclear fusion, applications of radiation and radioisotopes in medicine, agriculture, industry and pest control, as well as related fields of nuclear chemistry, nuclear physics and materials science. Special emphasis is placed on the environmental, economic and health effects of nuclear energy. Legal and social aspects associated with nuclear energy are also covered.

[6] http://inis.iaea.org/search.
[7] http://nkp.iaea.org/INISSubjectCategories.

Figure 1 lists a complete set of INIS Subject Categories.


**Figure 1:** INIS Subject Categories

Figure 2 on the next page gives a break-down of the amount of documents by major category, while Figure 3 on the following page gives a similar break-down according to various document types in the Collection.

# 5 INIS Search Engine

Since its inception, the INIS Collection has operated in a controlled environment, where users need to register through their national INIS centre, as well as the INIS Secretariat headquarters in Vienna, before being given access to the Collection. This changed in April 2009, when INIS became a free, open, and unrestricted information resource for internet users around the world. The opening of the Collection simplified access to reliable nuclear information on the peaceful uses of nuclear science and technology, including

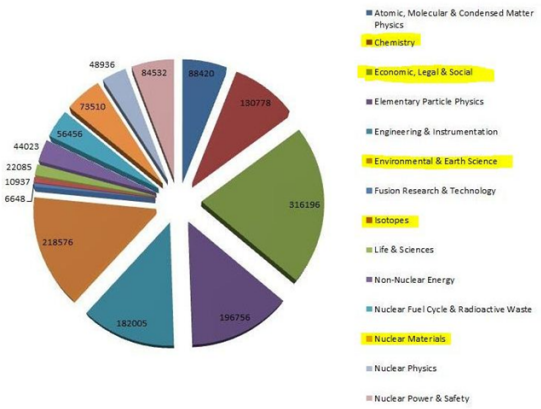


**Figure 2:** INIS Collection by Subject

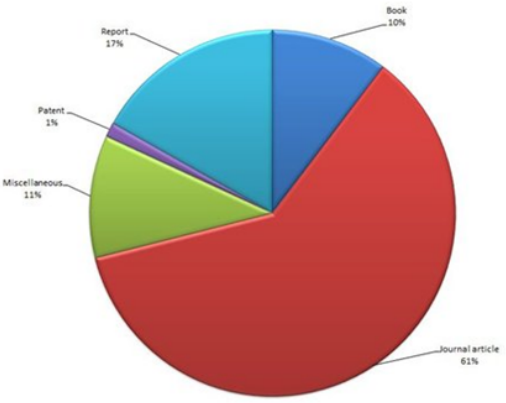


**Figure 3:** Bibliographic Records by Type (1 January 2014: 3,623,201 records)

non-conventional literature, and made nuclear knowledge readily available worldwide for research, development and other uses. The opening of the Collection resulted in a significant increase of users. The old search engine, a well-known BASIS ERDMS[8] was in operation from almost the beginning of INIS until 2011. Eventually, BASIS merged with an RDBMS system called DM, and became known as BASISplus. Currently, BASISplus is owned and supported by OpenText.

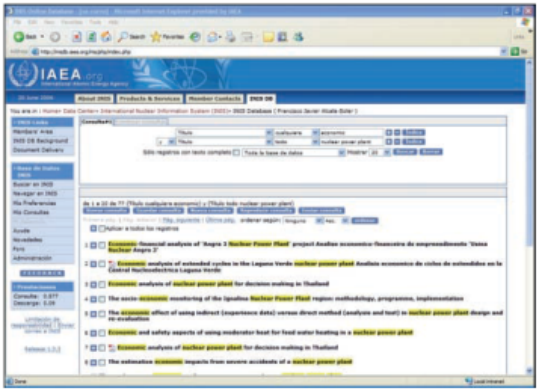

**Figure 4:** Old INIS BASIS Search Interface

The problems INIS experienced with its version of BASISplus included slow response time, a cluttered interface made for librarians, only an advanced search option, no full-text indexing, issues with support for a multilingual search interface, and lack of support for the thesaurus and different authorities. The new search engine was installed in 2010, and became fully operation in April 2011. It was based on GSA, which, at that time, became the IAEA-wide search engine standard. Although INIS reviewed a number of different

[8] http://en.wikipedia.org/wiki/Basis_database.

search engine offerings, the decision was made to use GSA as a de facto on-line catalogue and to search the digital collection of INIS records.


