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Chapter 12
Searching for Information on the Web:
A Guideline for Effective Searching

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ABSTRACT

To date, the World Wide Web (WWW) is the most popular environment for information searching and retrieval. One of the steps in searching for information on the web is by entering a query to the search system and reformulating the queries. There are many challenges and issues in formulating effective queries. Effective queries will produce relevant document that matches the user information need. The discussion of this chapter will be focusing on how to apply both breadth and depth search query formulation strategies for effective searching on the web. The discussion will be based on a selected search task. At the end of the chapter, a recommendation for a step-by-step searching procedure will be presented as a guideline for effective searching.

INTRODUCTION

To date WWW (also known as web) has been one of the main sources of information for Internet users which includes professionals, students, household, clerk, and others (Large, Tedd and Hartley, 2001). The web provides information that serve many purposes including research (Herring, 2001; Downs and Friedman, 1999), entertainment (Spink, Bateman, & Jasen, 1998; Park, 2009), getting travelling information (Gursoy & McCleary, 2004), business (Spink et. al., 1998) etc. The popularity of the web as a source of information is evident by the increase in Internet users world wide. Figure 1 shows the growth of Internet users from December 1995 until December 2007

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as published by Internet World Stats (2008). The graph shows that in 2007 the Internet user has increased to 1,319 million compared to 16 million when it was first popularized in 1995 (Xiaoming & Kay, 2004).

In Malaysia, the Internet usage has also increased from approximately 3 million in 2000 to 13 million in 2007 (Figure 2). According to Telekom Malaysia (TM) Bhd General Manager of Strategic Development Division, Dr Fadhlullah Suhaimi Abdul Malek, the increment of Internet user in Malaysia is expected to reach 10 billion in 2012 (Internet World Statistics, 2007). His view is based on the trend of Internet users in the last three years as Malaysia moved towards advanced information, communications and multimedia services.

The Malaysian Government has also taken additional steps to promote Internet use in education, public, and private sector. These efforts can be seen from the statistics of Internet access location as published by Malaysian Communications and Multimedia Commission (MCMC, 2008) that showed Internet access from school is the second highest (27.8%) after Internet access from place of work (54.5%). The survey also revealed that the most popular activity on the Internet was getting information (94.4%) followed by communication by text (84.7%) (Table 1). In 2006, the figure was 84.5% and 80.7% respectively. This shows that Internet has become one of the main sources of information among Internet users in Malaysia.

Figure 3 shows an example of a search engine interface - Google. Search engine is a computer program that retrieves information based on the query entered by the web surfer. Other examples of search engine are HotBot, Altavista, AllTheWeb and etc. Search engine is the most popular search tool for information searching (Day, 2001). To date, search engines have been translated and optimized for non-English user. This approach made it easy for the users to search for information using their own native language such as Chinese (Chau, Fang, & Yang, 2007), Spanish (Chung, 2006; Chung, Bonillas, Xi, & Chen, 2006), Arabic (Chung, et. al., 2006) & Korean (Park, Lee, & Bae, 2005).

The use of search engine and other search system on the Internet has enabled the access and retrieved of information from the WWW. However, due to the large amount of web pages available on the Internet and indexed in the search engine database, users are often overwhelmed by

Figure 1. Internet growth from 1995-2007 (Source: Internet World Stats, 2008 (http://www.Internetworldstats.com/asia/my.htm)

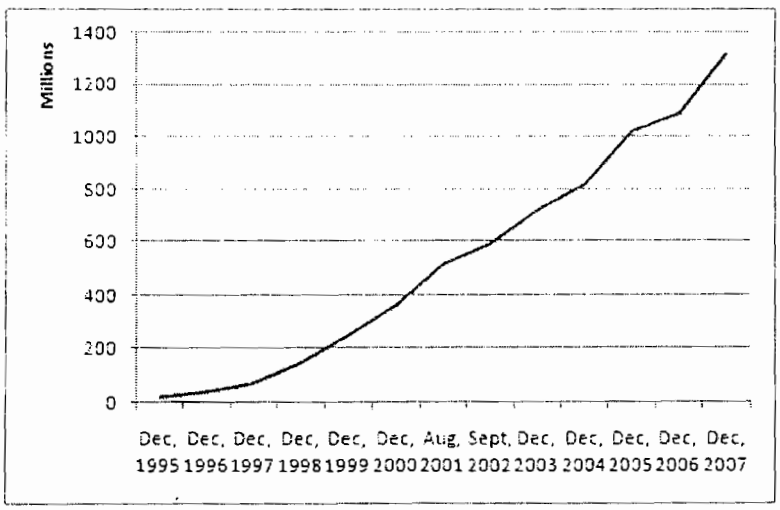


Figure 2. Malaysia Internet usage and population growth (2000-2007) (Source: Internet World Stats, 2008 (http://www.Internetworldstats.com/asia/my.htm)

