USE PATTERNS OF AEROSPACE PATENT SERVICES: A RESEARCH SURVEY OF AEROSPACE SCIENTISTS AND ENGINEERS OF BANGALORE

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ABSTRACT:

Electronic information resources like e-books, e-journals, e-databases, e-technical reports, e-conference proceedings and scholarly treatises are well known to the aerospace scientists and engineers. These are important sources of technological information to them. In addition to these, patent documents which are published by many patent offices across the world contain immense technological information. Generally, patents are overlooked as a very important information source. Actually, they constitute a rich source of information which is highly valuable in teaching a state of a given technological art, and thereby contribute to invention and innovation. This study is restricted to the geographic boundary of the city of Bangalore. The total percentage of responses usable from all the 16 aerospace organizations amounted to 89.7 percent. These responses were graded on a scale of 4 to 0, 4 representing 'Daily' and '0' representing 'Never'. The major findings that the authors would like to report in this paper are: *Analysis of Variance (ANOVA) Analysis of Variance (ANOVA)* was applied for testing the significant difference among the 16 mean scores attained from the scientists and engineers of the aerospace organizations for

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'Free Aerospace Patent Services Regularly Referred for Research Work'. It is observed that all the 16 aerospace organizations show a significant difference ($P < 0.05$) in their mean scores viz., ''The Institute of Engineering (IET)', 'ALTAR Aerospace Patents', 'BE Aerospace Patents', 'Franklin E Gibbs, Esq. Bigelow Aerospace Patents', 'Above Patents Aerospace Research', 'http://www.boeing.com', 'NAVAIR', 'http://www.patentsform.us/patents','http://www.theengineer.co.uk/Search', 'STG Aerospace', 'Asia's New High Tech Competitors', 'http://www.invention_protection.com/ip/publications/docs/Provisional_Patent_Applications_Pros_&_Cons.html' and 'Any other' *except for* **'www.freepatentsonline.com (P=0.090)', 'http://www.tmcnet.com (P=0.099)', 'Military and Electronics Forum (P=0.083)' and 'http://www.alcoa.com/global/en/innovation/paper_patents'**

Key Words: Electronic Information Resources, Use Patterns, Aerospace Scientists and Engineers, Aerospace Patent Services, City of Bangalore.

I. INTRODUCTION

Patents are a set of exclusive rights granted by a state (national government) to an inventor or his assignee for a limited period of time in exchange for a public disclosure of an invention. The tenure of the patents varies widely between countries according to their national laws and international agreements. Organizations coming under WTO (World Trade Organization), the term of patent protection is a minimum of twenty years.

In other words, a patent is a form of intellectual property. It consists of a set of exclusive rights granted by a sovereign state to an inventor or their assignee for a limited period of time in exchange for the public disclosure of an invention.

The procedure for granting patents, the requirements placed on the patentee, and the extent of the exclusive rights vary widely between countries according to national laws and international agreements. Typically, however, a patent application must include one or more claims defining the invention which must meet the relevant patentability requirements such as novelty and non-

obviousness. The exclusive right granted to a patentee in most countries is the right to prevent others from making, using, selling, or distributing the patented invention without permission.

Under the World Trade Organization's (WTO) Agreement on Trade-Related Aspects of Intellectual Property Rights, patents should be available in WTO member states for any invention, in all fields of technology, and the term of protection available should be a minimum of twenty years. In many countries, certain subject areas are excluded from patents, such as business methods and computer programs. **[1].**

A patent for an invention is the grant of a property right to the inventor, issued by the United States Patent and Trademark Office (USPTO). The term of a new patent is 20 years from the date on which the application for the patent was filed in the United States or, in special cases, from the date an earlier related application was filed, subject to the payment of maintenance fees. US patent grants are effective only within the US, US territories, and US possessions.

The right conferred by the patent grant is, in the language of the statute and of the grant itself, "the right to exclude others from making, using, offering for sale, or selling" the invention in the United States or "importing" the invention into the United States. What is granted is not the right to make, use, offer for sale, sell or import, but the right to exclude others from making, using, offering for sale, selling or importing the invention. Once a patent is issued, the patentee must enforce the patent without aid of the USPTO **[2].**

II. THE AEROSPACE INDUSTRY

The Aerospace industry is a high-tech industry and the industry is a powerful driver of innovation in the economy as a whole. Competition drives innovation in the Aerospace industry. The Aerospace industry is not a homogenous industry but it consists of several sub industries: the civilian aerospace industry, the defence or military aerospace industry and the space industry. Each of these industries faces a different industrial structure, a different innovation system and faces different major challenges.

Aircraft development and production is by far the largest component of the industry. The Aerospace industry is characterised by strong knowledge cumulativeness. Knowledge production

in the Aerospace industry is paramount: The Aerospace sector is highly R&D intensive and levels of competition are high. More competition acts an innovation driver in Aerospace. Aerospace is dominated by Strategic innovators, firms which drive innovation performance in the sector directly but also indirectly as they are the source of many innovative products and processes that are adopted by other firms throughout their domestic economy and internationally. The Aerospace industry is one of the few sectors where it may be claimed that military purposes are still a driver for technological development **[4].**

III. PATENTS AS A RICH SOURCE OF TECHNOLOGICAL INFORMATION AND ITS IMPORTANCE TO AEROSPACE

Patents are both an incentive for, and a result of R&D. Correlation of patent data with research and development expenditures for some major industries - electronics, machinery, instruments and drugs - confirms that patenting is significantly and directly related to R&D expenditures in those industries. As R&D expenditures increase, so do the number of patents

In today's economic environment, patents have become an increasingly important asset for both individuals and corporations. More and more, individuals and corporations, including those in the automotive and aerospace industries, are recognizing that revenue can be generated from their patent rights, whether those rights consist of a single patent, a family of patents or an entire portfolio. Indeed, some companies do not make or sell products; their entire revenue is derived from the licensing of their patents. Suffice it to say, licensing revenue has become a significant source of value in the global intellectual property economy **[5].**

