

# Perceived Islamic Work Ethics and Organisational Commitment among Muslim Engineers in Perak Tengah and Manjung District

Mohamed Shamaun Yushak, Adli Rafai Ahmad  
Rajuddin, Zakiah Mohamed, Norfazilah Bawadi,  
Khairiah Mohamad Daud

Master of Management Students, Graduate School of  
Management  
International Islamic University Malaysia  
Gombak, Malaysia  
e-mail: shamaun.yushak@bnsy.com.my

Suhaimi Mhd Sarif

Kulliyyah of Economics and Management Sciences  
International Islamic University Malaysia  
Gombak, Malaysia  
e-mail: suhaimims@iium.edu.my

**Abstract**— Many have argued that the productivity and quality of work of Muslim engineers are lower than their non-Muslim counterparts. Islamic Work Ethics is argued as the main barrier for higher productivity. The study aims to obtain the views of Muslim engineers in Perak Tengah and Manjung Districts whether Islamic Work Ethics (IWE) contributes to lower productivity and quality of work by Muslim professionals. The study distributed questionnaires to the 50 Muslim engineers. The preliminary findings show IWE enhances Muslim engineers' commitment towards their organisations and also work productivity and quality. Thus, the findings rejected the claim that IWE is the barrier for productivity and work quality. Nevertheless, the study found that the “theomorphic potential” of most Muslim engineers in Perak Tengah and Manjung are not fully realized. Such weakness reduces the conscious to be more careful and thoughtful in producing quality work. The study suggests that Muslim engineers should enhance the cognitive (aql'), affective (nafs') and normative (syariat) aspects of work with Qur'anic-based Islamic values as demonstrated by Prophet Muhammad P.B.U.H. Future studies should cross examine professionals from other sectors with larger sample size.

**Keywords**- *Islamic work ethics, organisational commitment, Muslim engineers*

## I. INTRODUCTION

Educating engineers with ethics and behavioral science is essential to ensure sustainability in engineering knowledge and development [1]. The inclusion of values in engineering requires the willingness and readiness from all stakeholders [1]. Engineers must their professionalism in all stages of the profession and aspects of life, such as how to solve ethical problems professionally [2]. In today's competitive and globalised world, talent and innovation with ethical dimension is highly valuable [3]. To convince engineers to learn more about ethics in engineering and decision making process, they must be convinced that such knowledge is sustainable [1], ethical in professional practice [2], and competitively advantage than other rivals [3].

This paper examines the availability of materials related to engineering ethics in relations to promote hands-on, professional, ethical and valuable engineers [2][3], which is promoted by the Malaysian Government along with its innovative economic, social, political and technology transformation programs [4]. Related terms are also searched for comparison. Rich databases of literature could imply that the concept is progressing rapidly [5].

The study is aimed to examine the relative frequency of engineering ethics and related materials via the Internet search engines. However, it is outside the scope of the paper to investigate the quality of the contents of the Web-based materials available. One of the results of the study will be able to answer this question: How many hits are produced when the term “engineering” is used in comparison with “ethics,” “Islam,” “professional,” “research,” and “training”?

## II. LITERATURE REVIEW

### A. Types of Internet Search Engines

There are many Internet Search Engines (ISEs) that have been used widely in searching for information for the quantity as well as quality [6][7]. For example, Mettropol and Nieuwenhuysen evaluated thirteen Internet search engines, namely AltaVista, EuroFerret, Excite, HotBot, InfoSeek, Lycos, MSN, NorthernLight, Snap, WebCrawler, Ilse, Search.nl, and Vindex [8]. The fluctuations or complications are characteristics of the performance of the Internet search engines [9][10]. The fluctuations in the search results affect the efficiency of Internet search as a publication/communication medium [9][11][12].

### B. Extend of usefulness of Different Internet Search Engines

Dreilinger and Howe found that large data obtained from the ISE's may pose difficulties in the selection process [13]. It is also time consuming to filter them, which eventually may not certainly be useful [12][13]. Prior to that, Tomaiuolo and

Packer found that similar results in one ISE also appeared in the other ISEs [14]. The repetition can be used as checker against the accuracy of the information within and among the ISE's [12][13]. Leighton and Srivastana argue that such rich results give more confidence in terms of information accuracy, not so much of effectiveness of information retrieval [15].