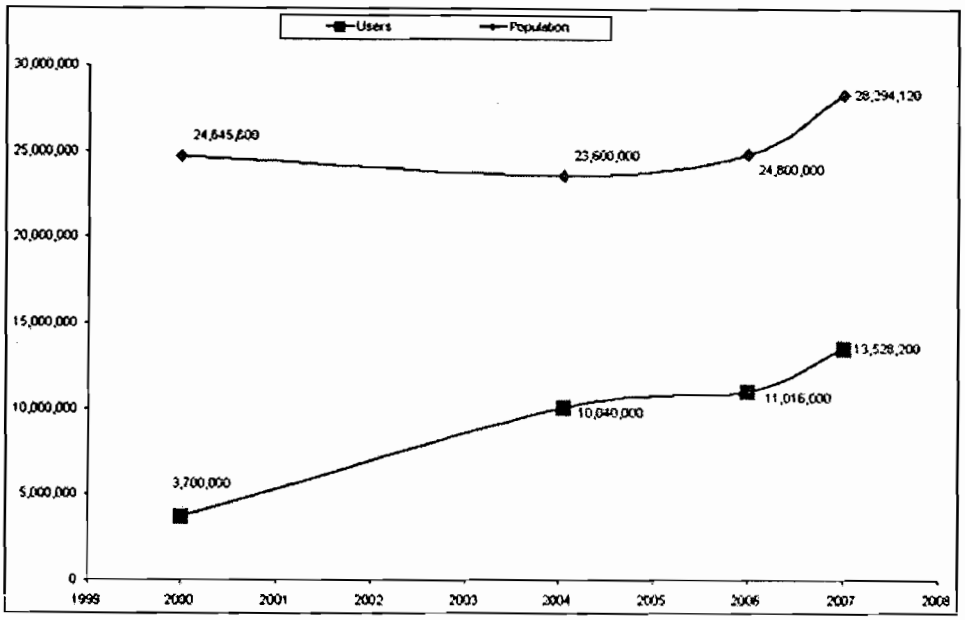


Table 1. Activity on the Intern

Activity	Years		
	2005	2006	2008
Getting Information	40.5%	84.5%	94.4%
Communication by text	99.6%	80.7%	84.7%
Leisure	47.1%	52.6%	63.5%
Education	46.8%	45.9%	64.5%
Financial Activities	14.6%	23.6%	31.8%
Public Services	12.7%	12.0%	29.2%
e-Government transactions	-	-	19.8%
Online stock trading	-	-	5.9%
Others	1.3%	0.2%	0.7%

Source: Malaysia Communications and Multimedia Commission (MCMC), Household Use of the Internet Survey 2008

thousands of search results, few of which are valuable (Glover, Lawrence, Gordon, Birmingham, & Giles, 2001). This scenario is regarded as information overload (Eppler & Mengis, 2004). In this situation, users are given with more information than they can handle within a given time frame (Liang, Lai & Ku, 2007).

Information overload is mainly related to the individual which plays a major role in making decision (McGaffey & Christy, 1975; O'Reilly, 1980; Large, Tedd, & Hartley, 2001; Farhoomand & Drury, 2002; Eppler & Mengis, 2004; Chen, Shang, & Kao, 2007) and the technology that support the decision making (Farhoomand & Drury, 2002; Eppler & Mengis, 2004). In the

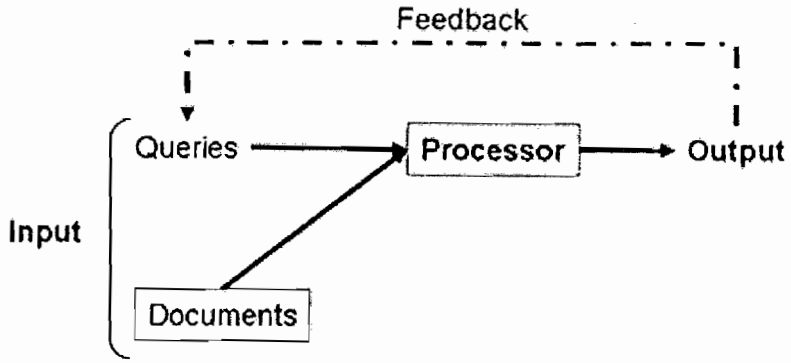
Figure 3. Example of search engine Google

context of information search on the WWW, users or the searchers play a role as the one with the information need, while the technology that is the search system, is the tool that supports the searching. The information need is inspire by the task requirement and the understanding of the problem to be solved (Marchionini, 1995). Additionally, Marchionini also urge that the selection and utilization of the search tool to assist the searching are heavily depend on the users' familiarity of the search system.