Typically, publication data is used to estimate basic research outputs while patent data is used to measure "inventiveness, innovation, or technological change" or technological development. Patent counts, similar to publication counts, are the number of patents produced by an organization. The authors state that a patent is a minimum standard of "inventive significance" and represents a base unit. Counts of patent data are counts of patents categorized by firm, type of

industry, patent class, nationality of inventor, or other category. As a measure of innovation or inventiveness, patents tend to measure outputs of applied research and development research. Patent counts are considered a proxy for innovative activity. It is postulated that applied research and development research expenditures are related to aerospace technology advancement. Development research expenditures is also strongly correlated with national aerospace R&D innovation, as measured by aerospace patents **[6].**

Patent documents constitute valuable source of technical information for advancing the understanding of a given technological art. Recent advances in information storage and retrieval technology such as CD-ROMS and on-line data accessibility with the coming of the Internet and WWW have greatly improved the availability of patent documentation so that it has become a viable and a convenient information resource. Especially organizations like the World Intellectual Property Organization (WIPO) and the International Patent Documentation Centeer (INPADOC) of the European Patent Office (EPO) have significantly contributed in the dissemination of patent documentation, more so to the developing countries, **Myrick. et al. [7a].**

The authors in their article inter-alia quote Kumar in saying that, technological information is the life-blood of the innovative and inventive process and patents are also the vital source for such purpose. Patents should be, an integral part of the any data base from which relevant items are selected in the provision of both current awareness and retrospective searches. There is a need for the change in the attitude of scientists and engineers towards the patents. The academic training of technologists and scientists should be similarly oriented to make them rely equally on patent literature along with journal articles.

Inter-alia quoting Chester, they opine that, as a source of technological information across the whole spectrum of technology, the collection of patents has no equivalent. To researchers it can be a rich source of current state-of-the-art information, new ideas, and problem solving technology, all of which may lead to more productive research and development. Patent documents are a vital information source which should be consulted before an industrial

enterprise, research and development laboratory or an individual engages in costly and time consuming experiments with the objective of developing a new patentable product. Similarly, inter-alia they also refer to Derday, who points out that the technological information contained in patent documents is very crucial in the field of innovation, and since the growth of any national economy is largely influenced by the degree of its innovativeness, the full exploitation of patent information becomes obvious. He further emphasized that patent information is a unique instrument for the transfer of technical knowledge from developed to developing countries.

All these definitions prove a point clearly that patents can play a very useful role in providing current information to those attempting to understand a given technology.

The authors also go about citing a number of reasons as to why patents are a valuable source of technical information:

- Firstly, a fundamental direction of patent systems around the world is that in order to be granted a patent, the applicant must disclose the invention with sufficient clarity and completeness that the invention could be carried out by a person skilled in the art to which the invention relates. This disclosure is often accompanied by a set of drawings which supports in the description of the invention.

- Another reason as it being a valuable source of technological information is that the patent application will include a discussion of the background art which is useful for understanding the invention. By consulting patent documents for technical information, one gets a concise summary of the state of the art with the invention placed in a historical context.

- Also, the invention must be new and it must involve an inventive step. These statutory provisions insure that the patented invention was not within the public domain before

the effective date on which the patent application was filed. Consequently, patent documents will generally reveal information which is at the forefront of the given area of technology.

In addition to being a source for the timely disclosure of technology, patent documents are often the only source of disclosure of important scientific or engineering information.

Another important aspect of patent documents is that they contain bibliographic data that provides useful information. Generally the bibliographic data typically provides an identification of the inventor, the assignee, if any, the filing date, the publication date, and the issue date. Such information can aid the researcher in determining the epoch of the technology involved. It also can assist the researcher in locating the inventor or assignee, to have direct interactions and discussions relating to the invention or obtain a license to avoid infringement. Also, such information also provides an indication of which individuals or corporate entities are involved in those particular areas of technology.

In a nutshell, patents are well-indexed and well-classified source of technological information. Hence, they can be productively used by researchers, corporations, research and development organizations, universities, governments, and others, to learn the technology revealed therein. Most importantly, patent documents are inherently valuable to scientists and engineers because of the technical information they contain.

IV. IMPORTANCE OF ELECTRONIC INFORMATION RESOURCES AMONGST SCIENTISTS AND ENGINEERS

Several studies on the influence of the use of electronic information resources on scholarly work have indicated that the use of electronic literature has improved their work considerably in several ways.

It is absolutely clear that the use of electronic media to support scientific communication has undoubtedly been one of the paradigm shifts in the practice of science in this era. For a research scientist today, with access to the Internet, working across continents and in different time zones and keeping in touch with his peers has indeed become a reality due to the exponential growth of the telecommunication infrastructure that the world has witnessed. Most surprisingly, all this happens with very marginal costs of communication.

With the coming of e-resources, there has been a significant transformation by which scholarly information is disseminated throughout the world. In fact, the arrival of e-journals has greatly affected the way a scientist or an engineer seeks this information, acquires it and then uses it effectively.

Scholarly communication is very rapidly evolving. The usage trend is leaning more and more towards electronic formats. In many of the scientific areas, it is also observed that the electronic version of scientific publications is being read almost as often as the printed journals. If this trend continues, many authors feel that in the years to come the print versions of scientific publications will more or less disappear. It is very clear that the World Wide Web has very largely facilitated and propelled the emergence of these electronic resources.

It is important to note that the scientists and engineers in aerospace organizations are currently working on projects, which are of strategic importance to this country. These scientists largely depend on rapid collection of information from various 'electronic information resources' Also, today, scientists and engineers use electronic resources because of quick, easy access, and convenience. Also, very little effort is required to retrieve information from these e-resources.