Wang, Xie and Goh contend that search engines are widely used as tools to find useful information from the Internet [16]. However, most search engines were developed on the basis of technical requirements and without much consideration for the customer's perspective. Ideally, ISE's should be very helpful not only to the designers, but also to the users.

Sullivan identified fourteen Internet Search Engines (ISE's) which he classified as top choices (Google, Yahoo, and Bing), strongly considered (Alltheweb, AOL, HotBot, and Teoma), and other choices (Altavista, Gigablast, LookSmart, Lycos, MSN, Netscape, and Open Directory) [17].

### III. METHODOLOGY

The study aims to ascertain the number of hits of the materials on engineering ethics that were produced by the Internet search engines (ISE's). Major single search terms used include education, engineer, engineering, ethics, Islam, professional, research, and training. Related terms are included in the search in order to generate comparative data.

The study is carried out to ascertain comparative availability of the materials on ethics and engineers in three top Internet Search Engines (ISE's): Google, Yahoo and Bing, from Sullivan's top choices only [17]. Sullivan's complete list comprised: top choices (Google, Yahoo, and Bing), strongly considered (Alltheweb, AOL, HotBot, and Teoma), and other choices (Altavista, Gigablast, LookSmart, Lycos, MSN, Netscape, and Open Directory) [17].

The Internet was accessed on 2 February 2011, 2.21 p.m. – 4.21 p.m. [Gombak Time] using a combination of selected search terms: education, engineer, engineering, ethics, Islam, professional, research, and training. A tabular format is created to capture the data of interest for each search engine. The ratio of hits for each term within each ISE is computed by dividing the hits into the total hits for the search engine.

The use of ratios to compute hits produced by the Internet search engines provides a means to assess impacts [18]. Moreover, it is more appropriate to make inference from the use of ratios [19], although such approach can be less reliable statistically [20]. However, given time constraints, it is still economical to use ratio approach [19].

There are five stages involved in the process of computing the ratios, namely, (1) identify search engines, (2) record number of hits for specified search terms, (3) compute the ratios, (4) consolidate all the ratios, and (5) perform the analysis.

### IV. FINDINGS

The findings section presents the results in terms of the number of hits of the materials on engineering ethics that were

produced by the Internet search engines (ISE's) on [these search terms](#): education, engineer, engineering, ethics, Islam, professional, research, and training.

The results of the study are presented according to the five steps. Firstly, *identify the Internet search engines*. The study adopted only three "top choices" of Internet search engines identified by Sullivan (2004), namely, Google (www.google.com), Yahoo (www.yahoo.com), and Bing (www.bing.com). Secondly, *record the number of hits*. The researchers recorded the hits shown for all the search terms education, engineer, engineering, ethics, Islam, professional, research, and training.

Tab. I shows the hits produced by **four** ISE's: Google, Yahoo, AlltheWeb (ATW) and AOL Search. The ISEs show the highest total hits for the terms "Engineer" and its combination with "Ethics," "Ethics Education," "Ethics Islam," "Ethics Professional," "Ethics Research," "Ethics Training," and "Ethics Education Professional Training." Google produced the highest hits (211,000,000) for "Engineer," while Yahoo and AlltheWeb produced the highest hits for "Engineer Ethics (23,800,000)," "Engineer Ethics Islam (2,020,000)," "Engineer Ethics Training (8,610,000)," and "Engineer Ethics Education Professional Training (32,500,000)." **These hits suggest that** ethics for engineers is available in the area of education for professional training. **With respect to** Internet Search Engines (ISEs) capability, Google scores **the highest** when it captured 44% of the total hits as opposed to Yahoo and AllTheWeb with 24% each, **respectively**. AOL Search scored the lowest with with 8%.