The users' aspect of evaluation on information search on WWW has been the focus by previous studies (Marchionini, 1995; Marchionini & White, 2007; Shtykh & Jin, 2009) as the search system directly interacts with the users (Shtykh & Jin, 2009). The focus was more on users' satisfaction on the search system's performance (the output) rather than its usability (how it works). In contrast with system's aspect of evaluation, the focus is on the usability and how the system (functions and facilities) serves the users (France, Nowell, Fox, Saad, & Zhao, 1999; Jeng, 2005). Furthermore, in information seeking process (Marchionini, 1995), user is responsible to comprehend the problem or the search task, select the source, formulate and execute the query, examine the results and give the feedback. Similarly, Large, Tedd, and Hartley, (2001) urge that users' decision on what to search and how to formulate the search is the most complex phase of any searching activity as it involves deciding the source of information and which part of record to search for.

This chapter highlights the major constraints for information searching on the web that is information overload. Information overload is influenced by the strategy that users employ during the search process. The strategy is conceptualized as behaviour of the user, typically when dealing with the query formulation. Issues related to the query formulation in conjunction to the users information need are also highlighted. A simple example of the querying session is also demonstrated. At the end of the chapter, a guideline for effective searching is outlined.

Figure 4. A conceptual framework of information retrieval system



BACKGROUND

The typical framework of a search system is popularized based on Rijsbergen's (1979) framework. This framework consists of four main components: input, processor, output and feedback (Figure 4). Theoretically, the processes in the search system can be comprehended based on system theory.

Based on system theory, the function of any system is to convert or process energy, information, or materials into a product or outcome for use within the system, or outside of the system or both (Begley, 1999; Bertalanffy, 1950). Typically as reviewed by Begley (1999), all systems have common elements; input, output, throughput or process, feedback, control, environment, and goal. These elements are identical with Information Retrieval (IR) system. Each component in the search system is interacting in order to achieve users' goal that is to fulfil their information need.

Table 2 compare elements in both system theory and IR system. System theory has been used in diverse area of disciplines such as communication (Ham, 1956), business (Dawson, 2006), information system (Mora, Gelman, Cano, Cervantes & Forgionne, 2006), and health services (Baura, 2004).

As shown in Figure 4, the input consists of query and document. Both query and document are the representation of the original document such as a list of extracted words. The query is then processed by the processor which is the engine that does the retrieval process such as structuring the information, matching and retrieving the matched information. In order to best serve the users' need, a search engine must find and filter the most relevant information matching a user's query, then present that information in a manner that makes the information most readily palatable to the user (Sahami, Mittal, Baluja & Rowley, 2004).

Output is the outcome of the search system which is usually a set of citations, document reference number or hyperlink. The output serves as the feedback to user's query. Consequently, feedback returns to the user will determine user's satisfaction of the search system. Experts believe that the understanding and a careful treatment of the query and the terms used will increase the search satisfaction (Large et. al., 2001; Kantor, 2007).

Table 2. Elements in IR system and system theory

IR System	System Theory
Query or keywords	Input
Relevance documents (matches document)	Output
Query processing, keyword matching	Process
Stop word, thesaurus	Control
Result list	Feedback
World Wide Web, terminal	Environment
Search satisfaction	Goal

This evaluation is simply based on the evaluation from the interaction with the search system (that is when entering a query and receiving a feedback). The evaluation is vital as the IR system will not only retrieve relevant results but also non-relevant (Rijsbergen, 1979). This limitation is typical to all kind of IR system. In addition, the concept of relevancy is subjective to user, as different users have different information need.

Norman (1988) stated that evaluation is a part of human cognitive process. As Norman illustrated (Figure 5), the evaluation is a part of human action. The first part of the action is the execution. In the IR perspective, execution is the process of searching which involve identifying the information need, query formulation, and entering the query into the search system. The search system will feedback to the user with the results, which are assumed to fulfil the users' need. On the other hand, the users will evaluate the results to ensure that they get what they want. According to Norman (1988), evaluation begins with our perception of the world which is interpreted according to our expectations and then compared (evaluated) with respect to both our intentions and our goals.

Norman's cognitive model can be applied parallel with system theory in the search system perspective. The system theory emphasis on the major system's components: input, processes and output, and how these components should work in achieving users' goal. This part of system theory is identical to the execution part of Norman's model. The feedback from the system, which is the output of the system, will be returned to the users. This part can be enhanced by incorporating evaluation as users' response towards the results. This part is also where users should state their satisfaction, which resulted from the termination of the search or reformulation of the query. Table 3 depicts the similarities of IR system, system theory and Norman's model.