Several studies on the perceived influence of e-resources use on scholarly productivity have indicated that factors like: (a) Easier to find material, (b) Easier to get hold of material, (c) Extended range of material available electronically, (d) Easier to keep updated in one's field of research, (e) Improved quality of work, (f) Inspired new ideas, (g) Greatly saved working time, (h) Reduced time browsing in libraries, (i) multi-user access, fast access, (j) 24 hour access, (k) Available before print, (l) Multiple file formats for downloading and storing (PDF, RTF, DOC, HTML etc..), (m) enhanced access and visibility to scientific papers, (n) Keeps current about global R&D etc. has indicated that the use of electronic resources has considerably influenced the quality of work of the scholars and inspired new ideas to some extent.

V. REVIEW OF LITERATURE

Myrick. et al. [7b], points out that, patents are a well-indexed and well-classified source of technological information. They can therefore be beneficially used by individual researchers, corporations, research and development organizations, universities, governments, and others, to learn the technology revealed therein. Patent documentation can also be a useful tool for planning development, allocating funding, and producing statistical information. Whereas patent documentation has traditionally been an underutilized information resource, perhaps due to its more remote accessibility, modem technology has greatly enhanced its availability. Moreover, accessibility is made even easier due to organizations, such as WIPO, which are chartered to improve the wide distribution of patent documentation and the dissemination of technological information. To the extent that the course of history amply demonstrates the value of learning from the teachings of others, it would certainly be undesirable for patents to remain an overlooked source of technological information, especially by developing nations.

McDonald [8], brings to the attention of the reader that, the patent is supposed to be a means to an end, that end being innovation. Whether the innovation comes from the protection the patent affords the inventor, or from the dissemination of the information of invention the patent allows, the patent is not meant to be an end in itself. This seems to be changing, the patent acquiring a strategic value increasingly independent of innovation. If this development has gone largely unnoticed, it may be because the patent system tends to be viewed from the entrenched perspectives of lawyers and economists, and of a number of interest groups that justify their reliance on the system in terms of the innovation it is supposed to encourage. These groups have never included small firms and developing countries in whose name they frequently defend the patent system. They may have some difficulty justifying a system whose strategic value is so divorced from its value for innovation.

Simmonds et al. [9], discusses that there has been a proliferation of Internet-based patent information services. From five service-providers with web-based offerings in 1996 to more than fifty in 2001. A high-level comparison of free and charged patent services reveal that: (a) Free patent databases exploit the data sets arising out of the official appraisal process, where the

charged services offer enhanced patent information (and non-patent data) directed to the requirements of particular end users and their internal research processes. The charged services are based on a business model and present a more flexible search environment, (b) Free patent databases permit users to search a limited set of patent information. More complex searches – family searches and legal status searches – tend to be available only through charged services, though there are exceptions, (c) The free databases have easy-to-navigate user interfaces, but the charged services tend to present search results in a more comprehensive fashion (more information on data attributes, with an opportunity for the researcher to specify the presentation of his or her results). Critically, the search results are presented with comprehensive hyperlinks to other databases. The Internet in general, and free patent databases in particular, are having a profound impact with respect to end-users' ability to access and process patent information.

Schwander. P. [10], points out that, When a scientist hears the word "Patent", he usually thinks of a legal instrument to protect an invention – involving business, finance, major corporations, etc. He would seldom consider patents as a source of technical or strategic information. There are several historical reasons for this situation. For a long time, patents were the preserve of a well-informed elite – patent professionals – who were aware of that precious source of information. The inaccessibility of patents is another reason for the widespread ignorance. Patent collections were often stored in huge archives and were only accessible through their publication number. A thematic search at that time was long and tedious. On top of that, scientists usually prefer to rely on classic sources of technical information such as specialised publications, conferences, and oral knowledge, without seeing the need for deeper exploration. Today, patents are easily accessible through electronic databases, taking advantage of the specific format of this information and its content. The first such tools were commercial on-line databases, which became available in the 1970s. By the late 1980s, CD-ROMs appeared on the market offering a considerable amount of data for a price unrelated to connection time. The Internet now offers the most democratic access yet to patent information. Even though it does not offer the speed and volume of information available from a commercial patent database, it remains a major breakthrough in the technical information world. Remember that 10 yr ago even professional users had no fully comparable tools.

Edfjäll. C. [11], recounts that in the user community, and generally in industry, there is a much higher awareness of patents – the usage statistics given in his paper certainly support that theory. The authors feel confident in saying that that more scientists and engineers search patents today than ever before. Promoting the use of patent information as a business tool will pave the way for managers to become "patent aware" too. And we finally have to remember that the databases have all grown dramatically since the 1980s. Taking the case study of European Patent Organization (EPO), its document archive which "only" had 20 million documents in those days, today has something close to 60 million. And there are many more databases to choose from, all with more fields, and which, to a great extent are not under the direct control of the user.

Wüsterfeld.M. et al. [12], talking about patent literature as a source of information for research and development says, that, the usefulness of patent literature for research and development is mostly unknown. Therefore a specific patent retrieval has been carried out concerning calcium phosphate-containing biomaterials. This research field includes chemical, medical, and engineering problems and is of importance to the development of bioactive materials for bone replacement. The preliminary work includes information on the characteristics and the availability of patent literature as well as about patent classification systems according to which the documents are filed in patent collections. By reading the non-patent literature searching questions can be formulated. The proper patent retrieval starts with the study of secondary literature especially that in *Chemical Abstracts*, which report on patents since 1907. The structure of *Chemical Abstracts*, their indexes and sections help to find relevant patents of chemical or chemical engineering contents fast and inspire to read patents of bordering areas. This retrieval from *Chemical Abstracts* led to 171 patents disclosed 1975–1985 and to 95 patents disclosed in 1986. The contents of the abstracts inform on the research activity and help to reduce time and effort for a continuation of the retrieval in a patent collections or database.

Meyer [13], opines that academic patents may be a more accurate measure of inventive output generated by academics than university-owned patents. Using Finnish data, a comparative

analysis suggests that number of academic patents is higher not only than the number of university-owned patents but also than patents citing domestic science. Also different linkage intensities could be identified. The second part of the study tries to identify areas for further analysis and introduces some results with respect to concentration of academic inventive activity, academic contributions to national patenting and utilization of patented inventions. Finally, limitations and applicability of the overall approach are discussed.