**Figure 5:** ICS Standard Interfaces

This decision was based on the following characteristics offered by GSA: great speed and scalability; uncluttered and easy to use starting interface; the possibility to use advanced options and to broaden or tighten searches; powerful full-text indexing; retrieval of more relevant results; and the existence of faceted/filtered search features. The images shown above are actual snapshots of two different versions of the INIS GSA-based standard (simple) search interfaces, both deployed on the INIS website.

# 6 Main Features of the INIS Collection Search ICS

The INIS Collection Search is based on Google Search Appliance© technology[9] — a renowned, simple, fast, and flexible search solution.

[9] http://www.google.com/enterprise/search/products/gsa.html.

Since its inception in 2010, the ICS has gone through a number of changes. Its current version, 4.3, was implemented in January 2014. The system is hosted internally on virtual servers within the IAEA and is constantly monitored for 24/7 availability. The INIS Collection Search, which in fact, is the INIS OPAC, includes the following main features:

## 6.1 Accessibility

ICS is an open web-based application freely accessible to Internet users interested in nuclear related publications. It's URL[10], as well as the INIS general URL[11], are open and well known web addresses which are easy to find and locate using any search engine. In fact, when searching for "nuclear information'" on Google.com, the INIS home page is among the first results. Besides web access, INIS and ICS are available through mobile applications for iPAD[12], iPHONE[13], and Android[14]. The NE News app, also available on the above devices, allows access to all of the IAEA Department of Nuclear Energy's newsletters, brochures and social media channels through a single portal. This includes the authoritative Nuclear Energy Series of technical publications that cover a wealth of topics, ranging from introducing nuclear power to decommissioning. The same app provides access to the ICS. A special widget — a compact version of the INIS Collection Search form that can be integrated into third-party Web sites — is also available. When users of third-party sites query the INIS Collection using the widget, they are redirected to

[10] http://inis.iaea.org/search.
[11] http://www.iaea.org/inis.
[12] https://itunes.apple.com/us/app/ne-news/id682405288?mt=8.
[13] https://itunes.apple.com/us/app/ne-news-for-iphone/id722935995?l=it&ls=1&mt=8.
[14] https://play.google.com/store/apps/details?id=org.iaea.nenews.

the INIS website, where the search results are displayed as if the query had been launched directly from the INIS Collection Search. The ICS widget can be deployed with or without a search term filter. The Japan Atomic Energy Agency uses the former ICS search widget[15]. Examples of the latter widget are the ones installed on the IAEA Research Reactors website[16], where the search is limited to research reactor documents, and the one on the IAEA Fast Reactor Technology website[17].

## 6.2 Ease of Use

The Initial ICS screen (Figure 6 on the next page) is intuitive and self-explanatory, enabling even those with no knowledge of specific INIS Collection characteristics to make queries and get desired results. It mirrors the Google.com user simplicity concept with one simple search box and very few additional, but optional commands. Based on this principle of straight-forward simplicity and usability, and due to the popularity of Google.com, previous knowledge is not needed to start using the system. The more advanced search, available as an option, might require some hints to achieve best results, but the ICS standard search is ready to use from the very first moment. As pointed out in the research article by (Lown, Sierra, and Boyer) «a single search box communicates confidence to users that our search tools can meet their information needs from a single point of entry».

The ICS Standard interface offers a *Main Search Box* for entering search terms; a *Tool Bar* linking to INIS Home, Thesaurus and Browse; a *Link to Advanced Search*; a *Link to Highlights*, a historical

[15] http://jolisfukyu.tokai-sc.jaea.go.jp/ird/english/index.html.

[16] http://www.iaea.org/OurWork/ST/NE/NEFW/Technical_Areas/RRS/home.html.

[17] http://www.iaea.org/NuclearPower/FR/index.html.