The typical IR model was revised by Broder (2002) who then proposed an augmented conceptual model of the IR for the web environment (Figure 6). The model highlight and elaborate two major components of typical IR system: the information need that verbalized into an appropriate form and the query refinement. Hearst (2009) has reviewed the model and recognized it as a standard model of the search process. Based on the model, the information need is associated with the search task. The need is verbalized and translated into a query which was then entered into the search system (search engine). The search engine will then produce the search results. Query refinement is then undertaken to refine the search results. Both search results and query refinement can be conceptualized as a part of evaluation as based on Norman's model.

Figure 5. Norman's cognitive execution-evaluation model (Norman, 1988)

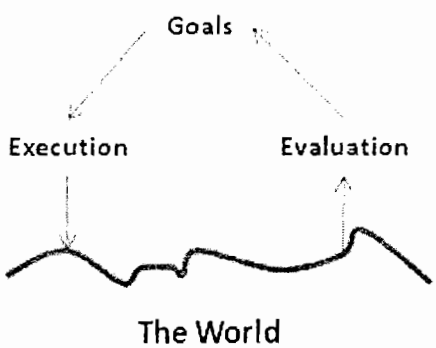
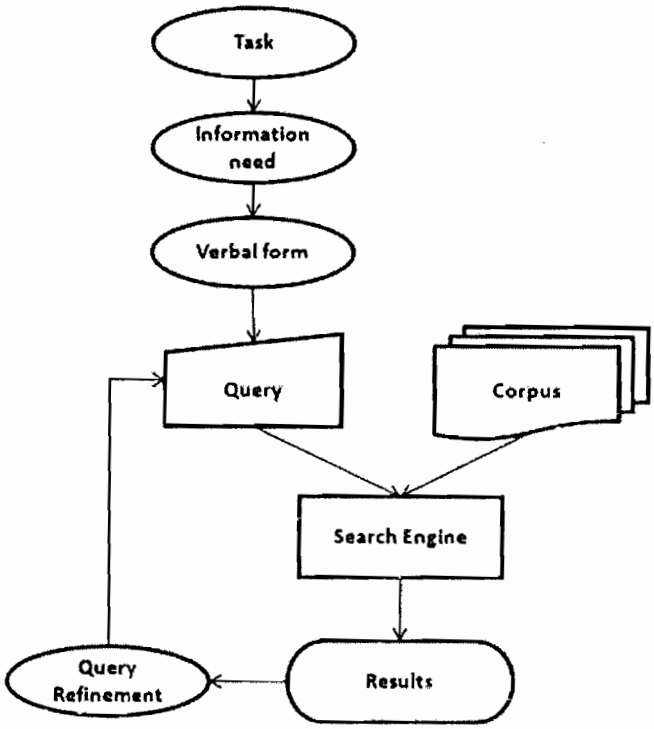


Table 3. Elements in IR System, System Theory and Norman's Mode

IR System	System Theory	Norman's Model
Query or keywords	Input	Execution
Relevance documents (matches document)	Output	
Query processing, keyword matching	Process	
Stop word, thesaurus	Control	
Result list	Feedback	Evaluation
World Wide Web, terminal	Environment	The world
Search satisfaction	Goal	Goal

Figure 6. Conceptual model of the web based information retrieval (Broder, 2002)



Detailed processes of information seeking have been established by Marchionini (1995) and Marchionini and White (2007). The framework consists of five major components: (1) recognize, accept, and formulate the problem, (2) express the problem, (3) examine results, (4) reformulate the problem, and (5) use information. During the search process, the user recognizes a need for information and takes the appropriate action to full fill the need. The user then formulate the problem by conceptualizing their needs, form an expectation of what they will be getting and identifying the sources of the information.

Once completed, the users will then express their need into the search system through the search interface. At this phase, users will enter the query that best represents their needs. In response to the query, the search system will return a list of search results. The users will examine the results in order to identify which matches their needs. According to Marchionini and White (2007), this phase is time consuming as users will have to go through the entire list and browse the intermediate and primary content whilst there are so many results to consider. At the same time users may require to re-express their need or reformulate the problem. The users may also make decision to stop the search and use the found information.

Parallel to Marchionini (1995), Sutcliffe and Ennis (1998) outline information search process in four main steps; problem identification, need articulation, queries formulation and results evaluation. Similarly, Mat Hassan and Levene (2005) indicate a typical search session activity involves several stages; a) query submission, where the user submits a query which (generally) represents his or her information goals, b) invocation of IR components, where given the input query, the search tools return a list of filtered documents for user inspection, c)selection and navigation, where the user selects the documents from the result page list for further inspection or d) reformulation, where user submits a revised query which may be related to the initial query and then restart the process.