TABLE I. HITS FOR SEARCH TERMS "ENGINEER" AND OTHERS

Search Terms	Internet Search Engines			
	Google	Yahoo	AllTheWeb	AOL Search
Engineer	211,000,000	59,600,000	59,600,000	34,200,000
Engineer Ethics	7,780,000	23,800,000	23,800,000	264,000
Engineer Ethics Education	16,500,000	10,900,000	10,900,000	7,370,000
Engineer Ethics Islam	1,340,000	2,020,000	2,020,000	264,000
Engineer Ethics Professional	11,500,000	8,100,000	8,100,000	1,680,000
Engineer Ethics Research	21,100,000	8,720,000	8,720,000	7,540,000
Engineer Ethics Training	784,000	8,610,000	8,610,000	725,000
Engineer Ethics Education Professional Training	6,840,000	32,500,000	32,500,000	415,000
<b>TOTAL</b>	<b>276,844,000</b>	<b>154,250,000</b>	<b>154,250,000</b>	<b>52,458,000</b>
<b>Percentage (%)</b>	44	24	24	8

Note: 2 February 2011, 2.21 p.m. – 4.21 p.m. Malaysian Time in Gombak, Kuala Lumpur, Malaysia.

Tab. II shows the hits produced by four ISE's: Google, Yahoo, AlltheWeb and AOL Search. The hits show that Yahoo and AllTheWeb produced higher hits compared to the other ISEs. The highest total hits for the terms "Engineering (446,000,000 with Google)" and when "Engineering" is combined with other terms, Yahoo and AllTheWeb produced highest hits, for example "Ethics (41,100,000)," "Ethics Education (10,600,000)," "Ethics Islam (2,260,000)," "Ethics Professional (8,500,000)," "Ethics Research (8,500,000)," "Ethics Training (16,000,000)," and "Ethics Education Professional Training (33,100,000)". In evaluating the capability of the Internet Search Engines (ISEs), Google scores the highest capability when it captured 41% of the total hits as opposed to Yahoo and AllTheWeb with 24% each. The lowest score is with AOL Search with 11%. When compared percentage of total hits obtained with Tab. II, Google's capability reduced from 44% to 41% and AOL Search increased from 8% to 11% when the search term was changed from "Engineer" to "Engineering."

TABLE II. HITS FOR SEARCH TERMS "ENGINEERING" AND OTHERS

Search Terms	Internet Search Engines			
	Google	Yahoo	AllTheWeb	AOL Search
Engineering	446,000,000	178,000,000	183,000,000	104,000,000
Engineering Ethics	4,050,000	20,200,000	19,600,000	3,900,000
Engineering Ethics Education	7,160,000	10,600,000	10,600,000	7,100,000
Engineering Ethics Islam	269,000	2,260,000	2,260,000	264,000
Engineering Ethics Professional	643,000	8,470,000	8,470,000	606,000
Engineering Ethics Research	7,370,000	8,500,000	8,500,000	7,350,000
Engineering Ethics Training	492,000	16,000,000	16,000,000	475,000
Engineering Ethics Education Professional Training	333,000	33,100,000	33,100,000	303,000
Ethics	79,300,000	41,100,000	41,100,000	26,100,000
TOTAL	545,617,000	318,230,000	322,630,000	150,098,000
Percentage (%)	41	24	24	11

Note: 2 February 2011, 2.21 p.m. – 4.21 p.m. Malaysian Time in Gombak, Kuala Lumpur, Malaysia.

Tab. III shows the top 10 total hits for "Engineering" and "Engineer" combined with several key terms generated by the four ISE's: Google, Yahoo, AlltheWeb and AOL Search. The highest rank is "Engineering" (46%), followed by "Engineer" (18%), "Ethics" (9%), and "Engineer Ethics Education" (4%). The remaining hits are not significant as the score is below 4%.

TABLE III. RANK ON TOP 10 OF TOTAL HITS FOR SEARCH TERMS "ENGINEERING" AND "ENGINEER" COMBINED WITH OTHER TERMS

Search Terms	Total Hits	Rank
Engineering	911,000,000 (46%)	1
Engineer	364,400,000 (18%)	2
Ethics	187,600,000 (9%)	3

Engineer Ethics Education Professional Training	72,255,000 (4%)	4
Engineering Ethics Education Professional Training	66,836,000 (3.4%)	5
Engineer Ethics	55,644,000 (2.8%)	6
Engineering Ethics	47,750,000 (2.4%)	7
Engineer Ethics Research	46,080,000 (2.34%)	8
Engineer Ethics Education	45,670,000 (2.3%)	9
Engineering Ethics Education	35,460,000 (1.8%)	10

Thirdly, compute the ratios. The ratio for specific term in each search engine is computed by dividing the hits of each search term by total hits for the search engine. The higher the ratio the higher the relative coverage of the search terms in the search engine.