Poynder [14], analyzes the increasing number of patent services due to the emergence of Internet. He emphasizes that, the increasing importance of patent information for companies has been matched by the growth in Internet-and Web-based patent information services. These services are currently patchy but are improving steadily in quality and sophistication. Derwent Information's Patent Explorer is the first service to make both European and US patents available on the same Web site in both full text and image form. Considers some of the problems inherent in the current state of the Internet (speed of access, security) and discusses the present and likely future issues associated with the pricing of patent services. Points to the continuing dominance of traditional online hosts and services for patent information, due to the broad coverage and sophistication of searching facilities, but suggests that this may be eroded as Web-based services improve.

Kvalnes [15], discusses a case study of about the History of Managing Technical Information at DuPont. In his paper he highlights the initiatives taken at DuPont in developing computer databases to manage its collection of technical information. Interestingly, many of the individual departments had their own information centers. Around 1960, at DuPont, the duplication of efforts of departments especially in the area of patent services was studied. These studies had an impact on the handling of proprietary technical information. Later on, the author goes about discussing the efforts at DuPont to develop, build and implement an integrated system for the storage, retrieval and distribution of its in-house scientific and technical information. The author points out that Technical Information Services has been a tradition at DuPont. He also adds that groups containing scientists and engineers were gradually formed within libraries to index patent and proprietary information in the form of formal research reports.

Lawal [16], emphasizes that patent literature is important in engineering, but technical reports are the mainstay of engineering research in many sub-fields. Engineers of all types use standards information. The author also adds that engineering as a discipline, is not optimally compatible with e-print archives. His study also revealed that patent literature is vital to research in chemistry. Sometimes patents are the only source of particular chemical information. The potential to patent a specific research finding might detract from putting that information in the public domain before the patent is applied for and awarded. A significant number of chemists do not think that e-print archives are relevant to their field.

Goldstein [17], discussing the patent laws for scientists and engineers that although many texts attempt to explain intellectual property law to scientists and engineers, they are ineffective because they fail to present the subject within the proper scope; they are either too expansive or too detailed for the needs of researchers and inventors. However, this book provides researchers and students with an understanding of the aspects of patent law necessary to work with patent professionals and enhance patent coverage. The textual content in the book has been structured in such a way that it can be easily integrated into a reader's research routine. Each chapter supports the issues discussed with fact patterns that emphasize the steps necessary to protect patent rights. The book describes actual scenarios encountered by scientists and engineers, highlighting the protection of latent patent rights that may exist within an invention or technical solution.

IV. NATIONAL AEROSPACE LABORATORIES, BANGALORE AND ALLIED AEROSPACE ORGANIZATIONS IN BANGALORE: THE SCOPE OF THE PRESENT STUDY

The city of Bangalore, Karnataka is considered the 'Aerospace Hub' of the country with many key aerospace organizations which have already been established several years ago like (a) The Hindustan Aeronautics Limited (HAL), (b) The National Aerospace Laboratories (NAL), (c)The Aeronautical Development Establishment (ADE), (d) The Indian Space Research Organization (ISRO), (e) The Aeronautical Development Agency (ADA). It also comprises many

key Indian Air Force establishments like (a) Air Force Systems and Testing Establishment (ASTE), (b) Air Force Technical College (AFTC) and the (c) Institute of Aviation Medicine (IAM). In a nutshell, many of these organizations come under the broad umbrella of (i) Council of Scientific and Industrial Research (CSIR), (ii) Defense Research and Development Organizations (DRDO), (iii) The Indian Air Force (IAF), (iv) Educational Institutions like IISc, and (v) Major public sector undertakings and (vi) The Department of Space. All of them in their own way have significantly contributed to a large number of Indian aerospace programmes.

The National Aerospace Laboratories is India's premier civil aviation R&D aerospace research organization in the country. Its main mandate is the 'Development of aerospace technologies with strong science content and with a view on their practical application to the design and construction of flight vehicles'. NAL is also required 'to use its aerospace technology base for general industrial applications'. 'Technology' would be its core engine-driver for the future. NAL is also best known for its main sophisticated aerospace R&D testing facilities which are not only unique for this country but also comparable to similar facilities elsewhere in the world.

V. OBJECTIVES OF THE STUDY

- To determine the use patterns of 'free aerospace patent services used for research work' amongst the aerospace scientists and engineers of Bangalore.
- To ascertain whether the percentage of preference of the Use Patterns of 'Free Aerospace Patent Services' by the aerospace engineers and scientists are approximately the same.
- To study whether there exists similar patterns (homogeneous) of use of 'Aerospace Patent Services' amongst these aerospace scientists and engineers of the 16 aerospace organizations in Bangalore.

VI. NULL HYPOTHESIS

- There is no significant difference in the mean scores of 'Aerospace Patent Services Referred for Research Work' amongst the aerospace scientists and engineers of the selected 16 aerospace organizations of Bangalore.

VII. MATERIALS AND METHODS

The present study is restricted to the selected 16 prominent aerospace organizations in Bangalore. A total number of 650 survey questionnaires were distributed amongst the aerospace scientists and engineers belonging to these 16 aerospace organizations. A total number of 612 questionnaires were received back finally 583 (89.7%) were selected for the study which were found suitable for the study.

A survey questionnaire has been used to conduct this research study. The total population size of this research study is restricted to the 1220 aerospace scientists and engineers in Bangalore. The distribution of Source Data is indicated in *Table 1*. Random sampling technique has been used for selection of the sample size.

Table 2. shows the Frequency of Use of Aerospace Patent Services graded on a scale of 0-4.

Various statistical tests like calculating the arithmetic mean, Co-efficient of Variation (CV), generating the P-value tests for obtaining the probability of a test statistic, Analysis of Variance (ANOVA) tests for comparing whether the arithmetic means of several groups are all equal etc., were deployed on the data using the SPSS package. The responses received were tabulated using the SPSS package. The findings of the frequency of usage of Aerospace Patent Services by the Aerospace Scientists and Engineers of Bangalore is indicated in *Table 3.*

Table 4. highlights some selected URLs of General Patent Services and Aerospace Specific Patent Services for the benefit of the readers as an immediate e-reference source.