The Broder (2002), Marchionini (1995), Marchionini and White (2007), Sutcliffe and Ennis (1998), and Mat Hassan and Levene (2005) framework on the search system and the information seeking and searching process have also clearly noted that user is the most important entity in the search system as users is directly involved in the search process. Moreover, during the search process users have to utilize different behavioural strategies and sometimes change the strategies in order to achieve the information need. The satisfaction of the search is the predominant aspect of the search activity as the satisfaction will indicate the fulfilment of the user's need which is determined from the evaluation phase. As highlighted in Norman's model, the evaluation is a part of human action.

INFORMATION NEED AND SEARCH SATISFACTION

Search satisfaction is a subset of user satisfaction in which the measurement is focused mainly on the experience faced by the searcher during the search session. It is a measure of how well the searcher is satisfied with the results returned by the search system. It is an indicator to determine searcher achievement of his information need (Zoe and DiMartino, 2000) supported by their search strategy (Johnson, 1997) which lead to the correct inference (Newell, Rakow, Weston & Shanks, 2004). Search satisfaction is also influenced by the search performance (correctness or accuracy, time) and the searcher's attitudes (confidence and satisfaction) towards the search activity (Topi and Lucas, 2005a; Topi & Lucas, 2005b).

Information search on the web is a complex process. The components of information seeking and searching processes as proposed by Marchionini (1995), Sutcliffe and Ennis (1998), and Mat Hassan and Levene (2005) are similar but not identical. The major difference between those processes is the sequence of the execution of the components. Correspondingly, in every model the main components are identification of the problem or search task analysis, information need articulation, formulation of the query, results evaluation, and decision to repeat or to stop the searching. Theoretically, users will stop searching when they have found what they were looking for or feel satisfied with what they have achieved.

Problem identification starts with task in hand that users have to search for. According to Broder (2002) the task will determine the information need which is verbalized and translated into a query posed to a search system. At this stage users need to have understanding of the task. The complexity of the search tasks is also an important factor in searchers' ability to find relevant information and their satisfaction (Bell & Ruthven, 2004). Complex task might be difficult to understand compared to less complex task.

Information need is the perceived need for information. This need leads to the use of information retrieval system to get the information (Schneiderman, Byrd, & Croft, 1997). Information need is also associated with the search task. The task particularly will state the kind of information that the user should acquire. Allen (1996) raises a question "how can users express their information needs in their own terms and still obtain information that will meet their information need?" Allen's question is concerned with users' knowledge and strategy to address their needs. In particular, different users might use different sets of queries to achieve the same need.

Once the information need has been identified, the next step is how to represent the information need in a suitable query. Queries are considered as formal statements of the information needs. Therefore, the quality of information retrieval depends on the user formulated query. The length of the query for example will influence the search results. Short queries is use to initiate the search when the users are not familiar with the subject (Barsky & Bar-Ilan, 2005). This query results in a huge number of search results that can give users

a general overview of the subject. In contrast to short query, long queries can be used to address more specific need of the user. This query allows users to naturally and fully describe their information need (Shapiro & Taksa, 2003). As Shapiro and Taksa demonstrated, long queries in web environment is practical and can substantially improve the quality of information retrieval. Therefore, understanding and knowing how to formulate the query will benefit best the user. Previous research has also proved that query-based search system is more popular compared to other search systems (Liaw & Huang, 2006; Ali, 2005).

Query reformulation is a modification to a search query that addresses the same information need (Shapiro & Taksa, 2003; Huang & Efthimiadis, 2009). According to Huang and Efthimiadis (2009), examples of query reformulation are word reordering, white space and punctuation, remove words, add words, form acronym, expand acronym, substring, abbreviation, word substitution and spelling correction. Users can also benefit from an improved search experience when performing reformulation (Huang & Efthimiadis, 2009). Experience is a kind of knowledge that is produced from repeating process of searching. After the search session, user will typically update his or her knowledge about the query manipulation and how to use the search system.

Query reformulation is part of user's strategy to improve the search results (Tu, Shih, & Tsai, 2008). This strategy is also called user's behaviour (Nachmias and Gilad, 2002). Nachmias and Gilad define search behaviour as a user plan that consists of a series of actions (steps), aimed at searching information and satisfaction of the search result. The search results are considered relevant to the users when it matches the query entered during the search session (Rieh, 2002).