Tab. IV produces comparative hits and ratios across the ISE's and the combined search terms. The highest ratios were shown for the single term "Engineer" with 0.762 (Google), 0.386 (Yahoo and AllTheWeb/ATW), and 0.652 (AOL Search). When "Engineer" was combined other terms, the resulting ratios diminished significantly; the lowest ratios being 0.005 for "Engineer Ethics Islam." Likewise, other ratios also registered lower, for example "Engineer Ethics," and "Engineer Ethics Education."

TABLE IV. RATIO HITS FOR SEARCH TERMS "ENGINEER" AND OTHERS

ISEs	Google		Yahoo +ATW		AOL Search		
	Terms	Hits	Ratio	Hits	Ratio	Hits	Ratio
Engineer		211,000,000	0.762	59,600,000	0.386	34,200,000	0.652
Engineer Ethics		7,780,000	0.028	23,800,000	0.154	264,000	0.005
Engineer Ethics Education		16,500,000	0.06	10,900,000	0.071	7,370,000	0.141
Engineer Ethics Islam		1,340,000	0.005	2,020,000	0.013	264,000	0.005
Engineer Ethics Professional		11,500,000	0.042	8,100,000	0.053	1,680,000	0.032
Engineer Ethics Research		21,100,000	0.076	8,720,000	0.057	7,540,000	0.144
Engineer Ethics Training		784,000	0.003	8,610,000	0.056	725,000	0.014
Engineer Ethics Education Professional Training		6,840,000	0.025	32,500,000	0.211	415,000	0.008

Tab. V produces comparative hits and ratios across the ISE's. The highest ratios were shown for the single term "Engineering" with 0.817 (Google), 0.559 (Yahoo and AllTheWeb/ATW), and 0.693 (AOL Search). When "Engineering" was combined other terms, the resulting ratios were reduced significantly, and the lowest ratio was 0.000 for "Engineering Ethics Islam." Similarly, other ratios registered lowers, for example "Engineering Ethics," and "Engineering Ethics Education."

TABLE V. RATIO HITS FOR SEARCH TERMS "ENGINEERING" AND OTHERS

ISEs	Google	Yahoo +ATW	AOL Search
------	--------	------------	------------

Terms	Hits	Ratio	Hits	Ratio	Hits	Ratio
Engineering	446,000,000	0.817	178,000,000	0.559	104,000,000	0.693
Engineering Ethics	4,050,000	0.007	20,200,000	0.063	3,900,000	0.026
Engineering Ethics Education	7,160,000	0.013	10,600,000	0.033	7,100,000	0.047
Engineering Ethics Islam	269,000	0.000	2,260,000	0.007	264,000	0.002
Engineering Ethics Professional	643,000	0.001	8,470,000	0.027	606,000	0.004
Engineering Ethics Research	7,370,000	0.014	8,500,000	0.027	7,350,000	0.049
Engineering Ethics Training	492,000	0.001	16,000,000	0.050	475,000	0.003
Engineering Ethics Education Professional Training	333,000	0.001	33,100,000	0.104	303,000	0.002
Ethics	79,300,000	0.145	41,100,000	0.129	26,100,000	0.174

Fourthly, *consolidate all the ratios*. All the hits ratios are aggregated into Tab. VI to facilitate comparison. The comparative analysis of single search term “Engineering” and “Engineer” shows that “Engineering” scores the lowest 0.559 and “Engineer” 0.386 at Yahoo and AllTheWeb (ATW). When search term “Engineering” was combined with other terms, the analysis produced lowest ratios: 0.000 (“Engineering Ethics Islam” at Google) and 0.001 (“Engineering Ethics Professional,” “Engineering Ethics Training,” and “Engineering Ethics Education Professional Training” at Google).