VIII. RESULTS AND DISCUSSION

 Summary of Total Scores on Free Aerospace Patents Regularly Referred for Research Work The summary of total scores obtained with regard to the frequency of usage of core aerospace engineering e-databases is as follows: The highest mean score 0.46(CV=205.88) is reflected by the respondents of 'www.freepatentsonline.com'. This is followed by a mean score of 0.37(CV=243.10) reflected by the respondents of 'The Institute of Engineering (IET)'. This is followed by a mean score of 0.34(CV=238.16) accrued by the respondents of 'http://www.boeing.com'. Similar mean scores of 0.33(CV=256.95) and 0.33(CV=245.34) is accrued by the respondents of 'Above Patents Aerospace Research' and 'ALTAIR Aerospace Patents' respectively. Again, similar mean scores of 0.29(CV=278.75) and 0.29(CV=261.67) is reflected by the respondents of 'http://www.patentsform.us/patents' and 'BE Aerospace Patents' respectively. Again, similar mean scores of 0.28(CV=272.64) and 0.28(CV=272.07) is accrued by the respondents of 'Military and Electronics Forum' and 'Franklin E Gibbs, Esq. Bigelow Aerospace Patents' respectively. This is followed by a means score of 0.27(CV=269.81) reflected by the respondents of 'http:www/tmcnet.com'. This is followed by similar mean scores of 0.26(CV=296.69) and 0.26(CV=285.34) by the respondents of 'http://www.invention_protection.com/ip/publications/docs/Provisional_Patent_Applications_Pros_&_Cons.html' and by 'NAVAIR' respectively. 'http://www.theengineer.co.uk/Search' reflects itself with a mean score of 0.25(CV=291.69). This is followed by a mean score of 0.24(CV=300.05) by the respondents of 'http://ww.alcoa.com/global/en/innovation/paper_patents'. 'Asia's New High Tech Competitors' reflect themselves with a mean score of 0.23(CV=302.74). This is followed by a mean score of 0.22(CV=297.21) by the respondents of 'STG Aerospace'.

 Analysis of Variance (ANOVA) Analysis of Variance (ANOVA) was applied for testing the significant difference among the 16 mean scores attained from the scientists and engineers of the aerospace organizations for 'Free Aerospace Patent Services Regularly Referred for Research Work'. It is observed that all the 16 aerospace organizations show a significant difference ($P < 0.05$) in their mean scores viz., ''The Institute of Engineering (IET)', 'ALTAR Aerospace Patents', 'BE Aerospace Patents', 'Franklin E Gibbs, Esq. Bigelow Aerospace Patents', 'Above Patents Aerospace Research', 'http://www.boeing.com', 'NAVAIR', 'http://www.patentsform.us/patents','http://www.theengineer.co.uk/Search', 'STG Aerospace',

'Asia's New High Tech Competitors', 'http://www.invention_protection.com/ip/publications/docs/Provisional_Patent_Applications_Pros_&_Cons.html' and 'Any other' *except for* **'www.freepatentsonline.com (P=0.090)', 'http://www.tmcnet.com (P=0.099)', 'Military and Electronics Forum (P=0.083)' and 'http://www.alcoa.com/global/en/innovation/paper_patents'**

IX. FINDING AEROSPACE RESOURCES ON THE INTERNET

There are a larger number of web resources on 'Aerospace Patent Services'. Few of the selected resources which the authors felt would be of useful and ready reference to the aerospace scientists and engineers are listed below in *Table 3*. These web resources offer searching capabilities, access to full-text, and gateways to several other patent services.

X. CONCLUSIONS

The main conclusions that we would like to draw from this study are:

- Aerospace Patent Services are a rich source of technological information to the aerospace scientists and engineers.
- It greatly aids them in their invention and innovation.
- Aerospace Scientists and Engineers also fully realize that significant revenue can be generated from their patent rights.

Analysis of Variance (ANOVA) Analysis of Variance (ANOVA) was applied for testing the significant difference among the 16 mean scores attained from the scientists and engineers of the aerospace organizations for 'Free Aerospace Patent Services Regularly Referred for Research Work'. It is observed that all the 16 aerospace organizations show a significant difference ($P < 0.05$) in their mean scores viz., ''The Institute of Engineering (IET)', 'ALTAR Aerospace Patents', 'BE Aerospace Patents', 'Franklin E Gibbs, Esq. Bigelow

Aerospace Patents', 'Above Patents Aerospace Research', 'http://www.boeing.com', 'NAVAIR', 'http://www.patentsform.us/patents','http://www.theengineer.co.uk/Search', 'STG Aerospace', 'Asia's New High Tech Competitors', 'http://www.invention_protection.com/ip/publications/docs/Provisional_Patent_Applications_Pros_&_Con s.html' and 'Any other' ***except for*** **'www.freepatentsonline.com (P=0.090)', 'http://www.tmcnet.com (P=0.099)', 'Military and Electronics Forum (P=0.083)' and 'http://www.alcoa.com/global/en/innovation/paper_patents'**

- This also implies that, the percentage of preference of the Use Patterns of 'Aerospace Patent Services' by the aerospace engineers and scientists are not approximately the same, ***except for*** **'www.freepatentsonline.com (P=0.090)', 'http://www.tmcnet.com (P=0.099)', 'Military and Electronics Forum (P=0.083)' and 'http://www.alcoa.com/global/en/innovation/paper_patents'**

- The study also reveals that there is heterogeneity in the Use Patterns of 'Aerospace Patent Services'**, *except for*** **'www.freepatentsonline.com (P=0.090)', 'http://www.tmcnet.com (P=0.099)', 'Military and Electronics Forum (P=0.083)' and 'http://www.alcoa.com/global/en/innovation/paper_patents',** amongst the aerospace scientists and engineers of Bangalore of the selected 16 aerospace organizations taken for the study.