**Figure 6:** Features of the ICS Standard Interface

list of announcements made regarding the ICS; and the *Language Selector*. Both ICS Standard and Advanced Search interfaces are available in eight languages (Arabic, Chinese, English, French, Germain, Japanese, Russian, and Spanish). All words put into the query are used; searches are always case insensitive; punctuation is ignored, including @#$%&*()=+[] and other special characters; and common articles or determiners, i.e. stop words, such as 'the', 'a', and 'for', are usually ignored. The inclusion of stop words for languages other than English is also possible.

## 6.3 Advanced Search

The Standard Search interface provides excellent results for most search requirements. Our statistics show that the overwhelming majority of visitors (99.5%) use the ICS Standard Search interface, or some other way, such as access through Google Scholar. Many other studies demonstrate that users are not inclined to become expert searchers (Novotni; Wallace; Valentine). However, if a more precise search is needed, a query can be constructed using the query builder

form on the Advanced Search page. Query builder also generates a query syntax which appears in the Advanced Search query box. Alternatively, very experienced users can type the query directly into the Advanced Search query box. In this case, the query builder form becomes disabled. The Advanced ICS Search (Figure 7), offers the possibility to search all words or an exact phrase; to select (include or exclude) specific metadata fields; and to select the language of publications to be covered by the search. It also supports 'range queries' which enable the user to search for results where field values are between the lower and upper range specified by the query. Range queries are specified using the Range operator, written as two consecutive dots (e.g. year:2007..2009).

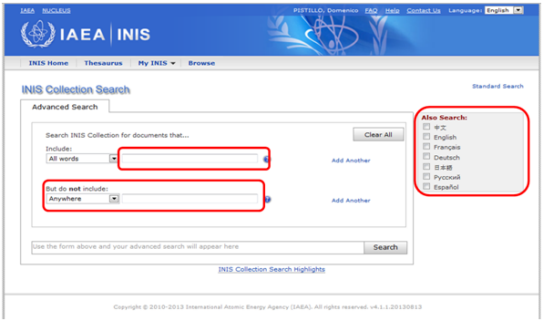


**Figure 7:** Features of the ICS Advanced Interface

The dropdown menu of the Advanced Search offers the list of fields (metadata elements) in which one can search. This includes Author, Abstract, Title, Country/Organization, Descriptors, Publication year, etc.

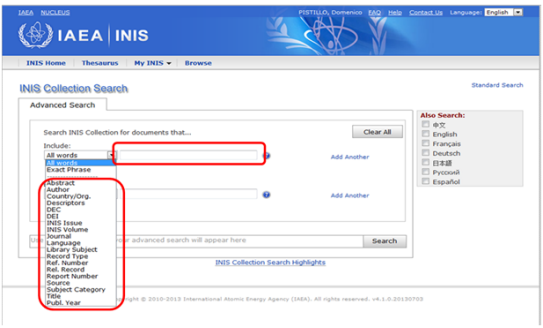


**Figure 8:** Dropdown menu in the ICS Advanced Interface

## 6.4 Faceted Search

The Faceted Search (Figure 9 on the next page), or dynamic navigation feature, allows further query filtering by specific metadata like Country, Language, Publication Year, and INIS Volume. Once a search is performed, the dynamic navigation filter options appear in the search results page separated by category. By clicking on a filter option under a category, the search results get filtered to the selected option.

## 6.5 Expandability

One of the major benefits of using GSA for the INIS Search is its expandability. At the very beginning, ICS searched only the INIS collection of bibliographic records and full texts. However, it was soon realised that the inclusion of the IAEA Library Catalogue, with its 90,000 records, would be beneficial to our users, as well. After the integration of the bibliographic records from the IAEA Library catalogue into the INIS Collection Search, information from the IAEA MoAE database, maintained by the IAEA Nuclear Knowledge Man-