TABLE VI. CONSOLIDATED RATIO HITS FOR SEARCH TERMS “ENGINEERING,” “ENGINEER,” AND OTHERS

Search Terms	Google	Yahoo & ATW	AOL Search
Engineering	0.817	0.559	0.693
Engineering Ethics	0.007	0.063	0.026
Engineering Ethics Education	0.013	0.033	0.047
Engineering Ethics Islam	0.000	0.007	0.002
Engineering Ethics Professional	0.001	0.027	0.004
Engineering Ethics Research	0.014	0.027	0.049
Engineering Ethics Training	0.001	0.050	0.003
Engineering Ethics Education Professional Training	0.001	0.104	0.002
Ethics	0.145	0.129	0.174
Engineer	0.762	0.386	0.652
Engineer Ethics	0.028	0.154	0.005
Engineer Ethics Education	0.060	0.071	0.141
Engineer Ethics Islam	0.005	0.013	0.005
Engineer Ethics Professional	0.042	0.053	0.032
Engineer Ethics Research	0.076	0.057	0.144
Engineer Ethics Training	0.003	0.056	0.014
Engineer Ethics Education Professional Training	0.025	0.211	0.008

Finally, *perform the analysis*. The last stage of the analysis identified the highest ratios for single search terms generated by each of the search engines. Tab. VII 4 shows that all the four ISE’s could capture all the search terms used despite producing varying ratios. The most eminent term was “Engineering”, which appeared as among the highest hits in all four ISEs. Nevertheless, search terms under Google produced

more ratios as opposed to the other ISEs. Thus, it is evident that Google is able to produce higher hits compared to the other ISEs.

TABLE VII. CONSOLIDATED RATIO HITS FOR SEARCH TERMS “ENGINEERING,” “ENGINEER,” AND OTHERS

Under Google	Ratios	Under Yahoo & ATW	Ratios	Under AOL Search	Ratios
Engineering	0.817	Engineering	0.559	Engineering	0.693
Engineer	0.762	Engineer	0.386	Engineer	0.652
Ethics	0.145	Engineer Ethics Education Professional Training	0.211	Ethics	0.174
Ethics	0.145	Engineer Ethics	0.154	Ethics	0.174
Engineer Ethics Research	0.076	Ethics	0.129	Engineer Ethics Research	0.144
Engineer Ethics Education	0.060	Ethics	0.129	Engineer Ethics Education	0.141
Engineer Ethics Professional	0.042	Engineering Ethics Education Professional Training	0.104	Engineering Ethics Research	0.049
Engineer Ethics	0.028	Engineer Ethics Education	0.071	Engineering Ethics Education	0.047
Engineer Ethics Education Professional Training	0.025	Engineering Ethics	0.063	Engineer Ethics Professional	0.032
Engineering Ethics Research	0.014	Engineer Ethics Research	0.057	Engineering Ethics	0.026
Engineering Ethics Education	0.013	Engineer Ethics Training	0.056	Engineer Ethics Training	0.014
Engineering Ethics	0.007	Engineer Ethics Professional	0.053	Engineer Ethics Education Professional Training	0.008
Engineer Ethics Islam	0.005	Engineering Ethics Training	0.050	Engineer Ethics	0.005
Engineer Ethics Training	0.003	Engineering Ethics Education	0.033	Engineer Ethics Islam	0.005
Engineering Ethics Professional	0.001	Engineering Ethics Research	0.027	Engineering Ethics Professional	0.004
Engineering Ethics Training	0.001	Engineering Ethics Professional	0.027	Engineering Ethics Training	0.003
Engineering Ethics Education Professional Training	0.001	Engineer Ethics Islam	0.013	Engineering Ethics Education Professional Training	0.002
Engineering Ethics Islam	0.000	Engineering Ethics Islam	0.007	Engineering Ethics Islam	0.002



## VI. LIMITATIONS OF THE STUDY

Total hits and ratios will not be that meaningful if one desires to know the productivity of each ISE for specific search terms. Drawing the ratios from various tables and consolidating them in Tab. VI provides us the efficiency of each search engine for single and combined search terms. Tab. VII shows that Google produced the highest hits (0.817) for generic “Engineering.” However, if a person wishes to identify the association between “Engineering” or “Engineer” and “Ethics Islam”, Yahoo and AllTheWeb are the more efficient ISEs. Yahoo is rated 0.013, whereas Google, 0.001 and AOL Search, 0.002.