XI. ACKNOWLEDGEMENTS

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TABLES AND FIGURES

Table-1: Distribution of Source Data (Sample Size)

Sl.No.	Organizations	No. of Questionnaires distributed	No. of Questionnaires received	No. of usable questionnaires usable
1.	ADA	67	63	58
2.	AFTC	19	16	15
3.	ADE	14	12	12
4.	ASTE	33	30	29
5.	CABS	16	15	14
6.	CEMILAC	33	30	29
7.	C-MMACS	8	6	6
8.	DARE	11	9	9
9.	LRDE	5	3	2
10.	GTRE	24	22	21
11.	HAL	144	140	134
12.	IAM	40	36	33
13.	ISRO-ISTRAC	25	24	22
14.	IISc	38	37	34
15.	JNCASR	5	3	1
16.	NAL	168	166	164
Total		**650**	**612**	**583 (89.7%)**

Geographical Boundary of the Study (16 Prominent Aerospace Organizations of Bangalore, INDIA).

Key: ADA=Aeronautical Development Agency, **AFTC**=Air Force Technical College, **ADE**=Aeronautical Development Establishment, **ASTE**=Aircraft Systems Testing Establishment, **CABS**=Centre for Airborne Systems, **CEMILAC**=Centre for Military Airworthiness and Certification, **C-MMACS**=Centre for Mathematical Modeling and Computer Simulation, **DARE**=Defense Avionics Research Establishment, **LRDE**=Electronics and Radar Development Establishment, **GTRE**=Gas Turbine Research Establishment, **HAL**=Hindustan Aeronautics Limited, **IAM**=Institute of Aerospace Medicine, **ISRO-ISTRAC**=Indian Space Research Organization, **IISc**=Indian Institute of Science, **JNCASR**=Jawaharlal Nehru Centre for Advanced Scientific Research, **NAL**=National Aerospace Laboratories.

Table – 2: Frequency of Use of Aerospace Patent Services for Research Work Graded on a Scale of 0 to 1.

4 – daily, 3 – weekly, 2 – fortnightly, 1 – monthly, 0 - Never					
Name of the Aerospace Patent	**4**	**3**	**2**	**1**	**0**
(1) IET: The Institute of Engineering and Technology: Patent Alert Online Service, (http://www.iee.org/oncomms/pn/aerospace/patents.cfm)	4	3	2	1	0
(2) ALTAIR Aerospace: ALTAAIR Aerospace Patents, (http://www.atairaerospace.com/patents/)	4	3	2	1	0
(3) BE Aerospace Patents, (http://www.patentgenius.com/assignee/BEAerospace.html)	4	3	2	1	0
(4) Franklin E. Gibbs, Esq. Bigelow Aerospace Patents, (www.freshpatents.com/Franklin-E-Gibbs-Esq-Bigelow-Aerospace-cndirf.php)	4	3	2	1	0
(5) www.freepatentsonline.com	4	3	2	1	0
(6) Above Patents Aerospace Research, (http://above-patents-aerospace-research.com)	4	3	2	1	0
(7) http://www.boeing.com	4	3	2	1	0
(8) http://www.tmcnet.com	4	3	2	1	0
(9) NAVAIR: (http://www.nawcwd.navy.mil/techTrans)	4	3	2	1	0
(10) Military and Electronics Forum: (http://mae.pennnet.com/search)	4	3	2	1	0
(11) http://www.patentstorm.us/patents	4	3	2	1	0
(12) http://www.theengineer.co.uk/Search	4	3	2	1	0
(13) http://www.alcoa.com/global/en/innovation/papers_patents	4	3	2	1	0
(14) STG Aerospace: (http://www.stgaerospace.com)	4	3	2	1	0
(15) Asia's New High Tech Competitors, (http://www.nsf.gov/statistics/s4495/conten1b.htm)	4	3	2	1	0
(16) http://www.invention-protection.com/ip/publications/docs/Provisional_Patent_Applications_Pros_&_Cons.html	4	3	2	1	0