USER SEARCH BEHAVIOUR - BREADTH AND DEPTH QUERY FORMULATION

Search behaviour is a strategy undertaken by the user in searching for information. Nachmias and Gilad (2002) defined search behaviour or search strategy as a user plan that consists of a series of actions (steps), aimed at searching for information. In order to successfully find useful information on the web, users need to consider the usage of their searching strategies to generate better outcome (Tu, Shih and Tsai, 2008). Zhang, Anghelescu, Hermina, and Yuan. (2005) defined search behaviour as the micro level of behaviour when a user interacts with a specific information retrieval system to search for relevant information.

The behaviours that are related to the Internet searching are search tactics (Thatcher, 2006; Hong, Thong, Wong, & Tam, 2002; Wildemuth, 2004), search strategy (White and Iivonen, 2001), seeking behaviour (Asunka, Chae, Hughes, & Natriello, 2009; Nesset, 2005; Thatcher, 2006; Seiden et. al., 1997) and search behaviour (Nachmias & Gilad, 2002). These terms which are used interchangeably in the Internet and information searching is mean to describe the behaviour of the users in order to achieve their goals.

The initiation of search behaviour are the impact of users' knowledge (Holsher & Strube, 2000; Wildemuth, 2004; Zhang, Anghelescu, & Yuan, 2005; White et. al., 2009). Wildemuth (2004) conceptualized user behavior as the search tactics that is the patterns of term use in queries. His study found that user tactics changed over time as their domain knowledge changed. Consistently, Zhang et. al (2005) reveal that the user behaviour towards searching increases when the domain knowledge increases. The user behaviour is observed as doing more searches or queries and using more terms in queries. Similarly, analyses of the interaction log of the search system by White et. al. (2009) indicates that expert users issue longer queries than non-experts. The expert

users were also found using more technical query terms than non-experts.

Formulating a search query is a challenging task for most users because they are required to express their information need to the search system. Query formulation is the initial stage in which the search strategy is constructed and the following reformulation stage in which the initial stage is modified either manually or system assisted (Mastora, Monopoli & Kapidakis, 2008). Therefore, it is not easy for users to choose the right search query that represents the topic or subject that they are looking for. This behaviour is in line with Spink et. al. (1998) which indicate that users tend to employ simple search strategies and conduct successive searches (changes or shifts in beliefs and cognitive, affective and situational states) over time to find information related to a particular topic. Users frequently modify their queries in hope of retrieving better results (Huang & Efthimiadis, 2009). Commonly, query formulated by users can be classified as breadth, depth or combination of breadth and depth type of query.

The concepts of breadth and depth of query are not new in the field of consumer behaviour and computer science. As illustrated by Hodkinson and Kiel (2003), in consumer behaviour these concepts are similar to the way a consumer moving through a shopping complex to find what he/she desires. While in computer science these concepts are formulated as search algorithms that search a problem space to find the specific solution (Korf, 1996). Even though, these two fields viewed breadth and depth of search differently, the nature, aim and the final outcome of both activities are similar that is to get the solution at minimum cost (reduce search time). The characteristic of broad and narrow queries are similar to the concept of breadth and depth of search. Therefore, broad queries can be conceptualized as breadth query manipulation, while narrow query can be conceptualized as depth query manipulation. In IR context, these concepts describe how searcher formulate and manipulate the query in order to achieve their information need (satisfaction).

Breadth Search Query

Breadth query strategy is a broad usage of query. The query formulated is general, wide and not focused to the domain. Mapping these characteristics with Nachmias and Gilad (2002) classification, breadth query can be conceptualized into three strategies: keyword search, wide search definition, and general knowledge. Commonly, these search strategies are employed by less experienced user, who have very little knowledge on the search topic and search facility.

Adapting Nachmias and Gilad (2002) example that is searching for information about "Mona Lisa", allow searcher to use a number of strategies. One, user may enter a keyword directly into the search system, for example "Mona Lisa". A search test with Google search system return 10,200,000 results for "Mona Lisa". In order to determine the needed information, searcher has to browse through all these results. Second, a knowledgeable searcher may consider adding another keyword such as "art" or "painting" to narrow the search. A search test with "mona lisa art" and "mona lisa painting" yield 2,610,000 and 584,000 results respectively. This has shown that adding another keyword will narrow the search and reduce the effort to browse the result list. This strategy is called wide search definition.

The third strategy called general knowledge search is focusing the search into the search subject. This strategy applies searcher's general knowledge on the search subject. Searcher knows that the person who paints Mona Lisa is Leonardo Da Vinci. Therefore, the searcher may include "Leonardo Da Vinci" as one of the keyword, as such "Leonardo Da Vinci mona lisa". A search test with Google yield only 122,000 results, which indicate that the search has been narrowed. Table 4 summarizes all the three strategies.