Google stands out among the four ISE’s for both single and combined search terms. For single search terms, Google’s hits produced the highest in eighteen search terms used in this study. Google’s hits for single and combined search terms portray a close association as reflected in the highest ratios. This suggests that it is highly probable that Google’s materials for combined hits, which are more specific, are included both in the generic and single search terms hits.

## V. DISCUSSIONS

Google stands out among the four ISE’s for both single and combined search term used in the study: education, engineer, engineering, ethics, Islam, professional, research, and training. For single search terms, Google’s hits produced the highest among eighteen search terms used in this study.

Some key literature of engineering ethics emphasizes on the obligations of employers, society and industry’s roles and prospective challenges to implement ethics in engineering or to train engineers to be ethical. Apparent scarcity of materials on engineering ethics may hinder employers, society, industry and engineers from using the Internet to obtain knowledge about engineering ethics. According to Frantz, employers have an obligation to give training on ethics for engineers [21]. When such materials are not readily available in the Internet, it requires them to search from specific databases, in which they might not be motivated to learn more about engineering ethics. Brenkert contends that, for any industries that need innovation, such as engineering and science, some rules and ethics are essential as precautionary measures [22]. Otherwise, such ventures will be less useful for the industry and the users.

Johnson has similar argument that ethics plays essential role in science and engineering [23]. For any society, ethics is catalysts for any right and effective accomplishment [24]. Engineering students need to study ethics since this knowledge can help them identify and evaluate their engineering decisions to be professionally right and ethical [24][25]. Bowden argues that teaching ethics to engineers strengthens their professions for the sake of the society and the industry [26]. According to Coeckelberg, engineering can learn from ethics, and vice versa [27]. Yearley argues that call for reviews of the societal and ethical aspects of synthetic biology [28].

The study is an attempt to assess the availability of materials on education, engineer, engineering, ethics, Islam, professional, research, and training. The relative ratios were comparable for search terms within each search engine. Although the ratios convey general comparability, the method does not provide strong cross ISE comparisons due to non-adjustment of factors such as size (or frequency of hits). Only adjusted ratios that incorporate some correction factors will reflect more statistically meaningful ratios (or indices).

Another limitation of the study is its use of cross-sectional data (hits). Stretching the study over time, for example, quarterly over a few years will be able to provide a meaningful pattern of coverage of the search terms across search engines.

Next, a pilot study with four ISE’s, i.e. Google, Yahoo, AllTheWeb and AOL Search, may not be adequate compared to the availability of other search engines. Future study should include other ISE’s as well.

## VII. CONCLUSION

Based on the results on the specific search terms generated from the four ISE’s, we can say that the amount of materials on engineering ethics is scarce. Researchers will have to resort to other sources of information to learn about engineering ethics. Despite this limitation, one can opt to use Google to gather materials on “Engineering” and “Engineer” but if he desires to learn only “Engineering” or “Engineer” that emphasizes “Ethics” then Yahoo is an appropriate search engine. Internet users need to be cautioned that hits only suggest apparent availability of the materials (in terms of hits) with the ISE’s; they in no way suggest the adequacy and quality of the contents of the materials.

## ACKNOWLEDGMENT

The study would like to thank Department of Business Administration, Kulliyah of Economics and Management Sciences for the administrative help and the use office resources to execute this study. Likewise, a big thank for the financial support from Research Management Office, International Islamic University Malaysia.

## REFERENCES

- [1] K. Mulder, J. Segalas-Coral, D. Ferrer-Balas, “Educating engineers for/in sustainable development? What we knew, what we learned, and what we should learn.” *Thermal Science*, vol. 14, pp.625-639, September 2010.
- [2] P. Bowden, “Teaching ethics to engineers – a research-based perspective.” *Euro. J. Eng. Edu*, vol. 35, pp. 563-572, October 2010.
- [3] T.Guo and J. Liu, “Multi-disciplinary education for product design and development.” *Adv. Mat. Research*, vol. 156-157, pp. 681-684, October 2010.
- [4] G. Malaysia. Tenth Malaysia Plan (2011-2015). Kuala Lumpur: Malaysia Printing, January 2011.
- [5] G. Jim, J. Gao and Y. Wang, “A multi-agent based knowledge search framework to support the product development process.” *Int J. Comp. Interg. Mfg*, vol. 23, pp. 237-247, October 2010.
- [6] M. Chau, C.H. Wong, Y. Zhou, and H. Chen, “Evaluating the use of search engine development tools in IT education,” *J. Ame. Soc. Info. Sci. Tech.*, vol. 61, pp. 288-299, 2010.