Table-3: Frequency of Usage of Aerospace Patent Services for Research Work

SN	Organizations	Mean and CV	AEROSPACE PATENT SERVICES								
			IET (Institute of Engg. Technology)	ALTAIR Aerospace	BE Aerospace Patents	Franklin E Gibbs, Esq. Bigelow Aerospace Patents	www.freepatentsonline.com	Above Patents Aerospace Research	http://www.boeing.com	http://www.tmcnet.com	NAV AIR
1	ADA	Mean	0.22	0.31	0.24	0.19	0.21	0.26	0.22	0.21	0.10
		CV	277.72	227.50	303.65	319.38	296.96	336.31	301.82	347.81	392.13
2	AFTC	Mean	0.47	0.27	0.20	0.27	0.33	0.33	0.40	0.40	0.53
		CV	227.16	263.90	207.02	222.61	244.95	217.12	227.56	280.31	211.02
3	ADE	Mean	0.83	1.00	0.92	0.67	1.00	0.75	1.00	0.58	0.75
		CV	123.58	112.82	127.04	133.14	104.45	115.47	95.35	135.94	100.50
4	ASTE	Mean	0.17	0.10	0.07	0.03	0.07	0.03	0.24	0.03	0.14
		CV	381.88	395.61	538.52	538.52	538.52	538.52	306.35	538.52	373.93
5	CABS	Mean	0.29	0.50	0.14	0.29	0.71	0.21	0.29	0.43	0.21
		CV	254.20	257.20	374.17	288.90	149.67	374.17	213.94	218.78	270.17
6	CEMILAC	Mean	1.14	0.48	0.31	0.55	0.48	0.45	0.31	0.31	0.28
		CV	136.39	211.68	259.83	203.14	204.32	277.00	273.73	311.73	319.81
7	C-MMACS	Mean	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
		CV	244.95	244.95	244.95	244.95	244.95	244.95	244.95	244.95	244.95
8	DARE	Mean	1.33	1.33	1.11	1.22	1.00	1.56	1.11	1.00	1.00
		CV	118.59	106.07	114.24	106.50	111.80	91.54	114.24	100.00	122.47
9	LRDE	Mean	1.50	1.00	1.00	1.00	1.50	1.00	1.00	1.00	1.50
		CV	141.42	141.42	141.42	141.42	141.42	141.42	141.42	141.42	141.42
10	GTRE	Mean	0.48	0.43	0.19	0.24	0.57	0.33	0.48	0.29	0.24
		CV	226.36	228.28	356.81	226.36	196.21	197.48	205.96	225.28	322.74
11	HAL	Mean	0.38	0.33	0.40	0.33	0.51	0.37	0.36	0.29	0.31
		CV	227.36	249.90	221.78	229.54	194.55	226.91	217.60	245.05	272.24
12	IAM	Mean	0.45	0.27	0.27	0.52	0.45	0.48	0.58	0.42	0.39
		CV	227.38	263.65	279.14	243.23	213.66	236.97	194.33	228.46	236.94
13	ISRO-ISTRAC	Mean	0.27	0.23	0.23	0.27	0.45	0.32	0.41	0.32	0.27
		CV	342.88	382.42	382.42	342.88	269.25	297.15	268.40	297.15	342.88
14	IISc	Mean	0.21	0.35	0.18	0.15	0.29	0.26	0.12	0.12	0.18
		CV	373.93	259.89	354.86	379.25	258.39	268.08	347.94	347.94	294.96
15	JNCASR	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		CV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	NAL	Mean	0.23	0.23	0.24	0.16	0.53	0.24	0.27	0.21	0.17
		CV	287.66	260.08	282.81	355.85	191.86	291.23	274.17	297.10	334.68
Mean Scores of Frequency of Use of Free Aerospace Patent Services		Mean	0.37	0.33	0.29	0.28	0.46	0.33	0.34	0.27	0.26
		CV	243.10	245.34	261.67	272.07	205.88	256.95	238.16	269.81	285.34
P Values			0.000	0.006	0.017	0.001	0.090	0.006	0.025	0.099	0.010

Table-3: Contd..

SN	Organizations	Mean and CV	AEROSPACE PATENT SERVICES						
			Military and Electronics Forum	http://www.patentsform.us/patents	http://www.theengineer.co.uk/Search	http://www.alcoa.com/global/en/innovation/papers_patents	STG Aerospace	Asia's New High Tech Competitors	http://www.invention-protection.com/ip/publications/docs/Provisional_Patent_Applications_Pros_&_Cons.html
1	ADA	Mean	0.22	0.17	0.28	0.19	0.21	0.12	0.22
		CV	324.14	378.51	316.99	375.53	335.82	412.90	334.74
2	AFTC	Mean	0.20	0.13	0.20	0.33	0.33	0.27	0.33
		CV	280.31	263.90	280.31	269.92	269.92	263.90	269.92
3	ADE	Mean	0.58	0.50	0.67	0.75	0.67	0.50	0.67
		CV	135.94	159.54	116.77	100.50	116.77	200.00	147.71
4	ASTE	Mean	0.03	0.07	0.03	0.07	0.03	0.07	0.10
		CV	538.52	538.52	538.52	538.52	538.52	538.52	538.52
5	CABS	Mean	0.29	0.21	0.36	0.14	0.21	0.14	0.21
		CV	288.90	270.17	235.73	374.17	270.17	374.17	270.17
6	CEMILAC	Mean	0.41	0.31	0.24	0.24	0.31	0.52	0.93
		CV	270.32	286.96	344.05	263.30	273.73	228.88	176.79
7	C-MMACS	Mean	0.17	0.17	0.17	0.17	0.17	0.17	0.17
		CV	244.95	244.95	244.95	244.95	244.95	244.95	244.95
8	DARE	Mean	1.11	1.22	1.22	0.89	1.11	1.33	1.33
		CV	114.24	114.09	106.50	104.40	105.00	99.22	106.07
9	LRDE	Mean	1.50	1.50	0.50	0.50	1.00	1.00	0.00
		CV	141.42	141.42	141.42	141.42	141.42	141.42	0.00
10	GTRE	Mean	0.38	0.29	0.19	0.19	0.10	0.24	0.19
		CV	268.68	274.32	268.68	356.81	458.26	294.14	268.68
11	HAL	Mean	0.29	0.35	0.25	0.31	0.25	0.25	0.25
		CV	269.21	259.89	284.64	269.41	287.93	292.21	300.57
12	IAM	Mean	0.36	0.48	0.45	0.36	0.33	0.21	0.27
		CV	255.56	231.29	233.93	273.43	256.17	306.37	293.80
13	ISRO-ISTRAC	Mean	0.27	0.36	0.23	0.23	0.23	0.23	0.09
		CV	342.88	288.37	382.42	382.42	382.42	382.42	469.04
14	IISc	Mean	0.24	0.15	0.18	0.18	0.15	0.21	0.15
		CV	257.54	340.30	294.96	259.89	296.28	311.34	379.25
15	JNCASR	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		CV	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	NAL	Mean	0.24	0.24	0.16	0.15	0.15	0.17	0.17
		CV	278.95	294.75	341.86	395.08	356.99	340.91	328.33
Mean Scores of Frequency of Use of Free Aerospace Patent		Mean	0.28	0.29	0.25	0.24	0.22	0.23	0.26
		CV	272.64	278.75	291.69	300.05	297.21	302.74	296.69

SN	Organizations	Mean and CV	AEROSPACE PATENT SERVICES						
			Military and Electronics Forum	http://www.patentsforum.us/patents	http://www.theengineer.co.uk/Search	http://www.alcoa.com/global/en/innovation/papers_patents	STG Aerospace	Asia's New High Tech Competitors	http://www.invention-protection.com/ip/publications/docs/Provisional_Patent_Applications_Pros_&_Cons.html
Services									
P Values			0.083	0.035	0.010	0.106	0.006	0.002	0.000