Table 4. Explanation of breadth query strat

Breadth search query		
Strategy	**Description**	**Example**
Keyword search	Direct typing the query subject	Typing the words Mona Lisa
Wide search definition	Searching using a broad query	Searching for art and painting to find the Mona Lisa
General knowledge	Using information that is not mentioned in the search task	Searching for the Mona Lisa mentioning Leonardo Da Vinci

Depth Search Query

Depth query strategy is a narrow usage of query. The query is narrowed into the domain, and the use of keyword is more specific towards the search task. Mapping these characteristics with Nachmias and Gilad (2002) classification, depth query can be conceptualized into three strategies: complex search, the use of computer convention, and Boolean operator. These strategies are usually employed by experienced and knowledgeable searchers especially in information technology. This category of searchers includes those with previous search experience, know how to use search strategies facilities and have in depth knowledge on the search task.

The first strategy, Boolean search is the lowest strategy in this category. Boolean search is a search that include Boolean operator AND, OR, and NOT in between the search keyword. In conjunction to the previous illustration about "Mona Lisa", a search test with Google for the keyword "Louver Mona Lisa" returns 24,800 of result while by inserting "AND" operator in between the two keyword such as "Louver AND Mona Lisa" returns only 6,800 results.

The second strategy, computer complexion search is the search using the computer convention such as using the file suffixes ".gif" or ".jpg" in order to find a picture of Mona Lisa. A search test with Google for "Louver Mona Lisa.gif" for example return only 1,460 of results.

Finally, complex search is considered as the most precise searching strategy. This strategy points the search directly to the search subject. A search test based on this strategy using the keyword "Picture, Mona Lisa, Louvre" has returned 172,000 results. Even though, the number of results is more compared to the other strategies, the first page of the results is the most relevant to the keyword and the information need. Table 5 summarizes the depth search strategy.

GUIDELINE FOR EFFECTIVE SEARCHING

Based on the previous studies, the information search process can be illustrated as a diagram as shown in Figure 7. The search process begins with task identification then followed by task comprehension. Task identification is a step

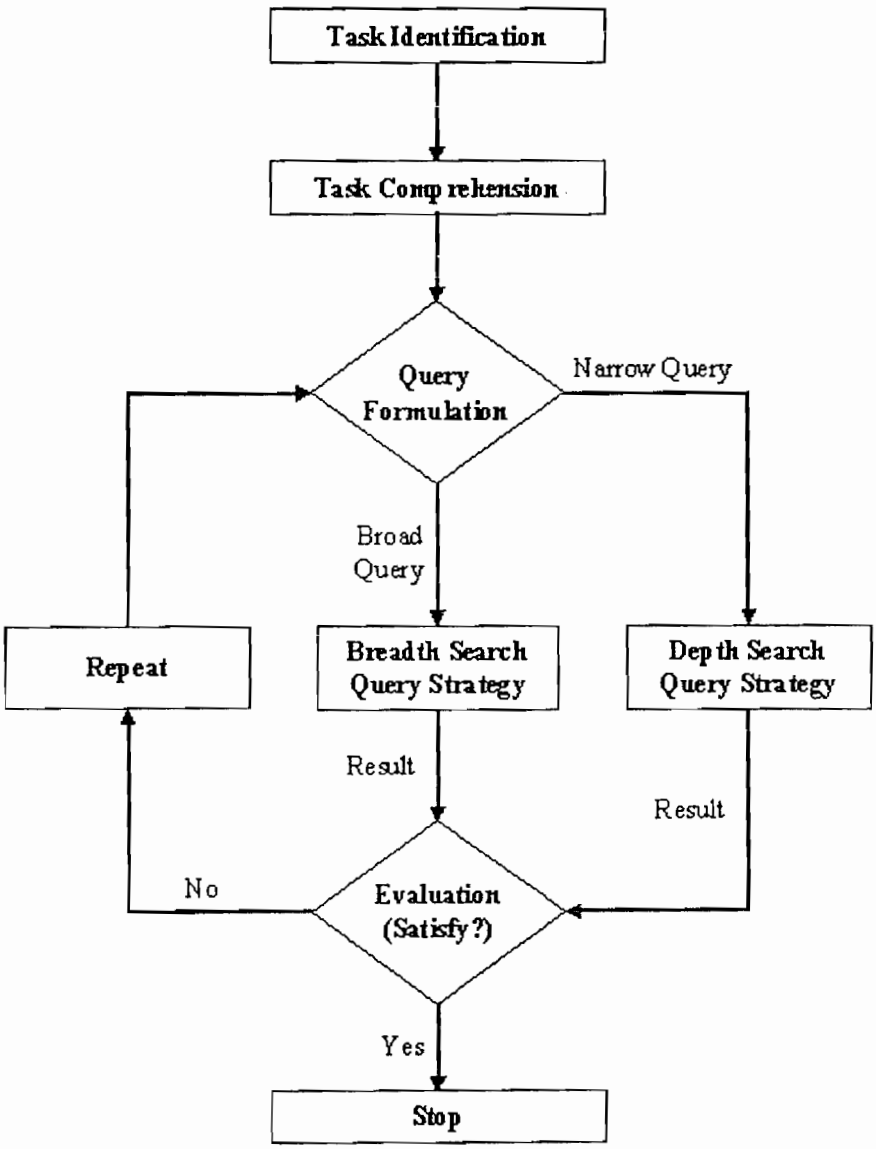
Table 5. Explanation of depth query strategy