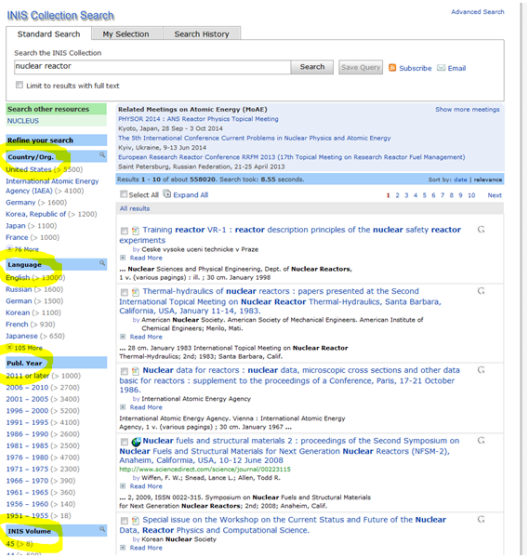


**Figure 9:** Faceted Search Options

agement Section, was also added. The most recent addition was the NUCLEUS database, which provides access to over 130 IAEA scientific, technical and regulatory resources. This includes databases, document repositories, websites, applications, publications, safety standards, training materials, and more. Current ICS implementation includes full text PDF documents, bibliographic records, and INIS and PDF metadata. However, the types of documents, as well as their numbers can be expanded. The most obvious expansion is the inclusion of various audio-visual formats, PowerPoint, Word and Excel files, which are not part of the presently deployed application.

## 6.6 Multilingualism

The ICS interface is available in eight languages — six official United Nations languages (Arabic, Chinese, French, English, Russian, and Spanish), plus Germain and Japanese. It is also integrated with the INIS/ETDE Multilingual Thesaurus (the same eight languages), which allows searching in different languages using the terms entered. Translation of bibliographic records into other languages is enabled through the integrated Google Translator. Although the translation is, perhaps, not the most satisfying, it gives users an idea about the content of the records found.

## 6.7 Authority Files

Authority control of a cataloguing database is essential to support the effective creation of adequate metadata (Mainconico), but it is also important for easier, better and faster searches. Keeping that in mind, and with the full integration with the INIS/ETDE Thesaurus, the ICS has fully incorporated an additional eight authority files. They are (Figure 10 on the following page):

| | |
|---|---|
| -Journal Title | -Descriptor (DEC, DEI in all languages) |
| -Journal CODEN | -Country/Organization (of publications) |
| -Journal ISSN | -Author |
| -Subject Category Code | -Report Number |

**Figure 10:** Faceted Search Options

## 6.8 Usability

Usability improvements and the addition of new functionalities increased with the introduction of the GSA-based ICS. Users can now print and export results in different formats, such as PDF, HTML, Excel, and XML, which was not previously possible. At the same time, they can also select individual records and even the fields (metadata elements) to be exported. Another usability improvement, especially for researchers and those working on preparing articles for publishing, was the option to download citations in plain text, RIS format, RefWorks, or as an EndNote. Creation of RSS feeds and the option to email selected search results as a link were also implemented.

## 6.9 User Profiling

The single most important and popular option is user registration and the creation of user profiles. This was done through a single signon feature which controls access not only to ICS, but also to a number of other information resources and repositories available through NUCLEUS. In other words, once the user is registered, his registration can be used across a number of resources offering easy single access and further personalization of specific options for each resource. ICS uses personalization to select and remember the interface language, the number of displayed results per page, and to save queries, search updates, and email query results. Connected

to user profiling is also a "Workspace concept" where documents which are found are associated with the user profile, and possibly translated into other languages.

### 6.10 Help

A complex system of aid tools was created and made available on the ICS, mainly through a Help function. It includes FAQ on INIS and a separate FAQ on ICS. The on-line help file covers two dozen elaborated topics, each geared towards a specific ICS feature or option. There are also pop-up hints — examples of how to build a query using metadata, and a recently developed ICS e-training course. Besides these aid tools, a hyperlink leads users to the INIS Collection Search Highlights, which shows a complete set of web announcements regarding the ICS from its inception in 2011. In a way, these announcements represent a brief history of the life and developments related to the ICS.