Table 4: Selective Web Resources of General and Aerospace Related Patent Services

SL. NO.	Selected Web Resources of Aerospace Patent Services and Aerospace Patent Related URLS	Brief Description of the Resources
	GENERAL PATENT SERVICES	
1.	http://www.ipo.gov.uk/: Intellectual Property Office	The Intellectual Property Office (IPO) is the UK official body for the granting of patents. Their website has a wealth of infomation about all kinds of intellectual property rights including copyright, design right and trademarks in addition to patents, and gives clear advice on making a UK patent application.
2.	http://www.epo.org/: European Patent Office	The European Patent Office (EPO) website provides information about the European patent application procedure and has links to each member country's patent-granting body.
3.	http://www.ipo.gov.uk/gb-espacenet-catch: Espacenet	espacenet is a European network of patent databases which provides free online access to patents and patent applications. Each member state has an espacenet service in its own language (e.g. gb.espacenet.com, fr.espacenet.com) which provides access to national and European standards as well as to the EPO's worldwide database of over 60 million patent publications from more than 80 different countries. The worldwide database covers a longer time period than the national or European databases: see the online Help on the espacenet site for details.
4.	http://www.uspto.gov/: The United States Patent and Trademark Office	The US Patent and Trademark Office (USPTO) is the federal agency for granting US patents. In addition to providing information about US patents and patent law, it gives online access to US patents and patent applications.
5.	http://www.wipo.int/portal/index.html.en: World Intellectual Property Organization (WIPO)	This UN organization promotes the protection of intellectual property worldwide. The site includes the Patentscope search service which allows full-text searching of almost 2 million international patent applications.
6.	http://www.ipo.gov.uk/business-patlibL Patent Information Centers (PATLIB)	This is a network of patent information centres offering information and competent advice. Contact the PATLIB CENTRE BELFAST to find out what help is available locally.
	AEROSPACE PATENT SERVICES AND AEROSPACE PATENT RELATED URLS	
7.	http://www.above-patents-aerospace-research.com/services	Above Patents Aerospace Research: Over the years Above Patents Aerospace Research has reviewed and examined thousands of patents and has become closely familiar with all aspects of the aeronautical technology. The organization is keenly aware of the Patent process and has come to see that there is a wealth of technical information that is untapped within the Patent disclosures.
8.	http://www.planetpatent.com/aboutus/	Planet Patent – A Professional Patent Search Services Company. Specializes in aerospace, biomedical, biotech, business method, chemical, electrical, genetic, mechanical, medical & software patent searches
9.	http://www.invntree.com/patent-inventions	Specialization in: (a) Patent Specification Drafting, (b) Patent filing and prosecution, (c) Patent opposition and maintenance, (d) Prior art search and analysis, (e) Patent intelligence support, (f) Patent watch and alerts. Expertise in Aerospace

SL. NO.	Selected Web Resources of Aerospace Patent Services and Aerospace Patent Related URLS	Brief Description of the Resources
		Domain
10.	http://www.murgitroyd.com/patents/mechanical-automotive/aerospace	Murgitroyd & ©ompany,: European Patent and Trademark Attorneys. Patent Attorneys domain expertise in: (a) Aerodynamics, (b) Aircraft Structures, (c) Alternative fuel systems, (d) Avionics, (e) Gas turbines, (e) Landing gear systems, (f) Manufacturing engineering, (g) Materials science, (h) Propulsion systems, (i) Software
11.	http://www.patentable.co.uk/2/patents/aerospace-and-defence.html	Abel & imray: Patent and trademark attorneys: The Abel & Imray Aerospace & Defence team is a multi-disciplinary practice group offering Intellectual Property services in all fields of aerospace technology, whether for commercial use or military/defence based, including mechanical and structural engineering, materials (composites, alloys etc), material processing techniques (machining, welding etc), manufacturing processes, electrical and hydraulic equipment, fuel systems, optics-related technologies, sensors, testing systems, aircraft interiors, and computer- and software- implemented inventions.
12.	http://www.kellysearch.com/	Business to Business Supplier Search: Patent Services, Engineering, Patent Profile Suppliers: North America
13.	http://www.navtechlpo.com/what-we-do/	NAVTECH LPO Services: The Intellectual Property Division delivers superior quality services that protect our clients' intellectual property from the likelihood of any infringement or litigation. The team comprises of highly competent patent attorneys with varied experience in patent prosecution, analysis and litigation. They are assisted by technology experts, engineers and scientists in the field of electronics & telecommunications, computer sciences, chemical, mechanical, computers, pharmaceutical, biotechnology, bioengineering, aerospace and general engineering domains.
14.	http://tgs.freshpatents.com/Aerospace-bx1.php	FreshPatents.com: Track new Patents and Technologies: This URL is frequently updated with new Aerospace related patents.
16.	http://www.patentstorm.us/assignee-patents/_Deutsche_Aerospace_Airbus_GmbH/30419/1.html	Assignee: Deutsche Aerospace Airbus GmbH PatentStorm offers full-text U.S. patents and patent applications from the U.S. Patent Office, providing advanced search capabilities and full image retrieval in handy PDF format.
17.	http://honeywell.com/sites/aero/Pages/Home.aspx	Honeywell is a diversified technology and manufacturing leader of aerospace products and services; control technologies for buildings, homes and industry; automotive products; power generation systems; specialty chemicals; fibers; plastics and advanced materials.
18.	http://www.aerospace.org/	The Aerospace Corporation has provided independent technical and scientific research, development, and advisory services to national security space programs since 1960. We operate a federally funded research and development center

SL. NO.	Selected Web Resources of Aerospace Patent Services and Aerospace Patent Related URLS	Brief Description of the Resources
		(FFRDC) for the United States Air Force and the National Reconnaissance Office and support all national security space programs. We also apply more than 50 years of experience with space systems to projects for civil agencies like NASA and the National Oceanic and Atmospheric Administration, commercial companies, universities, and international organizations in the national interest.