Depth search query		
Strategy	**Description**	**Example**
Complex search	Cross searching with more than one query	Picture, Mona Lisa, Louvre
Computer convention	Using a computer convention	File suffixes (.gif,.jpeg)
Boolean search	Using Boolean syntax	Louver AND Mona Lisa

where users are identifying "what to search?" and extract other related requirement from the task given. In the previous example, the task given is to find the portrait of Mona Lisa. Next, users have to comprehend the task by finding meaning over the task subject. In this step, users have to know "what is it?" In this example, Mona Lisa is a well-known portrait drawn by Leonardo Da Vinci. This understanding will remove all Mona Lisa related concepts except those that related to a picture called Mona Lisa drew by Leonardo Da Vinci from users' cognitive map. This understanding will help users verbalize their need as a suitable query.

Users' query can be further classified either as breadth or depth search query strategy. Breadth search query is the use of broad query, while the use of narrow query is classified as depth search query strategy. Broad query is a query that can give more than one meaning. For example, entering "Mona Lisa" in the search system will return all results that are related to the picture of Mona

Figure 7. Search process in information retrieval system



Lisa either drew by Leonardo Da Vinci or by other artists, homepage of a person name Mona Lisa, a good that was named Mona Lisa and etc. Joining the query with another term for example "picture Mona Lisa" will reduce the list and display only results for Mona Lisa's picture. Yet, the list can be further reduced by adding other terms such as the artist name, such as "picture Mona Lisa Leonardo Da Vinci". This query will return picture of Mona Lisa drawn by artist Leonardo Da Vinci.

The next step in the search process is the evaluation of the search results. Users will determine whether they are satisfied with the results or not. If not they will repeat the process by reformulating a new query. If yes, the search session is ended.

The following are steps that are recommended for typical users:

- **Step 1:** Retrieve the task.
- **Step 2:** Read and understand the task. Identify what need to be found.
- **Step 3:** Assess users' understanding towards the task or information need.
- **Step 3(a):** If users are not familiar with the task, verbalize the need as breadth query.
- **Step 3(b):** If users are familiar with the task, verbalize the need as depth query.
- **Step 4:** Evaluate the search results.
- **Step 4(a):** If the need is achieved then stop the search else repeat Step 3.

CONCLUSION

The initial step of the search process is to understand the users need which is derived from the task. This understanding is vital as users should know what to look for before beginning the search. The core of the search process is the formulation and reformulation of the users' query. This process exhibits the users' behavior when dealing with the task. Typically, the users' behavior is influenced by the users' knowledge. Though, the users' knowledge increases when the search process is repeated.

User behavior can be categorized into two categories namely breadth and depth search query. The determination of these categories is based on the evolution of the users' query. As illustrated in previous section, users' may enter any query into the search system. The use of breadth query will return enormous results which in return requires users' evaluation on each of the search results. This evaluation is costly as it consumes a lot of time. The use of depth query can reduce the evaluation effort but shrinks the results list, thus give less idea to the users to reformulate another query.

This chapter proposed that users should begin the search with the breadth query then narrow the search with depth query. Breadth query strategy will benefit the users that are lack knowledge of the task. Users that are familiar with the task or understand the task very well may begin the search with depth query. These strategy will reduce the searching time, thus increase the chance for finding what the user wants.

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KEY TERMS AND DEFINITIONS:

Breadth Search Query: A query in which the terms are more general than the terms in the search tasks. This type of query involves keyword search, wide search and general knowledge.

Depth Search Query: The usage of specific queries that focuses on the search topic, and all the main aspects of the task need to be covered in the query. This type of query involved complex search, computer convention and Boolean search techniques.

Information Need: An individual desire to locate and obtain information to satisfy a conscious or unconscious need.

Query Formulation: A process of selecting the search term to satisfy user information need.

Search Task: An element that represents a to-do task.

Search Engine: A computer program that retrieved information based on the query entered by the users.