## 7 GSA Advantages and Disadvantages

Major advantages of using GSA are users' familiarity with a Google-type interface; the possibility to include many features in the foreground or background; its scalability; quick and relevant response to searches; many out of the box features that can be deployed with minor configuration and easy customization of the user interface by editing its XSLT. In addition to these important advantages, there are also some disadvantages which need to be mentioned. The main one is cost. Google charges according to the number of records (price per each million records) for a GSA licence. In addition, there is the cost of deployment, customization, and daily running and maintenance. It should also be mentioned that the GSA index and/or

related database is not in the control of the system administrator since there is no direct access to it, nor is there any access to the search algorithm. One of the most interesting features of Google search is records relevance ranking[18], which many believe is based on hyper-links, among other criteria, and is not easily done within a closed collection, such as the INIS Collection. However, the relevance sorting is used for the display of ICS records, but it remains in a way a "black box". One of the disadvantages often mentioned, and easily noticed by more experienced library catalogue users, is a GSA limitation in building queries, namely, use of a wild card (*) search, which is not supported. Another way to look at the GSA advantages and disadvantages would be to compare some features of the next generation library catalogues, as listed by (Yang and Hofmann)[19]

As seen in Figure 11 on the next page, most of the features are covered in the INIS Collection Search, and even the ones which are not currently included, can be supported by GSA. However, some of the additions would require developmental work on the interface and background system logistics.

# 8 Conclusions

The decision to choose GSA as a replacement for the previous INIS classic library on-line catalogue was not an easy one. A number of available search engines were examined and evaluated, a team of

[18]To influence rankings, GSA uses a result biasing policy. A result biasing policy determines the source biasing, date biasing, and metadata biasing settings that are used with a front end. A default result biasing policy is built into the search appliance. Administrator can use default policy, or create one or more custom result biasing policies. A result biasing policy is specific to a front end, so it can be aimed at specific types of end users.

[19]Also referred to as "OPAC 2.0" (Tramullas and Garrido), the "library catalogue 2.0" (Chambers) or "the third generation catalogue" (Mercun and Žumer).

| Feature | Status |
|---|---|
| Single point of entry for all library information | Yes |
| State-of-the-art web presence | Yes |
| Enriched content | No |
| Faceted navigation | Yes |
| Keyword search | Yes |
| Relevancy | Yes |
| Did you mean...? | Yes |
| Recommended/related materials | No |
| User contribution | No |
| RSS feed | Yes |

**Figure 11:** Features of the next generation catalogue

various specialists was involved, and it was decided to select GSA. Although it might have seemed risky at the time, the last three years of GSA use has shown that it was the right decision that has brought considerable benefits, primarily to INIS Collection users, as well as to the INIS Secretariat — the managing body of the document collection and the search system. User satisfaction was obvious from the results of the survey conducted and from the comments received. The number of visits dramatically increased and most importantly, the number of full-text document downloads also went up. The initial increase in users came with the introduction of GSA, and was further increased by connecting INIS to WorldWideScience.org, and, finally, by making the INIS Collection available on Google Scholar[20] The number of searches increased five times and the number of downloads increased more than ten times[21]. Finally, it should be emphasised that GSA is a search tool. It is not a library collection management tool, not a reporting tool, and not a statistical tool.

[20]Impact of joining Google Scholar: 2013: 50,000 searches and 3,000 downloads per month; At the beginning of 2014, 250,00 searches and 32,000 downloads per month.

[21]https://twitter.com/INISsecretariat.

However, it works perfectly with Google Analytics for generating metrics and statistical reports. In conclusion, the case of the INIS Collection Search shows that using GSA to search digital library collections is a good choice to attract more users and increase the use of available information resources and repositories.

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ABSTRACT: Google Search has established a new standard for information retrieval which did not exist with previous generations of library search facilities. The INIS hosts one of the world's largest collections of published information on the peaceful uses of nuclear science and technology. It offers on-line access to a unique collection of 3.6 million bibliographic records and 483,000 full texts of non-conventional (grey) literature. This large digital library collection suffered from most of the well-known shortcomings of the classic library catalogue. Searching was complex and complicated, it required training in Boolean logic, full-text searching was not an option, and response time was slow. An opportune moment to improve the system came with the retirement of the previous catalogue software and the adoption of GSA as an organization-wide search engine standard. INIS was quick to realize the potential of using such a well-known application to replace its on-line catalogue. This paper presents the advantages and disadvantages encountered during three years of GSA use. Based on specific INIS-based practice and experience, this paper also offers some guidelines on ways to improve classic collections of millions of bibliographic and full-text documents, while reaping multiple benefits, such as increased use, accessibility, usability, expandability and improving user search and retrieval experiences.

KEYWORDS: INIS; Google.

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