- [7] Z. Xiang and U. Gretzel, "Role of social media in online travel information search," *Tourism Mgt.*, vol. 31, pp. 179-188, 2010.
- [8] W. Mettrop and P. Nieuwenhuysen, "Internet search engines – fluctuations in document accessibility," *J. Doc.*, vol. 57, pp. 623-651, 2001.
- [9] M. Thelwall, "Quantitative comparisons of search engine results," *J. Ame. Soc. Info. Sci. Tech.*, vol. 59, pp. 1702-1710, 2008.
- [10] A. Uyar, "Investigation of the accuracy of search engine hit counts," *J. Info. Sci.*, vol. 35, pp. 469-480, 2009.
- [11] A. Pirkola, "The effectiveness of web search engines to index new sites from different countries," *Info. Res.*, vol. 14, pp.1-11, 2009.
- [12] R. Prabowo and M. Thelwall, "Sentiment analysis: a combined approach," *J. Infometric*, vol. 3, pp. 143-157, 2009.
- [13] D. Dreilinger and A. Howe, "Experiences with selecting search engines using metasearch," *ACM Transac. Info. Sys.*, vol. 15, pp. 195-222, 1997.
- [14] N. Tomaiuolo and J. Parker, "An analysis of internet search engines: assessment of over 200 search queries," *Comp.Lib.*, vol. 16, pp. 58-62, 1996.
- [15] H. Leighton and J. Srivastava, "Precision among www search services (search engines): alta vista, excite, hotbot, infoseek and lycos," retrieved from <http://www.winona.edu/library/webind2.htm>, 21 October 2010.
- [16] H. Wang, M. Xie and T. Goh, "Service quality of internet search engines," *J. Info. Sci.*, vol. 25, pp.499-507, 1999.
- [17] D. Sullivan, "Major search engines and directories," retrieved from <http://searchenginewatch.com/author/index.php/dannysullivan>, 21 October 2010.
- [18] K. Bharat and A. Broder, "A technique for measuring the relative size and overlap of public web search engines," 7<sup>th</sup> Intl. World Wide Web Conf., April 1998.
- [19] S. Lawrence and C. Giles, "Searching the world wide web," *Science*, pp. 98-100, April 1998.
- [20] H. Chu and M. Rosenthal, "Search engines for the world wide web: a comparative study and evaluation methodology," *ASIS*, retrieved from <http://www.asis.org/annual-96/electronic-proceedings/chu.htm>, Retrieved 21 October 2010.
- [21] L. Frantz, "Engineering ethics: the responsibility of the manager," *Eng. Mgt. Intl.*, vol. 4, pp. 267-272, January 1988.
- [22] G. Brenkert, "Innovation, rule breaking and the ethics of entrepreneurship," *J.Bus.Vent.*, vol. 24, pp. 448-464, September 2009.
- [23] D.Johnson, "The role of ethics in science and engineering," *Trends Biotech.*, vol. 28, pp. 589-590, December 2010.
- [24] W.Wulf, "Engineering ethics and society," *Technology in Soc.*, vol. 26, pp.385-390, April-August 2004.
- [25] V.Weil, "The rise of engineering ethics," *Tech. in Soc.*, vol. 6, 341-345, April 1984.
- [26] P. Bowden, "Teaching ethics to engineers - a research-based perspective," *Euro. J. Eng. Edu.*, vol. 35, pp. 563-572, October 2010.
- [27] M. Coeckelbergh, "Engineering good: How engineering metaphors help us to understand the moral life and change society," *Sci. and Eng. Ethics*, vol. 16, pp. 371-385, April 2010.
- [28] S. Yearley, "The ethical landscape: Identifying the right way to think about the ethical and societal aspects of synthetic biology research and products," *J. Royal Soc. Interface*, vol. 6, pp. S559-S564, May 2009.